PORT
OF TILLAMOOK BAY

March 23, 2012

Mr. David Stuckey
Deputy Director
Financial and Recovery Services Section
Oregon Emergency Management
P.O. Box 14370
Salem, OR 97309-5062

RE: Disaster No.: 1733-DR-OR
Second Appeal – Port of Tillamook Bay (POTB)
PW No.: Alternate Project #13 to Project Worksheet (PW) 936

Dear Mr. Stuckey:

On January 24, 2012 POTB received by email your letter relating to the Deputy Regional Administrator of the Federal Emergency Management Agency, Region Ten's determination of POTB's June 2011 appeal request for funding consideration for the above-referenced Southern Flow Corridor Project. FEMA denied the first appeal. This denial was based on the criteria stated in FEMA's January 13, 2012 letter to you.

Pursuant to 44 CFR 206.206, enclosed please find documents which represent POTB's appeal of FEMA's decision within the 60-day time period for a second appeal, and which contain the following justifications: 1) Supporting POTB's position (which includes a revised benefit-cost analysis report and the previous comment responses we have sent to FEMA); 2) A specification of the monetary figure in dispute; and 3) The provisions in Federal law, regulation or policy which POTB believes the initial action was inconsistent.

It is our understanding that OEM will review the material submitted and, within sixty (60) days, will forward this appeal, through Region Ten, to FEMA's Assistant Administrator, Disaster Assistance Directorate in FEMA Headquarters and that, within 90 days following receipt of the appeal or any requested information, will notify the State of the disposition of the appeal, which decision is final.

Thank you for your assistance with this matter.

If you have any questions, please contact me.

Sincerely,

Michele Bradley
General Manager

Enclosures

# Final Appeal to Disaster Assistance Directorate, FEMA Headquarters, Washington, D.C.

PW NO.: Alternate Project #13 to
Project Worksheet (PW) 936
FEMA DR-1733-OR

Port of Tillamook Bay

March 23, 2012

The following document addresses the required appeal elements as listed in 44 CFR 206.206. For greater clarity we have re-ordered the response elements.

## 1. Monetary Figure in Dispute

The Port of Tillamook Bay has requested $ 4,310,000 from FEMA for this alternate project, which FEMA Region X has denied in its entirety.

## 2. Provisions in Federal law, regulation, or policy with which the appellant believes the initial action was inconsistent

### *Compliance with FEMA guidance and policy on Benefit-Cost Analysis*

We take the "initial action" in this case to be the letter of denial of the initial appeal from FEMA Region X. The reasons given for denial in this letter are that 1) the project has not been shown to be cost effective, and 2) this is due to the lack of validation of agricultural losses avoided using historical data. Prior responses to the initial denial of the project and further requests for information by FEMA contained other issues deemed lacking by FEMA. As these issues have not been listed in the January 13, 2011 letter, we presume that our responses properly addressed those and they are no longer relevant.

The Port asserts that:

- The Benefit-Cost Analysis (BCA) for this project has been done in full accordance with FEMA policies and guidance, including meeting all the requirements of the Public Assistance and HMGP programs.
- FEMA has required data validation above and beyond that required in the FEMA guidance.
- FEMA has essentially argued against the use of its own loss data functions and methodology, an approach that if applied consistently, would require FEMA to disallow many HMGP grants now awarded.

### *Failure to respond in timelines allowed*

We also note that it appears FEMA Region X did not meet the timelines specified in 44 CFR 206.206(3) which allows FEMA 90 days from receipt of an appeal or additional information requested to make a determination. In this case, the letter of denial of appeal is dated January 13, 2012, and refers to last receiving information from the applicant on September 6, 2011, a period of 130 days. There are matching funds allocated to the project by the Oregon Legislature in the form of state bonds that were sold in July, 2011. In the event the present appeal is not resolved in a timely manner, the state bond funds may become subject to arbitrage to the financial detriment of the applicant and the project.

## 3. Justification supporting the appellant's position

We now present our justification why the denial of the alternate project appeal is inconsistent with FEMA policies and guidance.

### *Requirements for Validation of Loss Estimates*

The benefit-cost analysis was performed using standard FEMA tools and methodology, specifically a HAZUS- BCAR Damage Frequency Analysis approach as detailed in section 5.1.3 of the *Supplement to the Benefit-Cost Analysis Reference Guide, June 2011*. Under the standard methods, loss estimates are generated with a combination of project specific data such as floor elevations and water depths, and additional data that is supplied with FEMA default values, the most important for flooding being the depth-damage functions for each structure class.

It is clear from numerous locations in various benefit-cost guidance documents that justification is normally only expected when non-default values are used, in order to prevent analysts from inflating project benefits without reason. For example, the following text is taken from the *Final BCA Reference Guide* (June 2009) Data Documentation Template for Floods (italics added):

> Displacement Costs: Possible documentation *if the default value* is overwritten includes: copies of advertisements…..
>
> Building Depth-Damage Function*: If the default value* is not used, provide complete documentation to support user-entered values.

Numerous other entries throughout the various hazard templates contain the same type of language, and this message is also repeated in other FEMA training classes and products: "*<u>If</u>* a default value is *<u>not</u>* used, you must provide justification…".

Despite using standard FEMA methods and default values throughout, FEMA reviewers requested validation/justification of the flood damages. In a letter dated March 24, 2011, Charles Axton, Recovery Division Director, stated "We find the use of modeled rather than actual historical data results in unrealistic damages. The estimated damages for agricultural and commercial buildings and contents appear to be substantially inflated." No reasoning or data to back up these assertions was provided in the letter.

There have been no comments regarding our data inputs for flood depths, building class, floor elevations, or any other project specific items, so we presume these have all been sufficiently justified. The one variable that remains in determining flood losses are the FEMA depth-damage functions. Therefore, the statement quoted above essentially argues that it is the FEMA default DDFs themselves that result in "unrealistic damages" that are "substantially inflated".

It is our understanding that the DDFs used in HAZUS and BCAR are the result of careful analysis by FEMA and the Corps of Engineers of thousands, if not tens of thousands, of flood insurance claims and other data, with the methods reviewed by expert panels before being loaded in these software packages. It is easily understood why FEMA guidance would allow the use of the default DDFs without additional justification given the confidence in these data the large sample size and extensive review have provided.

Thus the request for validation of the DDFs would seem to go against the guidance discussed above that only requires such information if non-default values are used. If the FEMA default values for depth-damage curves are indeed not to be used without validation, it makes the utility of programs such as HAZUS and BCAR for analysis of cost-effectiveness far more difficult.

Indeed, it is difficult to see how project or structure specific validation data for seismic or wind mitigation projects would be available at all in most cases, yet we presume FEMA has awarded numerous grants for these types of projects with the submittals based on FEMA software and using FEMA default values. In this case, the latest letter claims the percentages of damages that the "unvalidated" Agricultural category is responsible for range from 38%-56% of the totals. We cannot reproduce these percentages with our data, but a better metric is that agricultural damages are responsible for 29% of pre-project flood losses. In other words, the project has 71% of its losses "validated". When compared to a seismic project that addresses a building that likely has no historical losses whatsoever, and therefore has 100% "unvalidated" damages, this would appear to be a substantially better analysis. As our comments on agricultural damages show, even for flood hazards where there is more likely to be some historical record, certain areas or categories may simply not have any historic damage data to use.

Agricultural damages in particular seem to have been of interest to FEMA reviewers. The latest letter from FEMA Region X denying the appeal continues this theme - "However, a project to reduce flood levels by zero to eighteen inches will not substantially reduce flood hazards to milk parlors, milk tanks, or the risk of cows drowning."

We disagree with the conclusions drawn in this statement. Perusal of the depth-damage functions for any of the structure categories in HAZUS or BCAR will show that 18 inches of flood level reduction will provide significant lowering of damages. There is no reason this would not hold true for agricultural buildings uniquely. We refer the reader to our response to comment 1 in the September 2011 response to FEMA for a more detailed discussion of flood damages to dairy farms.

To summarize our findings regarding the denial of the appeal:

- FEMA asserted that flood losses were inflated, with no explanation of how this was determined.
- By the lack of comment on the methods and project specific data used, FEMA is essentially stating the default depth-damage functions it provides are the cause of the claimed inflated losses.
- FEMA required validation data for FEMA default values, whereas the guidance manuals clearly state this is only required if non-default values are used.
- FEMA has denied the appeal that is based on a BCA that:
    - contains 71% validated flood losses,
    - uses 50% reductions in default Agriculture and Commercial Inventory Losses, and
    - uses FEMA default values in all remaining cases.

### *Revised Benefit-Cost Analysis*

We are submitting a revised benefit-cost analysis as part of this appeal. There are two significant revisions in the document. First, we have provided an agricultural damages validation section. This uses the same source and data from the 1996 flood as was discussed in previous versions, but conducts a quantitative assessment of the portion of the reported damages that occurred within the project area. Our conclusion from this analysis is that the HAZUS expected damage values for all categories, including agriculture, are validated by the historical damages. Second, we have incorporated displacement losses into the BCA. These were previously calculated independently and supplied in our comment response to FEMA. They are now part of the single BCAR run and the documentation integrated into the BCA report. The addition of displacement costs increases the BCR from 1.14 to 1.25 and the net benefits (avoided losses) from $1,174,000 to $2,046,000.

## 4. Supporting Documentation

The following documents are attached:

- Revised Benefit-Cost Analysis, March 2012
- Response to FEMA comments, September 2011
- Response to initial denial (First Appeal), May 2011

Other documentation that can be provided upon request includes prior versions of the BCA report, HAZUS and BCAR model files, and the Southern Flow Corridor Design Report, in the event FEMA Region X does not forward this information.

Revised Benefit-Cost Analysis

March 2012

# Final Southern Flow Corridor Benefit-Cost Analysis

Prepared for:

**Tillamook Oregon Solutions Design Team**

**Under contract to Tillamook County**

Prepared by:


**Northwest Hydraulic Consultants**

**16300 Christensen Rd, Ste 350**

**Seattle, WA 98188**

and

**Tetra Tech, Inc**

**90 South Blackwood Avenue**

**Eagle, ID 83816**



**REVISED MARCH 2012**

Acknowledgements

Project design and this report were prepared by Vaughn Collins, P.E., CFM. of NHC. Sam Gould of NHC performed hydraulic modeling and GIS analysis.

The Benefit-Cost analyses were performed by Rob Flaner, CFM, Hazard Mitigation Program Manager for Tetra Tech, Inc. The HAZUS-MH analysis was performed by Ed Whitford, Senior GIS Analyst for Tetra Tech, Inc.

We wish to thank the numerous staff from Tillamook County, especially the Assessor's Office, that collected needed data for the analysis on very short notice.

## Contents

# 1 Executive Summary

The Port of Tillamook Bay has requested that the Southern Flow Corridor be eligible for FEMA funding under its Public Assistance Alternate Projects authority. A requirement under this program is that the proposed project meets benefit-cost criteria. The purpose of this report is to document the data sources, methods, and results of the benefit-cost analysis.

To measure the cost-effectiveness of the proposed Southern Flow Corridor project, FEMA's Benefit Cost Analysis Re-engineering (BCAR) version 4.5.5 was utilized. The damage frequency assessment (DFA) module within BCAR was utilized. The damages entered into the DFA module were estimated using FEMA's HAZUS-MH (version MR-4) risk assessment tool. Due to the complexity and comprehensive nature of this project, this approach to measuring the cost-effectiveness was deemed appropriate and within FEMA guidelines by the analyst.

This report supersedes all prior versions of this report. The main changes in this version are an updated agricultural loss validation section, and the addition of displacement costs to the analysis.

A limited amount of historic flood damage data was obtained and the HAZUS predicted damage results compared with the historic data. Comparisons show that HAZUS estimated losses were 40% less than actual flood insurance claims for residential structures, and 50% greater than estimated Replacement Cash Value (RCV) losses for commercial structures. For agricultural losses, using information from the 1996 flood, HAZUS losses were 78% higher than estimated historic losses. HAZUS values are expected to always exceed RCV and claims values because the model estimates additional direct losses (such as displacement costs) beyond the building, content, and inventory losses flood insurance will pay. For the analysis, commercial and agricultural inventory losses for the 6 and 22 year events were reduced by 50%. This resulted in the HAZUS losses being reduced to 18% and 32% higher than historic losses for commercial and agricultural structures, respectively.

The entire analysis was run as a lower bound analysis; that is, using only the largest benefit categories and conservative assumptions. The project was tested to see if the benefit-cost ratio was above 1.0. The lower bound approach leaves unquantified numerous known benefits, as the goal is to determine simply whether or not a project is cost-effective. If shown cost-effective, as this project is, the true benefit cost, while unknown, is guaranteed to be higher than the one calculated. Key conservative assumptions used in the analysis include:

- Commercial and Agricultural Inventory losses for the 2 more frequent floods used were reduced by 50%.
- Residential losses used FEMA default Depth Damage Curves even though HAZUS results were 40% less than historic flood insurance claims and would have justified increases to the DDFs.
- Agricultural Rental Displacement costs were set to zero based on the assumption it would not be possible to rent farm structures after a flood.
- The project construction cost estimate contains a 25% construction contingency.

The lower bound analysis results show that the project is cost-effective. As a result of including displacement costs, the revised benefit-cost ratio is 1.25.

# 2 Project Description

The Southern Flow Corridor consists of removing existing levees and fill to create an unobstructed flood pathway out to Tillamook Bay. The Southern Flow Corridor – Landowner Preferred Alternative Preliminary Design Report ("SFC Design Report") describes in detail the project elements.

# 3 Flood Level Reduction Benefits

Implementation of the Southern Flow Corridor will result in reductions in flood levels across the lower Wilson River floodplain and to a smaller degree on the lower Trask and Tillamook Rivers as well. The project does not reduce the frequency of flooding, which is controlled by flows and bank elevations upstream, but reduces the flood levels to more natural levels over a wide range of flood magnitudes.

Three floods (two historic floods and a synthetic 100-year flood) were selected for use in the Benefit-Cost Analysis. An updated flood frequency analysis for the Wilson River USGS was completed and the published USGS peak flows applied to the curve to generate estimated recurrence intervals for each of the historic floods. The synthetic 100-yr event was taken directly from the Preliminary Flood Insurance Study. Figures showing the reduction in water level due to the project for the 1999 and 100-yr floods are shown in the SFC Design Report.

*Table 1: Flood Recurrence Intervals*

| Flood Year | Recurrence Interval | Peak Flow (cfs) | Source |
|---|---|---|---|
| 1999 | 6 | 25,400 | USGS |
| 2007 | 22 | 33,100 | USGS |
| -- | 100 | 41,400 | FEMA FIS |

Modeled flood depths from the three floods, with and without the proposed project, were extracted and processed in GIS into depth grids for the analysis.

# 4 Project Costs

Project cost details and methods of estimation are described in the SFC Design Report. The summary project costs are shown here. Project costs are lower than the previous report. This is due primarily to two factors. 1) Two parcels that previously were assumed to be acquired will not be; the landowners have indicated they wish to keep the land and this has been reflected in the project layout, hydraulic modeling and costs, 2) As a result of some minor new dike realignment based on landowner negotiations the numbers of new floodgates required is substantially less and hence these costs.

As part of the reappraisal of the project in preparation for this appeal, the entire project cost estimate was revisited. Levee removal and dike construction quantities were recalculated and all unit and lump sum costs inspected and adjusted where necessary.

Project Design, Permitting and Construction costs are considered to be conservative. Project design and permitting alone have over $1,000,000 budgeted for a $4.2 million construction cost estimate. Given that the project, while large in scale, is a relatively simple earthmoving job without any of the complexities of buildings or urban environments, and that the major ecological benefits and support of resource agencies make permitting the project likely to be fairly easy allowing 25% of construction costs for design and permitting is conservative. In addition, a 25% contingency has been applied to the sum of construction and permitting/design costs.

# 5 HAZUS-MH Analysis

## *5.1 Building Inventory*

A User Defined Facility (UDF) approach was used to model potential flood loss in the project area.

