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.

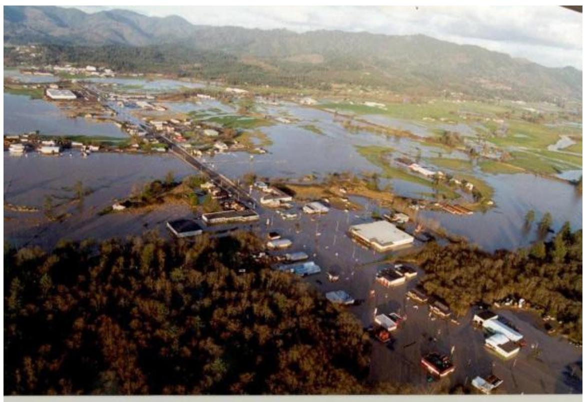
The estimated cost of $150,000 repair costs in a 10 year flood was based on conversations with Mr. Leo Kuntz of Nehalem Marine, who has maintained and repaired virtually every levee in the Tillamook area. In his opinion this is a typical repair cost to expected due to erosion or other levee failure in 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.