The project area was determined by using GIS to find all floodplain parcels that had at least a 0.1 foot reduction in flood level during the 100-yr flood as a result of the Southern Flow Corridor. All structures within the project area were digitized using 2009 aerial photographs and an ID number assigned. County Assessor staff then matched each structure with the appropriate structure from the County Assessor database using the parcel number. Assessor data extracted included Use Type, Building Square Feet, Building Construction Class, Year Built, and Assessed Improvement Value. GIS was used to determine the centroid of each digitized structure and coordinates extracted. A limited number of structures use the same coordinates. This occurred where large farm buildings covered by one roof are stored within the Assessor database as multiple individual structures; for instance, there may be a hay shed, equipment storage and milking parlor assessed separately under one roof. In these cases all structures under one roof were assigned the same centroid coordinates of the digitized roof polygon.

## *5.2 First Floor Height*

Three methods were used to determine first floor height.

FEMA elevation certificates provided by the County were used to determine the first floor elevation for 16 buildings in the study area. The mean ground elevation for each of these buildings was determined using LIDAR and the first floor height above ground was calculated by subtracting the mean ground elevation from the first floor elevation.

The County provided 285 photos of buildings in the study area from Assessor files. For agricultural buildings, the County Assessor structure database separates different functional areas within a building. Therefore many of the large farm buildings contain up to 10 structures within the Assessors database. It was assumed that all structures covered by one roof contained the same floor elevation. As a result of multiple structures being cataloged within one building, the first floor heights above ground for 361 structures were estimated using these photos.

Based on these photographs, an estimated first floor height was calculated to the nearest 0.5 foot by using points of reference above adjacent grade. For example, standard step and masonry block heights are 8 inches, allowing estimation of flood height by multiplying the number of steps or blocks visible by 8 inches. This approach was utilized using any available visual gauges such as siding, concrete block, bricks, doors etc. For a small number of commercial buildings on or near Highway 101, Google Street View was used to estimate the first floor height above ground using the same techniques.

The first floor heights above ground for the remaining 190 (one-third of the total) buildings were determined using the following assumptions:

- the first floor of farm buildings was assumed to be at grade
- the first floor of single family residences was assumed to be 2.5 ft above grade.

These assumptions were based on typical values noted for structures with photographs.

## *5.3 Building and Content Value*

For building replacement cost, the Tillamook County Assessor Real Market Value (RMV) was used when available. 96 of the 570 structures did not have RMV attributed. In these cases, an average value per square foot was applied, based on Occupancy Code/Use Type. For example, if an Agricultural structure was missing an improvement value, the average dollar amount per square foot was applied to that structure to create a building replacement cost.

The following percentages were used to create building content costs:

*Table 2: Content Cost Multipliers by Occupancy Type*

| Content Cost Description | |
|---|---|
| Occupancy/Use Code | Content Cost |
| RES1 To RES6 & COM10 | RMV * 1.0 |
| COM1 To COM5, COM8, COM9, IND6, AGR1, REL1, GOV1 and EDU1 | RMV* 1.0 |
| COM6 To COM7, IND1 To IND5, GOV2 and EDU2 | RMV * 1.5 |

After completion and validation of the building inventory, a total 570 buildings were loaded into the HAZUS-MH flood study region as user defined structures (UDF).

## *5.4 Flood Depth Grids*

NHC produced six flood depth grids from hydraulic model outputs that were used in the HAZUS Flood analysis. Pre-project and post-project depth grids were provided for flood intervals of 6, 22, and 100 years. All six depth grids were loaded into the HAZUS study region as User Supplied Digital Elevation Models (DEMs).

## *5.5 Flood Analysis*

HAZUS Flood Scenarios were created for each of the six events, and results included damage estimates for the 570 buildings in the study regions. For all Scenarios, USACE Generic Depth Damage Functions were used. For this reason, Residential Content Cost was set equal to Building Cost to be more in line with USACE standards. All results were summarized by General Occupancy Type, and included; Building Loss, Content Loss, and Inventory Loss. Inventory Loss was developed for all non-Residential and non-Agricultural structures. Flood loss types are defined below.

### 5.5.1 Building Loss

Building losses are dependent on depth-related percent damage (depth-damage functions). Building damage includes damages to the structure itself, as well as damages to components such as lighting, ceilings, mechanical and electrical equipment and other fixtures. The USACE generic damage functions for structures contained within HAZUS-MH (MR-4) were applied in this analysis.

**Building Content Loss:** Building contents are defined as furniture, equipment that is not integral with the structure, computers and other supplies. Contents damage functions are applied in the same manner as building damage functions. Once again, these damage functions are the USACE generic damage functions contained in HAZUS-MH.

**Building Inventory Loss:** Business inventories vary considerably with occupancy. For example, the value of inventory for a high tech manufacturing facility would be very different from that of a retail store. Thus, it is assumed for this model that business inventory for each occupancy class is based on annual sales. Business inventory losses then become the product of the total inventory value (floor area times the percent of gross sales or production per square foot) of buildings of a given occupancy in a given damage state, the percent loss to the inventory and the probability of given damage states.

Inventory losses in the flood module are determined in a manner consistent with the other building losses, as well as the methodology currently utilized in the HAZUS earthquake module. For occupancies with inventory considerations (COM1, COM2, IND1 - IND6 and AGR1, as defined in the HAZUS99 Earthquake Technical Manual), inventory losses are estimated using USACE-based depth-damage functions, in conjunction with HAZUS default inventory values determined as a percentage of annual sales per square foot.

### 5.5.2 Displacement Loss

Avoided displacement and disruption losses were calculated using the method detailed on page 5-19 in the FEMA *Supplement to the Benefit-Cost Analysis Reference Guide*, June 2011. Single family residential structures (RES1) used the BCAR default value of $1.44/sf/month for displacement costs. All other costs were generated using Table 11 from the Supplement, updated to 2011 costs using the CPI calculator as recommended, with one exception. Updated displacement costs for agricultural structures were set to zero rather than the table value of $0.77/sf/month. The reason for this is that it is unlikely farmers would be able to find replacement dairy farms for rent during the displacement period, unlike commercial or residential structures where there is extensive non floodplain rental inventory likely to be available. This is also consistent with our attempts to remain conservative in our evaluation. One time disruption costs for all categories were applied using updated Table 11 values. All classes used the FEMA default displacement time rate of 1.48 months displacement /foot of flood depth (45 days/ft).

The loss results generated by this analysis can be found in Attachment B of this memorandum.

# 6 Loss Validation

Loss validation was completed using what limited data was available. Available information included a spreadsheet of flood insurance claims in the Wilson River floodplain (including the project influence area and beyond) from 1977 through 2008, detailed proof of loss forms received directly from 3 businesses, and a report of agricultural damages from the 1996 flood.

The following analysis presents actual insurance data from two floods, occurring on December 12, 1998 and November 6, 2006. This is compared with HAZUS results from the December 3, 2007 flood. These three floods were all similar in flow magnitude, with flows of 35,300, 38,600 and 33,100 cfs respectively. While the modeled 2007 flood has the lowest peak flow, the hydraulic model under simulates water surface elevation along the Highway 101 corridor to do some degree, such that the high water mark from the November 2006 flood is within 0.3 feet of the model results for the 2007 flood. For the purposes of this validation analysis, the floods can be treated as approximately equal in regards to the flood stages created in the lower Wilson River.

## *6.1 Residential Properties*

Since 1977, sixty-two residential flood insurance claims have been paid within Tillamook County for a total of $1,978,146 based on flood insurance claims data provided by FEMA Region X. This value is not inflated to current valuation. This averages out to be $31,905.58 per claim paid (including both structure and contents, and does not represent costs associated with displacement or loss of rental income from rental property).

Based on claims data filed for the 12/28/1998 flood event, there were seven claims filed for a total of $374,066. There was an anomaly in the data with 2 large claims showing for 1 property on consecutive days, the total of which exceed FEMA specified coverage limits. Therefore, these lesser value of the 2 claims was used to establish the average for the flood event. The average claim paid for the 12/28/1998 flood event, adjusted to 2011 dollar values was $45,215.

Based on claims data for the 11/6/2006 flood event, there were 18 residential flood insurance claims paid for a total of $708,846. This averages out to be $43,960 per claim, adjusted to 2011 dollars.

Table-1 illustrates the results generated by the level 2, user defined HAZUS model, in comparison to the insurance claims data available for Tillamook County. It should be noted that claims data was the only source of data for validation of the residential damage functions for this analysis.

**Table 1**

**Claims versus HAZUS Comparison-Residential Properties**

| | Insurance Claims | | HAZUS Analysis (December 3, 2007 Flood) | | % differential |
|---|---|---|---|---|---|
| **Event** | Total Claims | Average Claim Paid[(1)] | Total Residential Loss | Average Loss | |
| **12/28/1998** | $182,405.00 | $45,215.00 | $1,055,738 | $27,070 | -40% |
| **11/6/2006** | $708,846.00 | $43,960.00 | $1,055,738 | $27,070 | -38% |

**1) Adjusted to 2011 dollars**

Upon review of this data, the damage estimates generated by HAZUS for the 2007 event about 40% percent less than the actual claims paid for those historical events. The HAZUS average losses are also less than the average of all residential claims (unadjusted $) paid since 1977. As insurance claims pay only a portion of total losses incurred due to coverage limits and claims adjustment policies, the true difference between actual total damages and HAZUS estimates will be greater, i.e. HAZUS underestimates losses by more than 40%. This seems to substantiate that HAZUS does not over state damages to residential properties, and offers a conservative estimate of damage potential, which supports the concept of a lower bound analysis.

## 6.2 Commercial Properties

The commercial loss estimates generated by HAZUS were validated using flood loss data from 2 sources. Proof of loss documentation was provided for 3 commercial properties within the project reach. Additionally, historical flood insurance claims data provided by FEMA Region X was analyzed to establish average claims paid for commercial properties.

Since 1977, 155 commercial property flood insurance claims have been paid in the amount of $6,033,398 (not adjusted to reflect 2011 dollars). This is an average of $38, 925 per claim paid.

Based on claims data filed for the 12/28/1998 flood event, there were twenty-three claims filed for a total of $1,176,731. The average claim paid for the 12/28/1998 flood event, adjusted to 2011 dollar values was $74,535.

Based on claims data for the 11/6/2006 flood event, there were 21 commercial flood insurance claims paid for a total of $1,769,332. This averages out to be $92,125 per claim, adjusted to 2011 dollars.

Table 2 illustrates the comparison of the results generated by the level 2, user defined HAZUS model, in comparison to the insurance claims data available for Tillamook County.

**Table 2**

**Claims versus HAZUS Comparison-Commercial Properties**

| | Insurance Claims | | HAZUS Analysis 12/3/2007 Flood | | % differential |
|---|---|---|---|---|---|
| **Flood Event** | Total Claims | Average Claim Paid[(1)] | Total Commercial Loss | Average Loss | |
| **12/28/1998** | $1,176,731 | $74,535 | $12,150,369 | $157,797 | +112% |
| **11/6/2006** | $1,769,332 | $92,125 | $12,150,369 | $157,797 | +71% |

**1) Adjusted to 2011 dollars**

To further validate the commercial loss estimates, we looked at Replacement Cash Values (RCV) for building and contents damages from Proof of Loss statements filed for 3 properties within the project area and compared them these numbers to the HAZUS generated loss estimates for these specific properties. Table 3, summarizes this analysis.

| **Table 3**<br>**Proof of Loss versus HAZUS Comparison-Commercial Properties** | | | | |
|---|---|---|---|---|
| **Address** | Event | RCV[(1)] | HAZUS Loss Estimate – 12/3/2007 Flood | % Differential |
| **# 1 Main Ave., North** | 11/6/2006 | $232,864 | $389,850 | +67 |
| **#2 Main Ave.** | 11/6/2006 | $536,243 | $1,092,045 | +103% |
| **#11 Main Ave.** | 11/6/2006 | $290,122 | $481,717 | +66% |
| **Adjusted to 2011 dollars** | | | | |

The data show that HAZUS reports loss estimates from 66%-112% higher than either flood insurance payments or total replacement cash value. In our opinion the most reliable value to use is the data from the November 2006 flood shown in Table 2. There are 21 buildings in the sample, and the data is from a recent flood. The value is close to 2 of the 3 buildings with Proof of Loss statements listed in Table 3.

An estimate of the ratio between replacement cash value and flood insurance payment was made by averaging data from the 3 buildings shown in Table 3. The #11 building had data from both the 2006 and 2007 floods, giving a total of four data points to use. The average ratio of RCV to flood insurance payment was 114% (stated inversely, insurance payments were around 86% of RCV). Adding this 14% increase to the November 2006 flood average commercial flood insurance payment (Table 2) gives an estimated average Replacement Cash Value for commercial buildings of $105,022. Recalculating the HAZUS loss ratio to the estimated average RCV value rather than flood insurance payment results in HAZUS producing values 50% greater than RCV.

## *6.3 Agricultural Properties*

### 6.3.1 Reasons for Lack of Agricultural Damage Data

In response to the letter of denial from Region X, we made another search for historic agricultural flood damages, one of many that have been made seeking data from local, state, and federal sources. Most historic flood damage data is derived from federal assistance or insurance programs; it is clear from the lack of historic data for farms that these programs are either not used or unavailable for the farming community in Tillamook. The recent attempt to find additional agricultural damage data was similarly unsuccessful. The responding email from Kent Willett of the USDA Farm Service Agency explains why:

> There are lots of situations in which the damage is ineligible for payment (loss thresholds, availability of feed, age of facility, limitation on program, etc.). In many cases producers will not apply for benefits because they do not want to “hassle with government paperwork”, they do not feel the need to apply for assistance, or they are unaware of the program.

The only source that has been located is the report referred to in prior versions of this document: the *Tillamook County, Oregon 1996 Flood Damage Assessment & Recovery Plan*, prepared by Tillamook

County in November 1996 under a grant from the U.S. Department of Commerce. This report contains extensive documentation of flood damages by category for various public agencies as well as private agricultural losses. The document estimates that nearly 60% of the agricultural damages reported were ineligible for any government aid program, explaining in part why farmers appear to not bother with government aid programs.

### 6.3.2 Summary of 1996 Flood Losses

Of the 155 dairy farms within the County, 90 were impacted, with 20 to 30 significantly impacted. Of note in the report are the long lasting effects of flood damages on the dairy industry. The following paragraphs summarize the report findings.

655 cows were lost to drowning. Another 45 cows were lost to residual effects in the following weeks. An additional 600 cows were injured or became sick. Milk production was significantly reduced. Cows not milked for more than 12 hours typically suffer a loss of production that takes weeks to recover, and never does in some cases. As a result, production losses were estimated at 10%, and were expected to remain at that level for at least a year.

The loss of pastures due to siltation was the major damage category. While the costs of renovating the pastures were extensive, the greatest damages occurred due to the loss of hay production, requiring farmers to buy rather than grow their own. With the next growing season lost, farmers were required to buy hay for over a year until their own field could once again produce it. Additional damages included damages to buildings, drainage systems, and fencing.

### 6.3.3 Validation Method

In our prior submittals, we reported the overall agricultural damages from this report as qualitative documentation that extensive agricultural damages are indeed incurred at floods of this magnitude. With the recent letter of denial appearing to be based entirely on the lack of validation of agricultural damages, we have completed a more quantitative check on the reported damages which is discussed herein. While not to the level of detail or certainty of the residential or commercial categories, this is the best available data.

For validation of agricultural losses, we compared damages from this event to those from the modeled December 2007 flood used in the HAZUS/BCAR analysis. The 1996 and 2007 floods were of similar peak flow magnitude (35,000 cfs vs. 33,100 cfs for the 1996 and 2007 floods, respectively at the USGS Wilson River gage).

Total reported agricultural damages for the 1996 event were $9,200,800. We removed farm home damages from this total as these would fall in the “residential” category of the BCA. This results in a damage total of $8,477,650. Adjusted to 2011 dollars using the CPI factor gives a value of $12,123,040.

The report indicates that 90 dairies in the County were affected by the flooding, and at the time of the report 9 months after the flood, 25-30 were still “severely impacted”. It should be noted that the vast majority of dairies in the County are concentrated around the town of Tillamook within or near the project area. The Southern Flow Corridor project area contains around 10-15 dairies, and many or most of these would have been in the severely impacted category due to their location at the center of the damaging floods. The report indicates that 7,200 acres of pasture were impacted by the flood and 4,900 of these acres were damaged to the point that complete field renovation was required. There are 4,200 acres, the majority of which are pasture, within the Southern Flow Corridor project area, and many of these acres would have been in the severely damaged category. Based on the ratios of dairies and acreages in the SFC project area versus the countywide damage totals, it was estimated that 20% of the reported damages likely occurred within the SFC project area. Multiplying this percentage by the total damages results in estimated damages within the project area of $2,435,000. These are damages that were incurred on the lands of the subject dairies.

The report also states that there were additional significant losses due to the flood related to milk production that were not included in the total reported above. Virtually all the dairies in the County are members and owners of the Tillamook Creamery Cooperative Association (Co-op). Milk from the dairies is processed into various products, most notably cheese, at the Co-op factory in Tillamook. Losses of $750,000/month in production are reported for the Co-op. These losses were expected to be incurred "for most of next year". There were 155 dairies in Tillamook County in 1996, so 65 of them were not affected by the flooding at all. Therefore, the Co-op production losses were being incurred by loss of milk production from a small subset of the overall dairies – presumably those reported as severely impacted. Based on this, 20% of the loss was apportioned to the dairies within the project area, the same percentage as used for the on-farm damages discussed previously. The report was issued in November, so "most of the next year" is assumed to be until September 1998, a period of 10 months. Multiplying the monthly losses by the project area percentage, and by 10 months, and adjusting to 2011 dollars, gives a total Co-op production loss of $2,145,000.

Summing the individual farm and Co-op based damages gives a total value within the SFC project area of $4,570,000. The HAZUS modeling of the 2007 event has an estimated agricultural damage value of $8,125,000. The historic damages are therefore 56% of the HAZUS estimates, or conversely HAZUS estimates are 78% greater than historic estimates.

### *6.4 Summary of Findings*

- Residential:
  - HAZUS loss values are 40% less than average flood insurance claims
- Commercial:
  - HAZUS loss values are 37% greater than commercial replacement cost value losses
- Agriculture:
  - HAZUS loss values are 56% of estimated historical losses

# 7 Lower Bound Analysis

Lower-bound analysis is a powerful tool that can often demonstrate that projects are cost-effective — in many cases regardless of whether the available data are complete or not. This is an important point, because a project's cost-effectiveness can sometimes be determined by using only one or two key pieces of data. This is because the lower-bound analysis considers only *some* of a project's benefits — those that are the most important or those for which data exist — and ignores other benefits that may be difficult to estimate or for which data may not be available. In other words, this analysis purposely uses only a few data to determine the project's cost-effectiveness and undercounts, or ignores other benefits that will be gained by funding the project. A lower bound analysis indicates whether or not a project is cost-effective, but not the degree to which it may be so.

The analysis performed for the Southern Flow Corridor was a true lower bound analysis. Conservative approaches to estimating losses were utilized and elements of avoided losses were purposely left out of the analysis to measure the level of cost-effectiveness of this project.

## 7.1 Modified Damage Functions

It is our opinion that the HAZUS loss values for commercial building being 50% higher than estimated RCV losses from insurance claims validates the HAZUS depth-damage curves. RCV values reflect only direct replacement costs for building, contents, and inventory damages. The HAZUS model reflects additional costs beyond these that are incurred, including relocation expenses, capital related income losses, wage losses, and rental income losses. These losses are time dependent functions incurred during the period required to restore the business to operation. The incorporation of these additional direct losses in HAZUS means HAZUS values should always be greater than RCV losses for a business even where the model perfectly predicts building, content, and inventory losses.

Given the strong indications of underreporting of damages for agricultural losses, we find that HAZUS losses 78% greater than historic estimates are similarly reasonable. Nevertheless, in our lower bounds approach, it was determined to modify the estimated losses to demonstrate cost-effectiveness even with lower damages. It was decided that, consistent with our findings above, the same approach should be taken with agriculture and commercial categories.

The approach taken was to reduce the agriculture and commercial inventory losses for the 6-yr and 22-yr events by 50% for entry into BCAR. The values for the 100-yr event were left at the HAZUS calculated values. This approach is based on the theory that being located in an area that frequently floods, floodplain farmers and business owners have taken actions to reduce damages during small events, but very large floods occur too infrequently to change normal human behavior regarding flood mitigation. In terms of overall damage loss estimates, this is approximately a 20% reduction for the two floods modified. For commercial properties, the HAZUS losses are reduced from 50% to 18% higher than historic losses. For agricultural properties, the HAZUS to historic flood difference ratio drops from 78% to 32%. In our opinion, these ratios are well within reasonable bounds of differences between HAZUS and historic damages, and therefore conclude the HAZUS model commercial and agricultural expected damage calculations are validated.

## 7.2 Ignored Damages

The following benefits were not included in this analysis:

*Functional Downtime-Roads*: No loss of function for Highway 101 was included in this analysis. Highway 101 within the project reach averages between 16, 000 to 18,000 cars per day. The project provides modest reductions in roadway time inundated.

*Actual Cash Value versus Replacement Costs*: Both HAZUS and BCAR are set up to use replacement costs to determining the value of the structures being protected by a mitigation project. These values can be extracted out of national costs estimation guides such as R.S. Means or the BNI Home Builders Construction Guides. For this analysis, taxed assessed valuations were used to establish these costs. Tax Assessor values tend to be 10% to 30% lower than values taken from cost guides. Use of this value once again supports to concept of the lower-bound analysis.

*Emergency Response Costs*: No values for emergency response costs were included in this analysis.

*Debris Removal*: No costs associated with debris removal and/or management were included in this analysis.

# 8 BCAR Crosswalk

The following discussions will crosswalk the BCAR data entries. The Damage Frequency Analysis (DFA) module of BCAR version 4.5.5 was utilized for this analysis. See attachment C for a copy of the final BCAR report for this project analysis.

## *8.1 Hazard and Mitigation Information*

The hazard to be mitigated is Flood

The Mitigation type is a Drainage improvement.

The basis for the damages is expected damages generated by HAZUS-MH version MR-4

The number of events analyzed will be 3. Probabilities of recurrence will be assigned for all 3 events.

## *8.2 Cost Estimation information*

The project life for this project has been assigned as 50 years based on the guidance provided in BCAR. The value assigned to "Major infrastructure projects" was selected.

The project cost utilized was $8,060,000, based on the detailed cost estimate provided by the study contractor. Documentation of the cost estimate was uploaded into BCAR. The cost estimate represents the total project cost for the Southern Flow Corridor. This includes all property acquisition, permitting, design and construction costs.  We also note that this cost includes a 25% construction contingency which makes the BCA more conservative.

A value of $20,000 was assigned for annual maintenance costs based on opinion of the project design contractor.

The cost reflects current prices and escalation was not calculated in the BCAR model.

## *8.3 Type of Services*

The type of services category for this analysis was determined to be not applicable by the analysts. The focus of this analysis is on general building stock considering both residential and non-residential properties.

## *8.4 Expected Damages before Mitigation*

Analysis year is 2010

Year Built - not applicable since the analysis will assign recurrence intervals for all events.

Damage year - the historic flood events of 2007 and 1999 were modeled in HAZUS. Depth grids for these 2 events as well as the 100-year flood event were generated.

Recurrence interval - Recurrence intervals were assigned for each event based on the hydrology generated for the flood study. (See Attachment C).

Damages were estimated for building loss, contents loss and inventory loss where applicable. All damages are based on current dollar values.

## 8.5 Expected Damages after Mitigation

As with the before-mitigation damages, HAZUS was utilized to model the expected damages after mitigation. The basis for this analysis was the hydraulic and hydrologic (H&H) modeling of the post-project impacts expected from this project. Depth grids were generated for the same hydrologic events modeled in the before-mitigation analysis. Once again, see Attachments A and B for more discussion on the project modeling.

# 9 Attachment A: Hydrology and Hydraulics Summary

## *9.1 Hydraulic Model*

The HEC-RAS hydraulic model developed for the Corps of Engineers Feasibility study was updated and used as the primary technical tool in hydraulic evaluation of alternatives for Project Exodus. Updating consisted of developing new floodplain cross sections using LiDAR data acquired in 2008. The geometry of berms and levees along the various channels were also updated from the LiDAR. In many areas these are covered in dense brush or under tree canopy, and the accuracy of both the LiDAR and Corps photogrammetric data is lower. No channel cross sections were resurveyed.

The basic structure and naming convention of the existing model was kept. Only the Wilson River portion of the model was updated - the Tillamook and Trask River systems did not have new LiDAR coverage available. In addition to topographic updates, some reaches were adjusted to better match flood flow paths, and extensive work was put into creating a numerically stable model that could reliably run under a variety of flood scenarios. The model was also extended down the bay to use the NOAA Garibaldi tide station as a lower boundary condition.

The sensitivity of the model to the tidal boundary condition was tested by running the 1999 (~5-yr) flood with the observed tides increased by 1 foot and decreased by 2 feet. Changes to maximum water surface elevations only extended up to around the junction of Hoquarten Slough and the Trask River under either scenario.

A series of observed floods was simulated in the model, along with a synthetic 100-year event. Hydrology was already defined for the 1999 and 2001 events from the Corps study. Gage data for the 2006 and 2007 floods was obtained from the USGS. The main inflows for the Wilson, Tillamook and Trask systems were obtained from the ongoing Flood Insurance Study for the 100-yr flood. Estimates of tributary inflows were derived independently using scaling factors based on Oregon regional flow regression equations from the USGS.

The model was calibrated by adjusting in-channel roughness values within physically plausible limits in order to match observed high water marks. The model was calibrated against the 1999 and 2001 floods. The 2006 and 2007 floods, which were substantially larger, were then simulated to verify the calibration. In addition to the high water marks supplied by the Corps of Engineers, a set of oblique aerials taken of the 1999 flood by George Best in conjunction with the LiDAR data, enabled the development of further high water marks as well as validation of flow paths. Finally, model results were compared with qualitative witness observations of various floods to ensure flood behavior was being modeled correctly. Mr. Leo Kuntz was of invaluable assistance in this regard.

Calibration focused on ensuring the model reasonably simulated the full range of floods rather than trying to exactly match one specific event. In general, calibration within the main Wilson River channel was consistent over the range of floods, and less so in the overbanks.

## *9.2 Comparison with FIS model.*

The preliminary Flood Insurance Study essentially used the Corps of Engineer HEC-RAS model for hydraulic analysis. While very similar in structure, the NHC model was selected for use as providing the best available data for the following reasons:

The NHC model was updated with new LiDAR overbank and Tillamook Bay data

The NHC model was modified specifically to better simulate smaller, more frequent floods where the greatest annualized damages are caused.

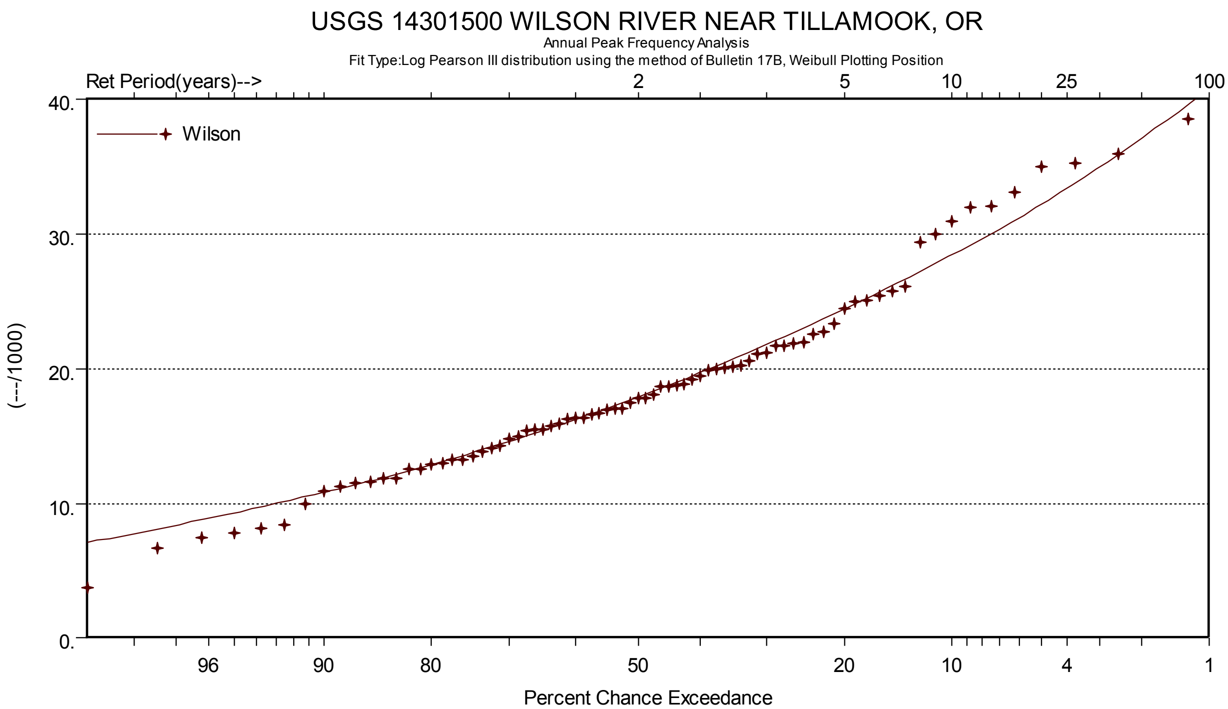
The NHC model included results for small floods, whereas the smallest flood in the FIS is the 10-yr event.

## 9.3 Processing of Modeling Results

Results from the hydraulic model were processed using a custom ArcGIS-based tool developed by NHC. Model outputs were processed through the tool into water surface elevation and depth grids for each flood. For HAZUS modeling, 20-foot cell size depth grids were generated.

## 9.4 Flood Frequencies

Three floods (two historic floods and a synthetic 100-year flood) were selected for use in the Benefit-Cost Analysis. An updated flood frequency analysis for the Wilson River USGS was completed and the published USGS peak flows applied to the curve to generate estimated recurrence intervals for the two historic floods. The synthetic 100-yr event was taken directly from the Preliminary Flood Insurance Study.




| Flood Date | Recurrence Interval | Peak Flow (cfs) | Source |
|---|---|---|---|
| November 1999 | 6 | 25,400 | USGS |
| December 2007 | 22 | 33,100 | USGS |
| -- | 100 | 41,400 | FEMA FIS |

# 10 Attachment B: HAZUS-MH Loss Estimates

| HAZUS OUTPUTS | AGR BUILDING LOSS | AGR CONTENT LOSS | AGR INVENTORY LOSS | COMM BUILDING LOSS | COMM CONTENT LOSS | COMM INVENTORY LOSS | RES BUILDING LOSS | RES CONTENT LOSS | RES INVENTORY LOSS | *OTHER BUILDING LOSS | *OTHER CONTENT LOSS | *OTHER INVENTORY LOSS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100YR PRE PROJECT | $2,208,581 | $6,058,512 | $8,775,132 | $2,039,940 | $7,434,477 | $6,896,835 | $1,546,791 | $1,628,429 | $0 | $306,835 | $923,819 | $803,716 |
| 100YR POST PROJECT | $1,817,151 | $5,437,598 | $7,792,295 | $1,565,129 | $5,728,424 | $5,138,179 | $1,166,609 | $1,268,143 | $0 | $224,408 | $631,220 | $587,425 |
| 22YR PRE PROJECT | $851,293 | $3,097,788 | $4,176,251 | $1,531,120 | $5,406,149 | $5,213,100 | $700,007 | $711,462 | $0 | $246,864 | $761,897 | $695,768 |
| 22YR POST PROJECT | $651,581 | $2,584,761 | $3,186,041 | $1,257,394 | $4,302,304 | $4,068,218 | $500,366 | $436,070 | $0 | $174,983 | $383,816 | $373,064 |
| 6YR PRE PROJECT | $400,456 | $1,513,665 | $1,719,734 | $945,695 | $3,067,978 | $2,700,866 | $432,745 | $392,414 | $0 | $101,043 | $146,127 | $151,539 |
| 6YR POST PROJECT | $270,491 | $1,111,591 | $1,179,023 | $761,129 | $2,440,985 | $2,077,245 | $367,961 | $336,010 | $0 | $14,449 | $0 | $0 |

| *HAZUS OUTPUTS* | TOTALS | | | |
|---|---|---|---|---|
| | **Bldg** | **Contents** | **Inventory** | **Displacement** |
| 100YR PRE PROJECT | **$6,102,147** | **$16,045,237** | **$16,475,683** | **$2,665,464** |
| 100YR POST PROJECT | **$4,773,297** | **$13,065,385** | **$13,517,899** | **$2,123,355** |
| 22YR PRE PROJECT | **$3,329,284** | **$9,977,295** | **$10,085,120** | **$1,693,572** |
| 22YR POST PROJECT | **$2,584,323** | **$7,706,951** | **$7,627,323** | **$1,229,518** |
| 6YR PRE PROJECT | **$1,879,939** | **$5,120,184** | **$4,572,138** | **$ 931,609** |
| 6YR POST PROJECT | **$1,414,030** | **$3,888,585** | **$3,256,267** | **$ 720,123** |

| ADJUSTED OUTPUTS USED IN BCAR MODEL | | | | | | |
|---|---|---|---|---|---|---|
| | **Bldg** | **Contents** | Commercial Inventory Adjusted** | Ag Inventory Adjusted** | **Total Adjusted Inventory** | **Displacement** |
| 100YR PRE PROJECT | **$6,102,147** | **$16,045,237** | $6,896,835 | $8,775,132 | **$16,475,683** | **$2,665,464** |
| 100YR POST PROJECT | **$4,773,297** | **$13,065,385** | $5,138,179 | $7,792,295 | **$13,517,899** | **$2,123,355** |
| 22YR PRE PROJECT | **$3,329,284** | **$9,977,295** | $2,606,550 | $2,088,125 | **$5,390,444** | **$1,693,572** |
| 22YR POST PROJECT | **$2,584,323** | **$7,706,951** | $2,034,109 | $1,593,020 | **$4,000,194** | **$1,229,518** |
| 6YR PRE PROJECT | **$1,879,939** | **$5,120,184** | $1,350,433 | $859,866.97 | **$2,361,839** | **$ 931,609** |
| 6YR POST PROJECT | **$1,414,030** | **$3,888,585** | $1,038,622 | $589,511 | **$1,628,134** | **$ 720,123** |

**Other Losses include; Industrial, Religion and Government (**) Inventory values were reduced by 50% for the 6-Year and 22-year events based on Historical data. The 100-Year was left at the HAZUS default value based on expected damages.*

# 12 Attachment C: BCAR Report

| | | | | | |
|---|---|---|---|---|---|
| 23 Mar 2012 | | Project: | **Tillamook County-Project Exodus - Revised 3-23-2012** | | |
| Total Benefits: | **$10,382,509** | Total Costs: | **$8,336,015** | BCR: | **1.25** |
| Project Number: | | Disaster #: | | Program: | |
| Agency: | **Northwest Hydraulics Consultants** | | | | |
| State: | **Washington** | Point of Contact: | Vaughn Collins | Analyst: | Rob Flaner |

**Project Summary:**

Project Number:

Disaster #:

Program:

Agency: Northwest Hydraulics Consultants

Analyst: Rob Flaner

Point of Contact: Vaughn Collins

Phone Number: 206-241-6000

Address: 16300 Christensen Rd, Ste 350, Seattle, Washington, 98188

Email: vCollins@nhc-sea.com

Comments: PA Alternative Project

**Structure Summary For:**

Copy Of Copy Of Copy Of Copy Of Tillamook county-Project Exodus, 2 Main Ave., Tillamook, Oregon, 97141, Tillamook

Structure Type: Building

Historic Building: No

Contact: Tillamook County

Benefits: $10,382,509

Costs: $8,336,015

BCR: 1.25

| Mitigation | Hazard | BCR | Benefits | Costs |
|---|---|---|---|---|
| Drainage Improvement | Damage-Frequency Assessment | 1.25 | $10,382,509 | $8,336,015 |

Total Benefits: **$10,382,509** Total Costs: **$8,336,015** BCR: **1.25**

Project Number: Disaster #: Program: Agency: **Northwest Hydraulics Consultants**

State: **Washington** Point of Contact: Vaughn Collins Analyst: Rob Flaner

**Structure and Mitigation Details For:** Copy Of Copy Of Copy Of Copy Of Tillamook county-Project Exodus, 2 Main Ave., Tillamook, Oregon, 97141, Tillamook

Benefits: $10,382,509 Costs: $8,336,015 BCR: 1.25

Hazard: **Damage-Frequency Assessment - Flood**

Mitigation Option: Drainage Improvement

Latitude: Longitude: Project Useful Life: 50

## Mitigation Information

Basis of Damages: Expected Damages

Number of Damage Events: 3

Number of Events with Know Recurrence Intervals: 3

## Expected Damages Before and After Mitigation

Analysis Year: 2010 Analysis Duration: 21 Utilities ($/day):

Year Built: 1990 User Input Analysis Duration: Buildings ($/day):

Roads/Bridges ($/day):

### Damages Before Mitigation

Damage Year:
RI: 22.40
Are Damages In Current Dollars? Yes

Buildings (Days):
Utilities (Days):
Roads (Days):

| | |
|---|---|
| Displacement ($) | $1,693,572 |
| Inventory Loss ($) | $5,390,444 |
| Content loss ($) | $9,977,295 |

### Damages After Mitigation

RI: 22.40
Are Damages In Current Dollars? Yes

Buildings (Days):
Utilities (Days):
Roads (Days):

| | |
|---|---|
| Displacement ($) | $1,229,518 |
| Inventory Loss ($) | $4,000,194 |
| Content loss ($) | $7,706,951 |

Total Benefits: **$10,382,509** Total Costs: **$8,336,015** BCR: **1.25**

Project Number: Disaster #: Program: Agency: **Northwest Hydraulics Consultants**

State: **Washington** Point of Contact: Vaughn Collins Analyst: Rob Flaner

| | |
|---|---|
| Building Loss ($) | $3,329,284 |
| Total | $20,390,595 |
| Total Inflated | |

| | |
|---|---|
| Building Loss ($) | $2,584,323 |
| Total | $15,520,986 |

Damage Year:
RI: 5.80
Are Damages In Current Dollars? Yes

Buildings (Days):
Utilities (Days):
Roads (Days):

| | |
|---|---|
| Displacement ($) | $931,609 |
| Inventory Loss ($) | $2,361,839 |
| Content loss ($) | $5,120,184 |
| Building Loss ($) | $1,879,939 |
| Total | $10,293,571 |
| Total Inflated | |

RI: 5.80
Are Damages In Current Dollars? Yes

Buildings (Days):
Utilities (Days):
Roads (Days):

| | |
|---|---|
| Displacement ($) | $720,123 |
| Inventory Loss ($) | $1,628,134 |
| Content loss ($) | $3,888,585 |
| Building Loss ($) | $1,414,030 |
| Total | $7,650,872 |

Damage Year:
RI: 100.00
Are Damages In Current Dollars? Yes

Buildings (Days):
Utilities (Days):
Roads (Days):

| | |
|---|---|
| Displacement ($) | $2,665,464 |
| Inventory Loss ($) | $16,475,683 |
| Content loss ($) | $16,045,237 |
| Building Loss ($) | $6,102,147 |
| Total | $41,288,531 |
| Total Inflated | |

RI: 100.00
Are Damages In Current Dollars? Yes

Buildings (Days):
Utilities (Days):
Roads (Days):

| | |
|---|---|
| Displacement ($) | $2,123,256 |
| Inventory Loss ($) | $13,517,899 |
| Content loss ($) | $13,065,385 |
| Building Loss ($) | $4,773,297 |
| Total | $33,479,837 |

| | | | | | |
|---|---|---|---|---|---|
| 23 Mar 2012 | | Project: | **Tillamook County-Project Exodus - Revised 3-23-2012** | | |
| Total Benefits: | **$10,382,509** | Total Costs: | **$8,336,015** | BCR: | **1.25** |
| Project Number: | Disaster #: | Program: | | Agency: | **Northwest Hydraulics Consultants** |
| State: | **Washington** | Point of Contact: | Vaughn Collins | Analyst: | Rob Flaner |

## Summary Of Benefits

| Expected Annual Damages Before Mitigation | | Expected Annual Damages After Mitigation | | Expected Avoided Damages After Mitigation (Benefits) | |
|---|---|---|---|---|---|
| Annual: | $3,269,161 | Annual: | $2,516,846 | Annual: | $752,315 |
| Present Value: | $45,116,862 | Present Value: | $34,734,353 | Present Value: | $10,382,509 |

| | | | |
|---|---|---|---|
| Mitigation Benefits: | $10,382,509 | Mitigation Costs: | $8,336,015 |
| Benefits Minus Costs: | $2,046,494 | Benefit-Cost Ratio: | 1.25 |

## Cost Estimate

| | | | |
|---|---|---|---|
| Project Useful Life (years): | 50 | Construction Type: | |
| Mitigation Project Cost: | $8,060,000 | Detailed Scope of Work: | Yes |
| Annual Project Maintenance Cost: | $20,000 | Detailed Estimate for Entire Project: | Yes |
| Final Mitigation Project Cost: | $8,336,015 | Years of Maintenance: | 50 |
| Cost Basis Year: | | Present Worth of Annual Maintenance Costs: | $276,015 |
| Construction Start Year: | | Estimate Reflects Current Prices: | Yes |
| Construction End Year: | | Project Escalation: | |

Total Benefits: **$10,382,509** Total Costs: **$8,336,015** BCR: **1.25**

Project Number: Disaster #: Program: Agency: **Northwest Hydraulics Consultants**

State: **Washington** Point of Contact: Vaughn Collins Analyst: Rob Flaner

**Justification/Attachments**

| Field | Description | Attachments |
|---|---|---|
| Historic damages before mitigation | See attached BCA methodology memorandum. | |
| Mitigation Project Cost | See cost estimate contained in BCA Methodology memorandum. | |
| Project useful life | Used FEMA recommended 50-year project life for major infrastructure projects. | |
| Unknown Frequency - Damages after Mitigation | See attached BCA methodology memorandum. | |
| Year Built | This field is not applicable to this analysis since recurrence intervals have been determined for all events analyzed. | |

Response to FEMA Comments

September 2011

Comments are shown in brown type and our responses in blue.

COMMENT 1:

The Applicant has submitted with this appeal actual damage costs that FEMA earlier requested. They include three commercial properties that were damaged in two declared flood disasters, occurring in November, 2006 and December, 1998. The Applicant states that these three properties are within the project area. No other actual damage data was provided, including agricultural building damages which initially were attributed to 47 percent of the total flood costs in the first benefit-cost analysis.

Because no actual damage costs were available for agricultural losses, it was assumed by the analyst that agricultural losses equated to commercial losses. This was based upon a 'qualitative check' used but a validation or explanation as to how they can be used equally in a benefit-cost analysis was not provided.

Commercial businesses have inventory losses. Agricultural buildings do not have business inventory, yet there was no distinction of the two, and the benefit-cost analysis did include "Agricultural Inventory Loss." The details of the ratio for agricultural structures versus residential and commercial were included in the initial benefit-cost analysis submitted, which were 47 percent agricultural and 39 percent commercial structures. However, with a new project scope proposed, any changes in this ratio or its impacts was not included. The Applicant did reduce the agricultural inventory values of the lower frequency events in its analysis by 50 percent. However, agricultural buildings have no commercial inventory, and there is no documentation submitted to justify the inclusion of agricultural buildings as having commercial inventory.

Agricultural buildings are comprised of tractors, feed, cows, and milk parlors built of concrete block designed to accommodate high volumes of water for sanitation. A flood depth of 0 to 18 inches will have vastly different impacts between agricultural buildings and commercial buildings with inventory. Documentation of a thorough analysis of how these two different building types could be treated the same is needed to justify inclusion in the analysis.

Removing the avoided future costs due to 'Agricultural Inventory Loss' results in a reduction of $1,748,298 in benefits. The total project cost detailed in the Southern Flow Corridor Design Report is $8,056,943. The benefit-cost analysis lists the project cost as $8,336,015 and the benefits of this project at $9,509,639. Even using the lower project cost estimate, by removing the Agricultural Inventory Loss benefits of $1,748,298, the project is not cost-effective and does not meet a benefit-cost ratio of 1.0. If significant unclaimed benefits exist in the existing lower bound analysis, they should be included.

The review comments seem to assert that 1) agricultural structures do not have inventory and 2) we used commercial structure depth damage functions to model inventory losses for agricultural structures. Both assumptions are incorrect.

HAZUS treats inventory as a direct economic impact and calculates not only the direct replacement cost of the inventory but net economic losses. If you do not have inventory to sell, you cannot generate profit from that inventory. Inventory losses in the flood module are determined in a manner consistent with the other building losses, as well as the methodology currently utilized in the HAZUS earthquake module.

For occupancies with inventory considerations (COM1, COM2, IND1 - IND6 and AGR1, as defined in the HAZUS99 Earthquake Technical Manual), inventory losses are estimated using USACE-based depth-damage functions, in conjunction with HAZUS default inventory values determined as a percentage of annual sales per square foot. To estimate inventory losses, percent damage (determined from the depth-damage function) will be multiplied by the total inventory value (determined according to HAZUS Earthquake Methodology - floor area times the percent of gross sales or production per square foot).

We did not apply commercial business damage functions to the agricultural structures. HAZUS has an occupancy class for agricultural buildings (AGR1) and the associated inventory damage function for this class is based upon data from agricultural operations generated by the USACE. The Tillamook County structure database allowed clear classification of every structure into the correct occupancy class (i.e. residential, commercial, ag etc.). To summarize: HAZUS has a specific classification of agricultural buildings; every agricultural building in the project area was classified as such; and HAZUS automatically calculates agriculture specific inventory losses for these structures. We followed the standard FEMA model for agricultural structures as we did for all structures.

For agricultural structures, inventory is analogous to industrial facilities. There is input inventory – the raw materials needed for production – and output inventory, - the produced material, in this case milk. Dairy farm input inventory items include fuel, bedding, feed, fertilizer, and seed. For dairy farms feed is the single largest inventory expense, and is produced on the farm to the maximum extent possible. Hay and silage are produced over the summer months to provide winter feed for the cows. This means that feed inventories are largest during flood season. The volume of feed required and methods of storage used also mean feed is stored at ground level and is susceptible to flooding – hay is stored in 1400 lb round bales and silage in open sided bins-. Finally, large floods can cause extensive damage to pasture fields which are the source of feed. Due to field damage from the February 1996 flood, it was estimated farmers would need to buy an extra 45,000 tons of dairy hay though April 1997 (14 months) when the first crop on repaired field would be available.

In addition to the loss of input inventory during floods, milk production itself is affected. Cows can drown in flood events. Floods can interrupt milk production in many ways and those impacts can be long term. In fact, according to a post-disaster report of the 1996 flood event prepared by FEMA that impacted the project area:

- 700 dairy animals were lost due to the flood event. (655 drowned, 45 lost due to residual effects)
- Milk distribution was impacted because the trucks could not get to the facilities due to the flooding and the subsequent soft ground once the waters receded.
- Milk production was significantly reduced due to the stress the cows received during the event. Production can be reduced for weeks or months afterwards and in some cases never returns to pre-flood levels.

Inventory losses for dairy farms can therefore extend for than a year after a flood, between reduced milk production and waiting for the next seasons hay production for feed. Note that in Attachment B agricultural inventory losses are higher than content losses, whereas for commercial buildings inventory losses are lower. Most commercial structures have the ability to immediately replace inventory as it is manufactured off-site; as discussed above this is not the case for dairy farms so inventory losses are drawn out over an extended period.

The reviewers also comment about the differences between agricultural and commercial buildings. We agree, and point out that is presumably why the FEMA developers of HAZUS have agricultural buildings as a separate classification with independent depth damage functions.

We reduced both commercial and agricultural contents and inventory losses by 50% for the analysis. Our analysis of commercial buildings showed that HAZUS results for the 2006 flood were 37% higher than estimated replacement cash value for the affected structures. Since HAZUS models economic losses beyond those directly incurred, as we discussed regarding inventory above, this is expected. In other words, for commercial structures it is our opinion that the HAZUS results are in line with actual damages observed and the default depth damage functions are valid. Nevertheless, for the lower bound analysis we reduced content and inventory losses for commercial structures by 50%.

Less data was available for agricultural structures but we did have some numbers to compare using HAZUS outputs and reported damages from the 1996 flood. (Note that although we called it qualitative actual dollar values were generated and compared). Based on this it did appear that agricultural damages were being overstated to some degree. We therefore reduced content and inventory losses for this category by 50% as well.

The reasoning given for removing the agricultural inventory loss seems to be related to the incorrect assumption that there is no inventory for this class of buildings. We do not believe this to be a valid reason for removal. Throughout this analysis we used standard FEMA models and methods and remained conservative on assumptions:

- We did not increase HAZUS values for residential losses even though data showed it was 40% lower than observed losses
- We lowered commercial contents and inventory losses by 50% even though the data shows in our opinion that HAZUS outputs and observed losses are reasonably in line with each other.
- We lowered agriculture contents and inventory losses by 50% based on what data we had that seemed to show HAZUS values were high.
- We used a lower bound analysis and did not include other losses including displacement costs, transportation delays and cleanup etc.

In summary, we stand by our Benefit-Cost Analysis made using FEMA software and damage curves, and believe the lower bounds approach and conservative assumptions validate the project has a BCR above 1.0 as presented.

Nevertheless we did calculate additional benefits in the form of avoided displacement and disruption losses using the method detailed on page 5-19 in the *Supplement to the Benefit-Cost Analysis Reference*

*Guide, June 2011* produced by FEMA. Single family residential structures (RES1) used the BCAR default value of $1.44/sf/month for displacement costs. All other costs were generated using Table 11 from the *Supplement*, updated to 2011 costs using the CPI calculator as recommended, with one exception. Updated displacement costs for agricultural structures were set to zero rather than the table value of $0.77/sf/month. The reason for this is that it is unlikely farmers would be able to find replacement dairy farms for rent during the displacement period, unlike commercial or residential structures where there is extensive non floodplain rental inventory likely to be available. This is also consistent with our attempts to remain conservative in our evaluation. One time disruption costs for all categories were applied using updated Table 11 values. All classes used the FEMA default displacement time rate of 1.48 months displacement /foot of flood depth (45 days/ft).

Avoided displacement and disruption costs (benefits) have a net present value of $873,781. While we do not agree with the complete exclusion of agricultural inventory benefits due to the reasons described above, we present the results here with and without this assumption to demonstrate that in both cases the project has a BCR above 1.0.

| Case | Project Benefits | Add'l Displacement - Disruption Loss Avoided Benefits | Total Benefits | Project Costs | BCR |
|---|---|---|---|---|---|
| As Submitted | $9,509,636 | $873,781 | $10,383,417 | $8,336,015 | 1.25 |
| W/O Ag Inventory | $7,761,338 | $873,781 | $8,635,119 | $8,336,015 | 1.04 |

A spreadsheet and BCAR output file with the Displacement/Disruption Loss calculations are included with these comments.

**COMMENT 2**: In addition, we'd like some more information about the assignment of 50 years as the project's useful life. Tide gates have no more than 30 years useful life per FEMA's own mitigation guidance, and are frequently assigned the useful life of concrete metal pipe culverts, which is 20 years.

The main high capacity flood gates will be a concrete structure with marine grade structural aluminum gates. The structure will sit within the levee and will only have flow through it every 2-3 years during floods. The design life for concrete pipe and box culverts easily meets the 70 year design life specified for culverts by most state transportation agencies. Similarly, aluminum CMP has a design life of 70+ years. The gates used in this structure are made of much thicker material than aluminum CMP.

There is a set of other minor culverts with tidegates needed for agricultural drainage. These will be constructed with corrugated HDPE plastic pipe that is immune to corrosion and chemical attack. These culverts will also have marine grade aluminum tide gates on the end.

The flood and tidegates will require replacement of seals and bushings during their service life but this is considered a maintenance cost and accounted for as such.

All culvert and gate components will be designed for a design life in excess of 50 years using design guidelines for culverts and bridges in saltwater environments. Salinity at the site does not approach full ocean values due to its location at the head of the estuary and freshwater inputs, during the winter salinities will be near zero much of the time, so this will provide an additional conservative design.

Some references on design life:

WSDOT Accepted Culvert Materials in Corrosion Zone III (Saltwater Environments): Concrete, HDPE, Aluminum. (WSDOT Hydraulics Manual, Ch 8, July 2008).

Estimated Service Life: Concrete, HDPE, Aluminum – 70 years (NYSDOT Highway Design Manual Ch 8 May 1996)

Estimated service life of concrete pipe: 100 years (concrete-pipe.org)

Estimated service life of 12 gage aluminum pipe: 70 years (Michigan DOT)

Estimated service life of HDPE Plastic pipe: > 100 years (plasticpipe.org)

The ongoing maintenance costs for 10,000 feet of levee and tide gates, which was assigned only $20,000 a year, still seems low.

Section 5.5 of the Preliminary Design Report gives details on the estimation of maintenance costs. The project has been designed to minimize maintenance costs. One of the major causes of levee failures and high maintenance costs is scour and erosion from construction directly adjacent to the river channel.

Between the period of January 1, 2002 through December 31, 2010 Tillamook County & the Tillamook Bay Habitat and Estuary Improvement District expended a total of $51,064 for repairs and maintenance on County owned lands in the project area (see Figure 5 of the preliminary design report). This includes everything from tide gate repairs to annual mowings and other miscellaneous levee maintenance. This averages $5,673/yr for maintaining a much longer length of poor quality levee, and more tide gates, than will be required under post-project conditions. As discussed above, all new gates, culverts and other structures will be constructed of corrosion resistant materials for long life, whereas current maintenance includes numerous older steel tidegates that are prone to corrosion and failure.

The estimated cost of $150,000 repair costs in a 10 year flood was based on conversations with Mr. Leo Kuntz of Nehalem Marine, who has maintained and repaired virtually every levee in the Tillamook area. In his opinion this is a typical repair cost to expected due to erosion or other levee failure in a large flood. Virtually all the existing levees in the area are constructed on the river bank, have a narrow top width and steep sides. The levees were originally constructed by early settlers as agricultural dikes, and subsequent repairs have not substantially improved them. In contrast, the new and upgraded levees for this project are set back far from the river channels in almost all cases, and will be engineered and constructed in accordance with Corps of Engineer levee design standards. The levees are also very low structures (typically 5 feet high or less) that will have 5:1 backslopes and wide tops in order to withstand overtopping floods without damage. In most cases during the flood peaks the levees will be fully submerged with little to no drop in flood level across them; therefore velocities will be relatively slow. The project designers have extensive experience with design of this type of levee and are confident in the ability of the levees to withstand numerous floods with minimal impact.

COMMENT 3:

For response to this comment we have highlighted and numbered (in brackets) what we see as the key issues in the comment and then address them.

The Applicant's appeal mentions potential confusion over the use of the term 'measure' versus 'alternative.' [1]FEMA's denial related to the inadequate demonstration that this mitigation project is a solution to the threat (flood hazards). While the project may include planning goals and objectives, and meet the desires of private property owners, to be eligible for FEMA funding it must demonstrate that it solves the threat. [2]The appeal documentation does not make clear either what the threat is to the built environment in the project area, [3] or how this project will mitigate that threat (or hazard). Hazard mitigation is the minimization or elimination of risk to the built environment and to lives from a natural hazard, such as a flood. While the proposed project has been revised for the Applicant's appeal, it remains unclear as to how the built environment will be protected from future damages due to this project which lowers the flood level 0 to 18 inches in the project area. The Applicant quotes FEMA in its own Appeal Brief on page 16, which is that a mitigation project must substantially reduce the risk of future damage, hardship, loss or suffering resulting from a major disaster. The Applicant's Project Description demonstrates an expansive alteration of the lower Wilson River floodplain that includes removing 36,000 feet of levee, constructing tidal dikes, replacing a floodgate structure, and restoring 520 acres of tidal marsh habitat. The Applicant writes that 10,100 feet of new and upgraded tidal dike "must be constructed to provide year-round protection to adjacent agricultural lands from twice daily tidal inundation…". There is also a brief mention that flood conditions along the Highway 101 business district will be improved. While the project includes thousands of feet of levees and dikes, and hundreds of acres, [4] there remains insufficient documentation to demonstrate this project directly reduces future costs and hazards to potential flood victims.

Sentence 2 states that the reviewers are unclear what the threat to the built environment is. Clearly the natural hazard being addressed is flooding, and the specific cause of damage is inundation of structures. There are 415 structures within the project effect area that are inundated in a 100-year flood with an average depth of 3.13 feet. This is reflected in the Benefit-Cost Analysis, which shows building structure (without inventory or contents) losses of $6.1 million in a 100-year flood. Flood insurance claims were paid in 1990, 1995, 1998, 2006 and 2007, ( five times in less than 20 years) indicating the frequency at which damaging flooding occurs in the project area. The image demonstrates the threat along the north Highway 101 corridor in the 1999 flood.

Sentence 3 implies the reviewers are uncertain how the project will function. We quote from the Appeal Brief p. 7 "The Southern Flow Corridor function is to reduce flood levels to near natural levels by the removal to the maximum extent possible of man-made impediments to flow." The Southern Flow

Corridor is a “natural floodway” currently blocked by numerous levees and dikes. The project proposes to remove these blockages and set back remaining levees in order to provide an unobstructured flow corridor. The net result is that flood levels are reduced over a wide area in the lower Wilson and even to some degree the lower Trask and Tillamook River systems. Figures 2-4 of the SFC design report shows the reductions in flood levels due to the project. The same hydraulic model outputs shown in these figures were loaded into HAZUS for the BCA. Page 9 of the Appeal Brief summarizes project benefits.

Inundation flood losses are directly tied to the depth of flooding; this is reflected in the depth-damage curve approach used in HAZUS and BCAR to model these losses. Reducing depth of flooding in a structure can be accomplished by either elevating the structure or reducing the flood levels, the latter is the approach taken by the Southern Flow Corridor project. We note again that the flood level reduction is not accomplished by traditional flood control measures such as building taller levees or dams, rather the project removes levees and restores natural floodways.

Sentences 1, 3 and 4 basically address the same issue; that there is insufficent/inadequate documentation that the project solves/mitigates/reduces flood hazards and costs. We take this to reflect the criteria listed in 44 CFR 434 (4) and (5) and discuss the project in the context of these here.

(4) [A project must] Solve a problem independently or constitute a functional portion of a solution where there is assurance that the project as a whole will be completed. Projects that merely identify or analyze hazards or problems are not eligible;

Sentence 1 uses wording from this section. We note that the use of the word “solve” implies a more concrete resolution to most hazard mitigation projects than actually is possible. With the exception of acquisition projects, typical mitigation project reduce but do not eliminate risk, be it a flood elevation or seismic retrofit. This is reflected in the reviewers comment that “Hazard mitigation is the **minimization** or elimination of risk” [bold added].

We assert that this project minimizes risk to the built environment within the constraints of the situation. A structure elevation project of similar cost could likely have been formulated. Such a project would provide a high level of risk reduction to a small set of properties. The proposed Southern Flow Corridor project provides a modest level of risk reduction to a far greater number of properties, and provides large additional benefits to the community as a whole as listed in page 9 of the Appeal Brief.

The Southern Flow Corridor is a stand alone, independent project that does not rely anything else for function. Page 18 of the Appeal Brief discusses this, and the SFC Design Report describes the project in detail.

(5) Be cost-effective and substantially reduce the risk of future damage, hardship, loss, or suffering resulting from a major disaster. The grantee must demonstrate this by documenting that the project;

Cost effectiveness is addressed by the Benefit-Cost Analysis. The project substantially reduces the risk of future damage from a major disaster – it provides the greatest flood level reductions in the 100-yr event. We note that “substantially reduce” has not been a project scale dependent issue in past FEMA funded project – we are aware of FEMA funded home elevation projects that addressed less than five homes-.

(i) Addresses a problem that has been repetitive, or a problem that poses a significant risk to public health and safety if left unsolved,

Clearly the flood hazard in Tillamook is repetitive and severe as the frequency of flood insurance claims show. Other evidence can be found in the value of acquisition and elevation funds FEMA has directed to Tillamook County over the past decades. The hazard will continue to cause losses at the same rate in the future if left unsolved.

(ii) Will not cost more than the anticipated value of the reduction in both direct damages and subsequent negative impacts to the area if future disasters were to occur,

The project has been shown to have a positive BCR using a lower bounds approach. This is addressed by our BCA report and response to comment 1.

(iii) Has been determined to be the most practical, effective, and environmentally sound alternative after consideration of a range of options,

The Oregon Solutions stakeholder group considered a range of options for the project area and determined this project to be the preferred solution. Please refer to p.18 of the Appeal Brief and the Project Exodus report for a description of this process.

(iv) Contributes, to the extent practicable, to a long-term solution to the problem it is intended to address,

The project directly contributes to reduction of flood levels in the lower Wilson River floodplain. Removal and setback of existing levees allows a return to more natural flooding patterns which can continue over the long term with minimal future intervention or maintenance.

(v) Considers long-term changes to the areas and entities it protects, and has manageable future maintenance and modification requirements.

Section 4.2 and 4.3 of the SFC Design Report discuss expected long term changes and project sustainability. Maintenance costs are addressed in the response to comment 1.

It is clear from the overall review comments that the greatest concern lies with the Benefit-Cost Analysis. The BCA is the only quantitative element of 44 CFR 434(5) and FEMA relies heavily upon it in all in grant programs. Our BCA included the following keys data sources and steps:

- Hydraulic Data is from a calibrated, Corps of Engineers developed and reviewed model.
- Elevation data is from recent high accuracy Lidar survey of the area
- Structure information is from Tillamook County and contains all detailed information needed for analysis. The great majority of structures analyzed used either elevation certificates or photographs available to accurately estimate first floor elevations

- Loss estimates were developed using FEMA HAZUS and BCAR software packages, with individual structure classification of over 500 buildings. Methods followed those approved in *Supplement to the Benefit-Cost Analysis Reference Guide, June 2011* produced by FEMA.

- Loss estimates were validated and adjusted based on actual claims and damage data

- A lower bounds approach was taken with numerous conservative assumptions. The BCR was 1.14 using this approach.

In our opinion we followed a rigorous and defensible methodology for the analysis. The level of effort to perform this analysis for 570+ structures was extensive and we used all loss data we were able to gather. For agricultural structures where loss data was sparse we reduced contents and inventory values by 50%.

The Southern Flow Corridor project is unusual compared to standard flood mitigation project in that the level of risk reduction is modest. A qualitative comparison of the project against a more typical mitigation project such as a home elevation (which has a much higher level of risk reduction) understandably would make this project appear to be of small value. It is precisely for this reason that we believe the quantitative Benefit-Cost Analysis is critical. The translation to economic costs a BCA performs allows objective comparison and review of mitigation projects, even those that use non-traditional methods or have low net risk reduction. We are aware of many FEMA funded mitigation projects with Benefit-Cost ratios below that we have calculated, as well as many projects with much smaller areas of benefit and scale. We have also looked at projects such as home elevations that clearly provide excellent risk reduction but failed to meet the Benefit Cost criteria. The Southern Flow Corridor project meets the Benefit-Cost ratio because it provides modest loss reduction to a large number of structures.

Response to Initial Denial (First Appeal)

May 2011

# APPEAL BRIEF
FEMA: 1733-DR-OR
FEMA No.: 057-U1ZZV-00
Applicant: Port of Tillamook Bay (POTB)
PW No: 946 (Alternate Project #13 to PW936(1))
Southern Flow Corridor Project

## STATEMENT OF THE CASE

This Project, entitled "Southern Flow Corridor Project" is one of several alternate projects to DR-1733-OR's Project Worksheet (PW) 936 for the repair of POTB's historic railroad. By letter on March 16, 2011 Charles Axton, FEMA Region X Recovery Division Director, determined that this project is ineligible for Public Assistance (PA) program grant funding for the following reasons:

1. The project does not appear to be cost-effective and has not sufficiently demonstrated to have a Benefit Cost Analysis (BCA) greater than 1.0. This issue was further clarified by Charles Axton in a letter dated March 24, 2011 that identified two key issues:
    a. The lack of use of actual historic damages to validate the FEMA HAZUS model depth damage functions
    b. Failure to adequately document project costs
2. The project does not appear to solve the threat independently or constitute a functional portion of a solution to the threat
3. The project does not appear to have the necessary assurances related to long-term and ongoing maintenance, repairs and operations

For those reasons, FEMA denied POTB's funding request for the Southern Flow Corridor Project. Subsequent discussions with FEMA staff established that FEMA would accept revised documents, including a BCA and Scope of Work, in addition to clarified statements of commitment relating to item 3 above during the appeal period.

POTB files this appeal of FEMA's denial pursuant to 44 CFR 206.440 and has submitted this appeal within the 60-day period required by 44 CFR 206.206.

## SUMMARY OF ARGUMENTS

1. This project is demonstrated to be cost effective with a BCA of 1.14.

Per discussions with FEMA staff and the supplementary letter clarifying FEMA's issues with the BCA from Charles Axton dated March 16, 2011 a validation of the modeled damages with actual observed damages was undertaken. The project costs were also reviewed and revised, including construction, real estate and maintenance costs. A revised BCA for the Southern Flow Corridor (Exhibit C) is attached with full details.

2. The Southern Flow Corridor is a standalone, independent project that constitutes the single most cost effective alternative for reducing flooding in the lower Wilson River floodplain. Some confusion may have been introduced on this issue in poorly communicating the difference between Project Exodus and the Southern Flow Corridor, especially as the Project Exodus design report was attached and the Alternate Project Request cover sheet included more than the Southern Flow Corridor.

The issue can best be clarified by using Corps of Engineers definitions from their flood planning guidelines. A “Measure” is a stand-alone, independent project that is economically justified on its own. An “Alternative” is a collection of measures that together seek to maximize meeting the planning goals and objectives.

Using these terms, Project Exodus is the preferred Alternative for meeting the Oregon Solutions goals and objectives for the lower Wilson River. The Southern Flow Corridor is one of three measures that comprise this Alternative.

This Alternate Project Request deals <u>only</u> with the Southern Flow Corridor. However, the Project Exodus Design Report is again submitted as Exhibit B here within this Appeal for the sole purpose of documenting the planning goals, objectives, background information and process used to arrive at the preferred Alternative. Since the Project Exodus Design Report was issued, the Southern Flow Corridor project has been revised to meet the desires and concerns of the private property owners affected by the Project, something that was not done at the initial stage.

Therefore, a new report is included with this brief as Exhibit A – the Southern Flow Corridor – Landowner Preferred Alternative Preliminary Design Report. This report (hereafter referred to as the Southern Flow Corridor Design Report) contains the most up to date information on the Southern Flow Corridor and supersedes any details given in the Project Exodus Design Report. This new report should be used for evaluating the Southern Flow Corridor in terms of scope of work, cost estimates, levee and dike alignments, etc.

3. POTB is committed to providing long-term and ongoing maintenance, repairs and operations of the completed project site. The administrative framework for accomplishing that commitment is described below in Section III General Work Eligibility.

Project maintenance costs previously submitted were also reviewed and compared with current estimated costs incurred by Tillamook County and various private parties in maintenance of nearby dikes and floodgates. The previous maintenance cost used of $20,000 per year remains unchanged based on this review. Details of how the cost was estimated are contained in the Southern Flow Corridor Design Report.

## PROJECT SUMMARY AND ELIGIBILITY

A full description of the Project is contained in the Southern Flow Corridor Design Report attached hereto as Exhibit A. By way of summary, the Southern Flow Corridor Project is described below. These sections also address project eligibility as well as respond to the matters that are at issue in this appeal.

# I. PROJECT REQUIREMENTS AND SCOPE OF WORK

**DAP9525.13 (VII) (G) The proposal must include a description of the project, including the project location, an estimate of costs, a schedule of work, including a starting date for work and a targeted completion date and the necessary assurances to document compliance with special requirements, including, but not limited to floodplain management, environmental review, hazard mitigation, protection of wetlands and insurance.**

**44 CFR 206.203(d)(2)(v). Historic and any other legal considerations should also be identified. The applicant should identify the source of funding for projects when the cost estimate for the alternate project is greater than the eligible alternate project funding.**

### (1) Project Description

The Southern Flow Corridor Project proposes to remove manmade impediments to flood flows to the maximum extent possible in the lower Wilson River floodplain. By doing so, flood level reductions exceeding one point five feet in some locations can be obtained in the area.

The Southern Flow Corridor project would:

- Remove approximately 36,000 lineal feet of existing levee
- Lower an additional 11,100 feet of levee
- Construct 7,000 feet of new setback tidal dike and upgrade an additional 3,100 feet of pre-existing tidal dike
- Replace an existing floodgate structure with a new one
- Provide over 520 acres of restored tidal marsh habitat in a key location of the Tillamook Bay Estuary

The 10,100 feet of new and upgraded tidal dike must be constructed to provide year-round protection to adjacent agricultural lands from twice daily tidal inundation, particularly during the summertime higher tides. It should also be noted that the habitat restoration component of the project is a byproduct of the flood damage reduction benefits. Virtually all the costs related to habitat restoration are either anticipated to be required as permit conditions or benefit the flood damage reduction purpose of the Project. For instance, ditch filling is desired to allow the formation of natural tidal channels, but this allows on-site disposal of organic soils that would otherwise need to hauled off site and disposed of at much greater cost. Additionally, the excavated tidal channels shown, function as required flood conveyance or agricultural drainage channels, but are given sinuosity in order to provide habitat benefits.

Figure 1 below shows the Project elements. The Project is described in more detail in the attached Southern Flow Corridor Design Report.

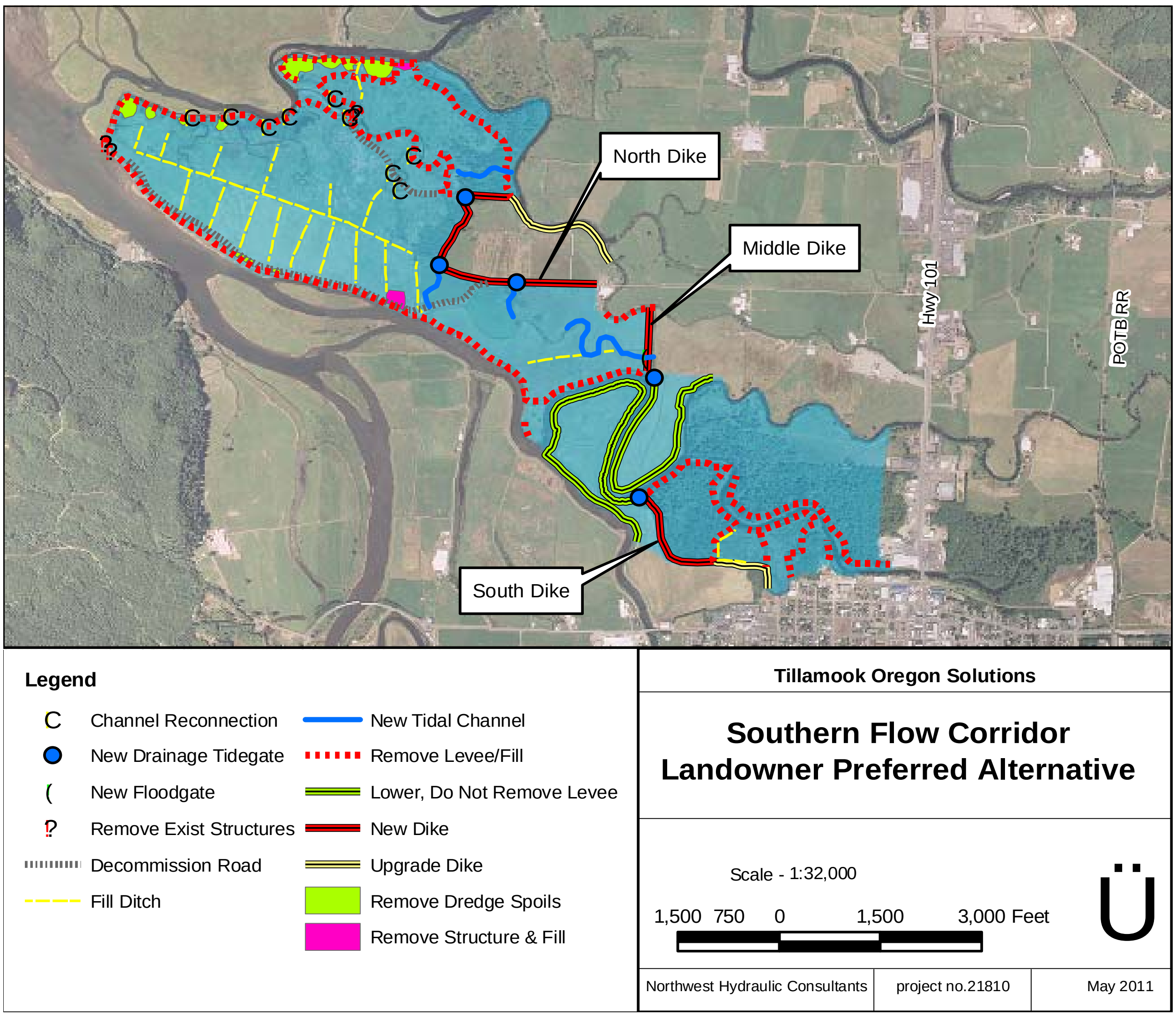


Figure 1: Southern Flow Corridor Project Elements

Also attached is the Project Exodus Design Report, dated February 2010 (Exhibit B). As discussed above, this report is provided here for the sole purpose of providing the background, objectives and methods that were used to investigate possible flood damage reduction measures within the flood plain that lies between Hoquarton Slough, Wilson River and Tillamook Bay. The report also describes various alternatives that were evaluated. Finally, the report presents a preliminary design for a recommended Project, consisting of three independent, standalone project elements, one of which is the Southern Flow Corridor. This report is provided for background and context of the Project, however, all design details, cost estimates and land needs have been refined since the publication of this report. The reader should refer to the Southern Flow Corridor Design Report (Exhibit A) for up-to-date project details.

(2) **Project Location**

The Southern Flow Corridor Project area is located at the confluence of the Wilson, Trask and Tillamook Rivers on the southern end of Tillamook Bay (see Figure 2 below). These three rivers and multiple sloughs connect in a complex delta system around the City of Tillamook. The area of influence of the Project (i.e. area of flood level reduction created by the Project) extends up the Wilson River east of the POTB railroad, west to Tillamook Bay and up the Tillamook and Trask Rivers to the south. Please refer to the Southern Flow Corridor Design Report (Exhibit A) for figures showing the extents of benefit from this project.

GPS Point #1: 45°27'32.76"N 123°50'45.74"W; then Northwesterly to GPS Point #2: 45°28'32.54"N 123°53'32.83"W; then Northeasterly to GPS Point #3: 45°28'26.69"N 123°52'09.36"W; then Southeasterly to GPS Point #4: 45°28'00.40"N 123°51 '23.24"W.

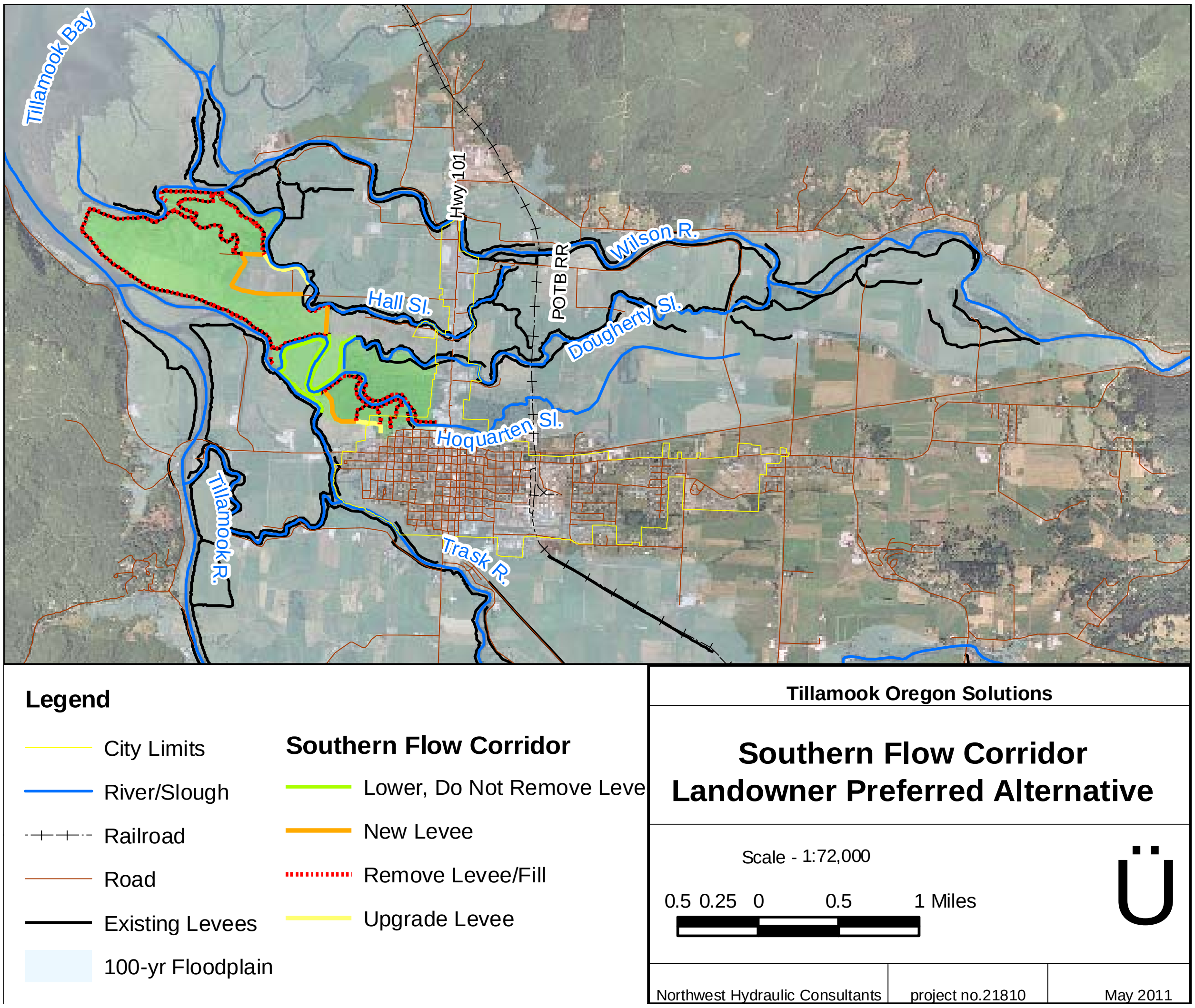



Figure 2: Southern Flow Corridor Project Location

### (3) Project Function

The Southern Flow Corridor function is to reduce flood levels to near natural levels by the removal, to the maximum extent possible, of man-made impediments to flow.

The Wilson River flows through a steep canyon out of the mountains where it enters the lower valley about six miles above Tillamook Bay. The river channel meanders along the northern side of the floodplain and is perched - it runs in a channel with natural banks that are higher than the flood plains around it, while the southern side of the flood plain contains the lowest elevations. As a consequence, flood flows that spill over the south river banks never return to the channel, but instead flow south and west across the flood plain, across Highway 101 and mix with Trask and Tillamook River floodwaters at the head of the bay. As Figure 2 shows, below Highway 101 there are numerous levees bounding virtually the sloughs and channels in the area, a legacy of over a century of marsh reclamation, diking and draining. When the westerly flood flows hit these levees, especially those that run north-south, a back water effect occurs, substantially contributing to the flood conditions along the Highway 101 business district and POTB's railroad.  The Southern Flow Corridor project would remove these flow impediments to the maximum extent possible, removing or lowering over 47,000 lineal feet of levee in addition to remnant dredge spoils that were deposited between 1900 – 1973.

The 7,000 feet of new tidal dikes must be constructed to provide year-round protection to adjacent agricultural lands from twice daily tidal inundation, particularly during the summertime higher tides. Unless these dikes are constructed, the daily tidal cycle would convert the lands behind the dikes to salt marsh, making the lands no longer suitable for agricultural uses and necessitating the acquisition of entire farm parcels, together with the farm homes and agricultural buildings, thereby substantially increasing the total project costs.  Privately held land in the amount of 119.8 acres will be purchased and flood easements will be acquired on three additional properties, thereby leaving the homes and agricultural operations behind the new setback dikes intact.

It is important to note the new dikes do not function as flood control levees or flood control works designed to exclude riverine floodwaters.  Due to the floodwaters that arrive from upstream spillover as described above, the new setback dikes and lowered existing dikes are built as low as possible to pass river flood flows out without restriction while still preventing high tides from getting in.  The dikes are designed to function as overtopping spillways during floods.   The middle dike also includes a high capacity flood gate structure to pass flows and allow rapid post-flood drainage.  Flood flows will pass through this structure every second or third year, a sufficient frequency which to keep the channels open and able to convey flood flows out to the main channels and bay along relic channels where the structures will be placed.

The habitat restoration function of the Project will be enabled primarily by the removal of the existing levees, culverts and other fill.  Daily tides will then begin the process of rebuilding natural marsh surfaces, conversion of vegetation to salt-tolerant marsh species and formation of tidal channels.  Filling of existing linear ditches provides a disposal location for organic soils and also serves to enhance the creation of natural channels.

A summary of the functions and benefits of the Project is as follows:

- Provides significant flood level reduction to near natural levels over a wide area of the lower Wilson River floodplain

- Provides faster post-flood drainage and consequent road re-openings

- Protects adjacent agricultural lands from tidal inundation and provides improved drainage to these lands

- Removes County obligations to maintain over 30,000 feet of sub-standard levee located on riverbanks and prone to erosion and failure. Replaces this with 7,000 feet of new tidal dike, setback from all main river channels and engineered for long term function with minimal maintenance

- Provides very significant habitat restoration value of critical habitat types in a key ecological location

(4) **Cost Estimates and Financial Assurances**

A summary of estimated costs of the Southern Flow Corridor is presented here. Cost details and methods of development are given in the Southern Flow Corridor Design Report (Exhibit A).

| ITEM | COST |
|---|---|
| Permitting, Design & Construction | $6,517,000 |
| Property Acquisition | $1,540,000 |
| Maintenance | $ 20,000/year |

The sources of funding for total project costs, including property acquisition, are described in the table below. These sources include acquisition and development funds from the Oregon Watershed Enhancement Board (OWEB) for which a commitment letter is attached as Exhibit J.

| SOURCES OF FUNDING | AMOUNT |
|---|---|
| FEMA Alternate Project Funds | $3,225,000 |
| OWEB Restoration Funds | $1,625,000 |
| State Bond Matching Funds | $1,075,000 |
| Other grant/loan funding | $2,132,000 |
| | $8,057,000 |

Additionally, a loan commitment dated May 18, 2011 in the amount of up to $3,000,000 has been provided by TLC Federal Credit Union (Exhibit K). Tillamook County, to whom the commitment is made, has stated that it intends to replace the loan prior to the need for the funds.

More specifically, the Southern Flow Corridor is a flood damage reduction Project. Aside from FEMA, there are few, if any other funding sources available for flood reduction projects. However, the strategic location of the Southern Flow Corridor adjoining the estuary at the confluence of two major coastal salmon rivers, positions this Project to result in one of the largest habitat restoration projects on the Oregon Coast. Initially there was some skepticism that a hazard mitigation project could produce such results. However, the full range of natural resource agencies at the Oregon Solutions table for this Project have come to embrace this project, to the extent that the May 13, 2011 Oregon Solutions meeting produced a unanimous endorsement.

This project will restore natural hydrologic processes to the site. It will re-establish tidal exchange with the bay and hydrologic connectivity between the Wilson and Trask Rivers and their associated flood plains. This will result in a large number of key priority habitats for fish and wildlife, including intertidal mudflats, tidally influenced freshwater wetlands, flood plain lowland riparian and linear wetlands, lowland non-linear forested wetlands and Sitka spruce forest.

For these reasons the Southern Flow Corridor is eligible for a wide array of habitat restoration funding. As soon as property acquisitions are complete, grant applications will be submitted to the National Oceanic and Atmospheric Administration (NOAA), Office of Ocean and Resource Management and the US Fish and Wildlife Service. These agencies have already provided funds for the acquisition of the original 377 acres presently owned by the County and are committed to seeing this project being completed. Although these agencies are represented on this Oregon Solutions Project and Design Teams, program limitations prevented the representatives from making formal commitments outside the grant application process.

Additionally, other funding sources have expressed strong interests in this project and have invited applications. These include the Oregon Department of Fish and Wildlife, the Nature Conservancy, the Oregon Hunters Association and others.

Oregon Solutions has an uninterrupted string of successful projects across the state. Eleven million dollars was just secured last month to make the Vernonia project funding complete. FEMA is involved in that project as well. The POTB and its Tillamook Oregon Solutions partners are confident that this project will be another Oregon Solutions success.

(5) **Work Schedule**

Proposed Work Schedule

| ITEM | TIMELINE |
|---|---|
| Property Acquisition | May 2011 - July 2012 |
| Environmental Assessment & Permitting | August 2011 - February 2013 |
| Preliminary Design | August 2011 - February 2012 |
| Final Design | February 2012 - March 2013 |
| Procurement/Bidding | March - April 2013 |
| Construction | May - October 2013 |
| Project Closeout | December 2013 |

**Property Acquisition** is ongoing. Two options have been obtained and appraisals on ongoing on other parcels. Options on all properties and easements are anticipated to have been acquired by August 2011. Funding for property acquisition will be submitted to OWEB when completed. OWEB is waiting to fund the Project once all property details have been fixed. Complete acquisition is anticipated for completion by July 2012.

**Environmental Assessment and Permitting**: Nineteen months are budgeted for environmental assessment and permitting. As mentioned in the design report, the project has been designed for the ability to obtain a Corps of Engineers nationwide permit. Whether or not a nationwide or individual permit is required, it is an indication of the relative ease of permitting the Project is expected to have given the very large ecological benefits that will accrue.

On April 26, 2011 Mark Eberlein, FEMA Region X's Regional Environmental Officer, discussed this project during his visit to the POTB. Mr. Eberlein indicated an Environmental Impact Study (EIS) would most likely be required for the Southern Flow Corridor Project. Given the additional requirements and time an EIS would require, the project schedule includes a 19-month period for this activity. Work will begin in August 2011 with environmental scoping and field data collection and conclude in February 2013 with the issuance of permits for construction.

**Preliminary Design:** Preliminary Design will begin concurrently with the environmental assessment as they are complementary. The exact Project feature alignments must be designed and laid out so they can be field marked for wetlands and cultural resource assessments to begin. The extensive involvement of resource agencies in the Oregon Solutions process will be utilized to ensure project design details will maximize habitat restoration benefits and not become issues during permit review. Preliminary design will conclude with the submittal of 30% plans for permit review.

**Final Design:** Final design will complete the preliminary design and incorporate any permit review and other environmental assessment requirements that may occur. The final construction ready plans, specifications and engineering (PSE) package will be prepared.

**Procurement/Bidding:** A bid package will be prepared with the PSE and other required bid documents and advertised in April 2013. Bid award will follow shortly thereafter.

**Construction:** A six-month construction window is allotted from May through October 2013. The majority of the work is anticipated to be completed in the middle of this period during the time of lowest high tides.

**Project Closeout:** After the end of construction, administrative tasks needed for project documentation, accounting and other items will be completed and necessary reports submitted to the requesting agencies.

(6) **Special Requirements, Environmental Reviews and Permitting**

The Southern Flow Corridor Project has benefited from a large amount of information generated by previous studies and other efforts in the area, including the US Army Corps of Engineers Tillamook Feasibility Study and various studies completed by the Tillamook Estuaries Partnership. The flood analysis is based on a detailed hydraulic model calibrated and validated against data from four floods of varying sizes. The process of selecting the Project was completed through the locally driven, stakeholder based Oregon Solutions process, with both key resource agencies and local community participation throughout. For these reasons the Project has been well-vetted, has strong community and resource agency support and a strong technical basis to justify each element.

(7) **Floodplain Management**

The Project is located entirely within the floodplain and floodway of the Wilson River. As such, floodplain management regulations will apply, including zero rise criteria. The Southern Flow Corridor Design Report shows that the Project results in water level reductions across the entire lower Wilson River floodplain in a 100 year flood. During the permitting phase this will be documented using the official FEMA hydraulic model as part of the flood hazard permit.

(8) **Environmental Assessment**

A fairly extensive discussion on permitting and the favorable environmental consequences of the proposed Project is contained in the Southern Flow Corridor Design Report (Exhibit A). As stated therein, "No major hurdles are anticipated". The Southern Flow Corridor has large ecosystem restoration benefits and would likely qualify for a streamlined restoration permit. The Project has been designed to qualify under the Federal Nationwide Permit (NWP-27) and the General Authorization under the State of Oregon Removal-Fill law. It has also been designed to comport with NOAA fisheries restoration programmatic biological opinion (SLOPES IV).

(9) **Hazard Mitigation Plan**

Please refer to Section 13(a) and 13(f) of this brief for documentation of compliance with state and local mitigation plans.

(10) **Protection of Wetlands**

The project will restore or enhance over 520 acres of wetlands through the removal of levees and reconnection of floodplain with the river system.

### (11) **Insurance Requirement**

The project reduces 100 year flood levels throughout its area of influence. Therefore, even though the Project is located within the floodway, no flood hazard permit issues are known at this time. This result is determined with the NHC model, which is related to but different from the official FEMA flood model. The Project will be modeled using the FEMA model during permitting to verify the no-rise finding. No structures are proposed that would be subject to flood insurance requirements.

### (12) **Property Acquisition**

The Southern Flow Corridor will require the acquisition of title to 119.8 acres and flood easements over another 85.3 acres. The County is presently undertaking the acquisitions. The specific parcels and rationale for these acquisitions is described in the Southern Flow Corridor Project Report (Exhibit A) and is summarized in the table below:

| ID | Property | Acres | Cost ($) | Note |
|---|---|---|---|---|
| A | Fuhrman | 1.5 | $ 675,000 | Signed Option |
| B | Allen | 4.3 | $ 31,300 | Estimate |
| C | Jones | 48.0 | $ 192,000 | Scaled Appraisal |
| D | Sadri | 66.0 | $ 485,000 | Signed Option |
| E | Aufdermauer (Flood Easement) | 50.5 | $ 27,800 | Estimate |
| F | Beeler (Flood Easement) | 34.8 | $ 19,100 | Estimate |
| G | Temp. Construction Easements (2) | -- | $ 20,000 | Estimate |
| | | Subtotal | $ 1,450,200 | |
| | Appraisals/negotiations | | $ 60,500 | |
| | Title Reports | | $ 2,500 | |
| | Surveys for Legal Descriptions | | $ 12,000 | |
| | Environmental Assessment | | $ 12,500 | |
| | Closing costs/Title Insurance | | $ 2,500 | |
| | TOTAL | | $ 1,540,200 | |

The status of each of these acquisitions is described as follows:

**Sadri:** A two year purchase option agreement was executed on February 23, 2011 for this 65.98 acre parcel in the amount of $485,000. The County will exercise its option upon receipt of the OWEB grant funds that have been committed to the Project. This is expected to occur by early 2012. Acquisition will be completed by July 2012.

**Fuhrman:** This property consists of an approximate 1.48 acre parcel and single family residential structure. A two year purchase option agreement was executed on March 9, 2011 in the amount of $675,000. The County will exercise its option upon receipt of the OWEB grant funds that have been committed to the Project. This is expected to occur by early 2012, with acquisition completed by July 2012.

**Jones:** This parcel consists of about 48 acres of marginal farmland. The yellow book appraisal is expected to be completed before the end of July 2011. The cost estimate presented here is based on a recently completed appraisal of the property that assumed the purchase of around 30 acres; the unit price from this appraisal was used for the new amount. The property will be under a purchase option agreement by September 2011. Funds for the purchase of this property are earmarked within the OWEB grant funds that have been committed to this Project. The is expected to occur by early 2012, with acquisition completed by July 2012.

**Allen:** This 4.25 acre parcel consists primarily of a disconnected slough that, once acquired, can be reconnected to further contribute to the flood discharge capacity of the Project. The yellow book appraisal is expected to be completed before the end of July 2011. The current estimate is based on unit acre costs from the Sadri purchase, as both parcels are primarily wetlands and open water. The property will be under a purchase option agreement by September 2011. Funds for the purchase of this property are included within the OWEB grant funds that have been committed to this Project. Acquisition will be completed by July 2012.

**Aufdermauer/Beeler:** Flood easements will be required over an 85.31 acre portion from the farmlands of these owners. This is due to the fact that these pastures are protected by levees that are slated to be lowered as part of this Project. The parcels will benefit from flood level reduction and drainage improvements due to the project. The flood easements will be negotiated and executed during final design of the Project, once the detailed requirements for drainage elevations and construction needs are determined.

**Construction Easements:** Three additional parcels owned by two parties will have work completed on their land as part of the Project. This work consists of either a) fill removal in an undiked area where the property will benefit from flood level reduction and will otherwise be unaffected and b) minor dike improvements necessary to tie into a new dike adjacent where the property will receive substantial flood level reduction benefits. In these cases $10,000 for each owner is budgeted for obtaining a temporary construction access easement only.

(13) **Guidelines for Mitigation Projects**

Under DAP9525.13 (VII) (J) the types of mitigation projects that may be approved for alternate project funds are very broad. Under that guideline, mitigation measures may be the same type as would be eligible for funding under section 404 of the Stafford Act, the Hazard Mitigation Grant Program (HMGP). As such, a project must meet five minimum project eligibility criteria, 44 CFR 206.434(b), as follows:

*(a) The Project conforms with the State Hazard Mitigation Plan (HMP):*

HMP Goal 1 - Protect life and reduce injuries resulting from natural hazards

Presently, Highway 101 is closed several times each year due to flooding. When Wilson River Loop Road also closes due to high water, access to Tillamook County General Hospital, the County's only hospital, is cut off to ambulances and other emergency vehicles transporting patients from the north end of Tillamook County, the most populous area of the County outside the City of Tillamook. In such cases, access to Seaside Hospital in Clatsop County is also usually blocked south of Seaside, leaving this population at great risk to injury or death without any hospital care. The proposed project will reduce depths and durations of this highway closure due to flooding.

HMP Goal 2 - Minimize public and private property damages and the disruption of essential services

The stretch of commercial property that will be benefited by this Project consists of a swath of businesses 1,000 feet wide along Highway 101 over one mile long. This area represents the business core of Tillamook City's highway commercial district, containing a number of the County's major employers. Even those properties in this area that are elevated sustain damages due to business disruption. A number of the remaining businesses have sustained repetitive loss from direct flood damage. Moreover, when the highway closes there are major disruptions to businesses outside the flood plain due to employees who cannot get to work. The proposed project will have a dramatic effect in reducing property damage and business disruptions. There are over 500 structures in the overall area that receive some benefit in flood level reduction to the project.

HMP Goal 3 - Increase the resilience of local, regional and statewide economies

When Highway 101 closes, some of the County's largest employers have to either shut down or reduce production. Businesses such as Tillamook Cheese, Fred Meyer, Rosenberg's Builders Supply, to name a few, are either forced to close or sustain major disruptions. Moreover, goods in transit over Highway 6 from the Willamette Valley to points in the flood area, in North Tillamook or in Southern Clatsop County are unable to reach their destinations. The flow of feed to farmers and milk to the Tillamook County Creamery Association or bottlers in the Willamette Valley are interrupted. Milk production often has to be dumped. Once again, this Project will have substantial benefits to the resilience of local, regional and state economies.

HMP Goal 4 - Minimize the impact of natural hazards while protecting and restoring the environment and

HMP Short Term Action #3 - Continue seeking effective hazard mitigation opportunities compatible with habitat and fisheries protection via multi-objective mitigation efforts

Out of the 59 project alternatives considered as part of the US Army Corps of Engineers Feasibility Project and the ten project alternatives analyzed under Project Exodus, the Southern Flow Corridor project was not only the most effective at flood mitigation but it is also the one project that provides the most environmental restoration, with approximately 450 acres of salt marsh creation and many miles of stream restoration. Perhaps more importantly, the Southern Flow Corridor Project has substantial benefits to the federally listed threatened and endangered Coho Salmon, benefits to Chinook and Chum Salmon, as well as to Steelhead Trout.

Long Term Action #6 - Assist local communities in securing funding to implement measures to mitigate damage to buildings exposed to or having experienced repetitive losses

Although Tillamook County has done much to relocate National Flood Insurance Program (NFIP) repetitive loss structures, there are still yet other NFIP repetitive loss structures remaining in the Project area. Moreover, there are other repetitive loss structures in the Project area that are not in the NFIP. All of these would be directly benefited by FEMA funding of the proposed mitigation project.

***(b) Provides a beneficial impact upon the designated disaster area***

Tillamook County was designated as a disaster area under DR-1733-OR that also included a number of Western Oregon Counties and the state. As noted above, there are substantial benefits from this Project locally, regionally and for the State of Oregon.

***(c) Conforms to environmental laws and regulations***

In addition to the substantial flood mitigation benefits from this Project, it has very large ecosystem restoration benefits and will likely qualify for a streamlined restoration permit. The project has been designated to qualify under the Federal Nationwide Permit (NWP-27) and the General Authorization under the State of Oregon Removal-Fill law. It has also been designed to comport with NOAA Fisheries restoration programmatic biological opinion (SLOPES IV).

***(d) Solves a problem independently or constitutes a functional portion of a solution***

The Southern Flow Corridor constitutes a standalone, independent solution to flooding in the lower Wilson River floodplain. It provides substantial flood level reduction over a wide area through the removal of man-made flow impediments to the maximum extent possible. No other projects are needed for these benefits to occur.

Oregon Solutions, the locally driven stakeholder group formed after the flood of 2006 to address flooding issues, identified a suite of flood damage reduction measures for implementation. Many measures were immediately implemented, such as removal of fill in the floodway; but in recognition of the complexity of flood issues on the lower Wilson River, an extensive technical alternatives analysis was undertaken with multiple public meetings and input. As a result of this process, Oregon Solutions voted to select Project Exodus as the preferred alternative for implementation. Project Exodus consists of three geographically separated projects, one of which is the Southern Flow Corridor. The Southern Flow Corridor was selected as the first project to implement, due to its standalone nature, availability of FEMA funding and having the widest and most significant flood damage reduction benefits of the three projects.

The Southern Flow Corridor Design Report (Exhibit A) and Benefit-Cost Analysis (Exhibit C) describe and analyze this project on its own, with benefits and costs compared to existing, present day conditions.

***(e) Is cost effective***

**The Stafford Act and its implementing regulations require that HMGP projects be cost effective. 44 CFR 206.434(b). Among the minimum criteria for cost effectiveness is that a project must be "cost effective and substantially reduce the risk of future damage, hardship, loss or suffering resulting from a major disaster".**

The cost effectiveness of the Project has been demonstrated by a BCA using FEMA developed software. The Project functions to provide risk reduction over all floods from a two year through 100 year event. The BCA Report (Exhibit C), addresses the concerns raised, including providing validation of the FEMA depth-damage curves with local observed historic damages.

**In addition to the five minimum project eligibility criteria addressed above, an HMGP project must also meet three minimum project selection criteria, 44 CFR 206.435(b), as follows:**

***(f) The project must provide the best fit within the overall development plan and/or the Hazard Mitigation Plan for the area***

For more than a decade, POTB, Tillamook County and the City of Tillamook have worked with other local, state and federal partners for flood mitigation and ecosystem restoration planning for this area. Initially, with the US Army Corps of Engineers Feasibility Study and later with the Project Exodus study, HEC-RAS computer modeling was used to identify a series of alternatives which were narrowed down to the preferred Alternative identified in the Project Exodus Design Report (Exhibit B), of which the

Southern Flow Corridor is the more important stand-alone component. This Project has the solid support of the local community and local governments as well as state and federal regulators.

Additionally, this Project fulfills the following goals and actions of the current City of Tillamook Hazard Mitigation Plan.

Goal A: Protect Life and Property

Engage in and promote long-term, cost-effective regional planning and property protection activities that will reduce or eliminate adverse impacts from flooding.

Goal B: Preserve Natural Areas Related to Flooding

Preserve and restore natural areas and water conveyance to enhance flood plain function. Protect or enlarge existing wetlands and open areas to maintain or create additional floodwater holding areas. Preserve and enhance public open space along floodways, rivers, sloughs, tributary streams and the bay to insure adequate floodplain function.

Goal D: Modify existing structures to improve hydrologic function

Develop solutions that ensure all non-emergency flood mitigation maintains or enhances natural resource protection. Implement structural flood mitigation solutions to protect critical structures and infrastructure when other alternatives do not exist.

Goal F: Improve and Promote Partnerships, Coordination and Implementation

Foster on-going community partnerships and forge new links with other agencies and organizations within and outside the city when implementing flood mitigation activities.

***(g) Selected projects should be those that clearly reduce loss of life, loss of essential services, damage to critical facilities or severe economic hardship***

This Project will substantially reduce the risk of future flood damages to the benefitted section of railroad. As noted elsewhere in this application, the POTB railroad will continue to be an important asset to the POTB. In past years when Highway 101 and Wilson River Loop road closed, the railroad was the only transportation link joining the North and South ends of Tillamook County. Additionally, Tillamook County General Hospital, the County's only hospital, is a critical facility. As indicated elsewhere within this brief, the limited hospital access issue for much of the County's population will be reduced by the project.

***(h) Have the greatest potential to reduce losses after examining the alternatives available***

As indicated in several locations elsewhere within this brief, this Project has the greatest potential to reduce future losses after examining the 59 alternatives identified in the US Army Corps of Engineers Feasibility Study and the ten alternatives explored in Project Exodus. The HEC-RAS modeling demonstrates between a one foot and one point five foot reduction in flood levels along Highway 101 and a six inch reduction along the POTB's railroad during a 100 year flood event. No other project examined or modeled over the last decade has shown as much potential to reduce future losses.

The HMGP manual (at Page 5-3) also lists a number of other considerations the state may add to its evaluation criteria when selecting an HMGP project. Each of the following criteria from that list is justified by elements of the proposed Project:

- Level of protection provided by the Project
- Measures designed to accomplish multi-objectives, including damage reduction, environmental enhancement and economic recovery
- The applicant community's participation in the National Flood Insurance Program, compliance record and Community Rating System level
- Local commitment and public buy-in

## II. Project Eligibility

FEMA's Disaster Assistance Policy for Alternate Projects authorizes an eligible applicant to perform hazard mitigation measures unrelated to the original facility. DAP9525.13 (VI). In order to do so, an applicant must first demonstrate project eligibility under the guidelines of DAP9525.13 (VII). The following section lists each of those guidelines and applicant's documentation of eligibility.

(1) **The applicant may request approval of an alternate project from FEMA through the grantee which an applicant determines that the public welfare would not be best served by either restoring a damaged facility or by restoring the function of a damaged facility. Either one of the two conditions must be met. See 44 CFR 206.203(d)(2).**

The POTB has previously received authorization from FEMA to pursue a series of Alternate Projects in lieu of restoring its damaged railroad facilities. This Project application is one in that series of Alternate Projects.

(2) **The proposed alternate project must be a permanent project that benefits the general public. See 44 CFR 206.203(d)(2).**

The proposed project is permanent and the public benefits are substantial. As shown in the Southern Flow Corridor Design Report (Exhibit A), during the 100 year flood there will be up to a one foot reduction in flood levels at the south end of the Project area along Highway 101 and up to one point five foot flood reduction in flood levels at the north end of the Project area along Highway 101. This portion of the Project area, consisting of 500 feet on each side of Highway 101, contains a major piece of the City of Tillamook's commercial businesses representing millions of dollars in value. This Project will also reduce flooding on POTB's railroad up and downstream of the north-south rail line by about six inches in the 100 year flood. The environmental benefits will also be substantial. Between 500 and 600 acres of salt marsh wetland will be created as a direct consequence of this Project with direct benefit to the federally listed Coho Salmon. Also both Hoquarton and Dougherty Sloughs are currently listed by the Oregon Department of Environmental Quality (DEQ) as water quality impaired streams. According to the Director of DEQ, the beneficial effects on water quality in those streams as a direct result of this Project will be "immediate and dramatic".

(3) **A damaged facility whose repair costs were used for an approved alternate project may be eligible for future PA funding provided that the applicant funded and performed the repairs to the original damaged facility**

This policy guidance does not appear to be relevant to the issue of eligibility of the proposed Alternate Project.

(4) **Funds may be used to repair or expand other selected facilities to construct new facilities, purchase equipment or to fund hazard mitigation measures in accordance with other provisions of this policy**

This policy authorizes the proposed Alternate Project to be funded as a hazard mitigation measure.

(5) **FEMA expects the proposed alternate project to serve the same general area that was being served by the originally funded project**

The proposed Alternate Project is situated entirely within the exterior boundaries of the POTB. The POTB's railroad traverses through the project area.

(6) **The FEMA Regional Administrator must approve all alternate projects prior to the start of construction. See 44 CFR 206.203(d)(2)(v).**

The appeal is an important step in that process.

## III. General Work Eligibility

**Under 44 CFR 206.223 (a)(3), to be eligible for financial assistance, an item of work must be the legal responsibility of an eligible applicant**

The POTB is a district and political subdivision of the State of Oregon organized under ORS 777.010 and 777.050. The State of Oregon has granted to each port, to the full extent possible "… full control of all bays, rivers and harbors within its limits and the sea." **ORS 777.120**. Under Oregon law, the POTB has legal authority and responsibility to:

(1) Regulate the placement or removal of obstructions to navigation from the bays, rivers and harbors; and

(2) Engage in the control and prevention of river and stream bank erosion and the prevention of damage from flood-water and sediment. Id.

The POTB is the owner of the railroad line and has been the owner prior to and since the date of the disaster. According to FEMA policy guidance, an eligible mitigation measure may be distinct from the integral parts of the damaged property. In this instance, the proposed hazard mitigation measure:

(1) Directly benefits the disaster-damaged railroad line owned by the POTB.

(2) Will be conducted within the jurisdictional boundaries of the POTB wherein the POTB has authority under Oregon law to take measures for the prevention of flood-related damage to life and property.

(3) Will be conducted on land to which the POTB has made arrangements to obtain ownership.

Based on a review of Oregon law relating to POTB's, federal law and regulations, hazard mitigation project documentation and FEMA recovery policy guidance documents, including appeal letters construing the requirements for legal responsibility under 44 CFR 206.223(a), both Senior Deputy Legislative Counsel Dexter Johnson and Tillamook County Counsel William Sargent have found that the POTB satisfies the requirement for legal responsibility. Legislative Counsel

Dexter Johnson's August 24, 2010 letter opinion is attached as Exhibit D; and Tillamook County Counsel William Sargent's August 20, 2010 letter opinion is attached as Exhibit E.

As noted above, the POTB has made arrangements to take ownership of the lands and easements upon which the hazard mitigation project will be constructed. More specifically, there are two Intergovernmental Agreements (IGAs) that not only address the process for the POTB's assumption of ownership for the project lands, but that also provide for the necessary assurances related to long-term and ongoing maintenance, repairs and operations for the project site.

Under an IGA effective April 14, 2010 (Exhibit F) between the POTB and Tillamook County, a process is set forth for the transfer of title and easements for the Project Lands upon completion of certain conditions precedent, including approval of the project by FEMA as an eligible FEMA Alternate Project. See Section 1.1, Exhibit F. No transfer of the lands will be made until these conditions precedent have been fully completed. There is also an additional IGA dated July 31, 2002 (Exhibit G) between the County, Soil and Water Conservation District (SWCD) and the Oregon Department of Fish and Wildlife (ODFW) that provides an existing administrative framework for financing on-going and long-term maintenance, repair and operations of the existing 377 acre County-owned wetland. The April 14, 2010 IGA (Exhibit F) provides at Section 2.3, that upon POTB's acquisition of the Project Lands, POTB will enter into an amended version of the July 31, 2002 IGA. This latter Section 2.3 is important because it provides the framework for ongoing and long term maintenance, repair and operations. For example, under the current version of the 2002 IGA, an annual work plan for maintenance is developed (Section 1.2), the County will coordinate and provide for ongoing maintenance and include within its annual budget such amounts as might be required to perform this work (Section 2.5). The County is responsible for making all Project maintenance expenditures (Section 2.3). A fund within the County budget is established for that purpose (Sections 5.1 and 5.2). The addition of the POTB to this financing structure further reinforces the ability of the POTB to carry out its financial assurance for ongoing and long term maintenance, repairs and operations.

Moreover, the Tillamook Bay Habitat and Estuary Improvement District (TBHEID) is an ORS Chapter 554 corporation for flood control that has been involved for more than a decade on project maintenance within the existing 377 acre tract despite the fact that the County tract is not part of its district by way of County membership in the corporation. Not only is TBHEID a member of the management committee that advises on project maintenance as described in Exhibit G, Section 5.3, but it is not subject to the same limitations of Oregon budget law as are the other parties. TBHEID collects approximately $30,000 annually in dues from its members.  TBHEID has also provided a letter of financial assurance to assist with the expenses of on-going and long term maintenance, repairs and operations (Exhibit H).

Finally, the POTB has been an enrolled participant with the city, county, state and federal partners in the Oregon Solutions program that led to the proposed Project.  This Oregon Solutions Project was established by Oregon Governor Ted Kulongoski, who appointed State Senator Betsy Johnson and County Commissioner Mark Labhart as Co-Conveners.  The staff of all of Oregon's congressional delegation are also active participants.  The POTB and all other members of the Project Team each signed the Declaration of Cooperation and a separate Statement of Assurances.  (Exhibit I).  The proposed Project is an important part of applicant's commitment to this Oregon Solutions Project.

# EXHIBIT LIST

A. Southern Flow Corridor – Landowner Preferred Alternative Preliminary Design Report, May 2011

B. Project Exodus Design Report, February 2010

C. Benefit Cost Analysis Report for Southern Flow Corridor (Revised), May 2011

D. August 24, 2010 letter opinion by Legislative Counsel Dexter Johnson

E. August 20, 2010 letter opinion by Tillamook County Counsel William Sargent

F. April 14, 2010 Intergovernmental Agreement between Port of Tillamook Bay and Tillamook County

G. July 31, 2002 Intergovernmental Agreement between Tillamook County, Oregon Department of Fish and Wildlife and Tillamook County Soil and Water Conservation District

H. May 19, 2011 letter from the Tillamook Bay Habitat and Estuary Improvement District

I. Oregon Solutions Declaration of Cooperation (with the Port of Tillamook Bay's signature page) and Port of Tillamook Bay Statement of Assurances

J. Letter of Financial Commitment dated May 9, 2011 from the Oregon Watershed Enhancement Board

K. Loan Commitment dated May 18, 2011 from TLC Federal Credit Union