



**Final Supplemental Watershed Plan No. 1 - Environmental
Assessment**

United States
Department of
Agriculture

Central Sonoma Watershed - Matanzas Creek Dam Rehabilitation Project
Sonoma County, California

Natural
Resources
Conservation
Service

Sponsoring Local Organization: Sonoma County Water Agency
Lead Agency: Natural Resources Conservation Service (NRCS)

October 2026

Appendix D - TM009 - Economic Analysis



TM009 – Economic Analysis

Technical Memorandum – Economic Analysis

Supplemental Watershed Plan and Environmental Document for Matanzas Creek Dam Project

D.1 INTRODUCTION

AECOM Technical Services, Inc. (AECOM) conducted economic analyses for four alternatives associated with the Supplemental Watershed Plan and Environmental Document for Matanzas Creek Dam Project (the “Project”). Matanzas Creek Dam (CA00794) is an earthen embankment dam located in Sonoma County, California. Construction of the dam was proposed in result of the Central Sonoma Watershed project, which was developed in 1958 under the National Resources Conservation Service (NRCS) PL-566 program. The dam was designed by the NRCS and constructed in 1964 as a flood control structure to protect downstream infrastructure. Sonoma County Water Agency (Sonoma Water) currently owns, operates, and maintains the dam.

In 2016, HDR, Inc. and Kleinfelder completed a dam assessment for the NRCS, which evaluated the dam based on Technical Release 210-60 (TR-60) design criteria. It was determined that the Matanzas Creek Dam is out of compliance with TR-60 criteria due to its inability to route the principal spillway (PS) hydrograph without activating the auxiliary spillway.

Several alternatives were considered for the Project: No Federal Action (also referred to as the Future Without Project (FWOP) alternative); federal decommissioning; non-structural; and structural rehabilitation. Following a preliminary analysis of possible alternatives, four alternatives were carried forward for evaluation (see *TM007 – Alternative Development and Evaluation*). The alternatives are comprised of one No Federal Action alternative and three future-with-federal-investment (FWFI) alternatives. Table 1 describes the four alternatives evaluated for the Project.

Table 1: Description of Project Alternatives

Alternative	Description
Alternative 1 (FWFI)	Labyrinth weir, lining (structural concrete) of remainder of auxiliary spillway (AS), stilling basin, seismic modifications, and associated principal spillway (PS) modifications
Alternative 2 (FWFI)	Earthen AS crest raise (to meet PSH criterion), earthen dam crest raise, seismic modifications, and associated PS modifications
Alternative 3 (FWFI)	Earthen AS crest raise (to 1-percent annual probability 24-hr storm water surface elevation (WSE)), earthen dam crest raise, seismic modifications, and associated PS modifications
No Federal Action (FWOP)	Continue the regular maintenance of the dam, including the periodic removal of sediment. No modifications to the dam or spillways would be made.

D.2 ECONOMIC FRAMEWORK

In general, the national economic benefits presented in this supplemental plan were developed based on guidance contained in the *Economic and Environmental Principles and Guidelines for Water and Related*

*Land Resources Implementation Studies*¹ and the *Principles, Requirements and Guidelines for Federal Investments in Water Resources*.²

Economic feasibility for a FWFI alternative is determined by comparing the average annual benefits to the average annual costs. If the average annual benefits for a FWFI alternative exceed the average annual costs, then the alternative is considered economically feasible. The economic analysis considers the No Federal Action alternative as the baseline condition, which assumes the existing maintenance activities continue but no major changes are made to dam. The analysis is formulated from the perspective that changes/impacts resulting from implementation of a FWFI alternative (Alternatives 1, 2, and 3) in relation to the No Federal Action alternative were measured as a cost or a benefit (i.e., a zero benefit, zero cost approach was applied to No Federal Action alternative). Costs and benefits are reported in 2022 dollars (2022\$) and were evaluated over a 52-year period of analysis (24 months of construction and 50-year evaluation period) using 2.5 percent discount rate. Inputs or assumptions provided in a year prior to 2022 were adjusted to 2022 dollars using the U.S. Gross Domestic Product (GDP) deflators.

The hydrologic and hydraulic (H&H) analysis conducted by Jones & DeMille Engineering (JDE) for each of the alternatives was used to estimate the depth of flooding throughout the study area. The economic analysis uses inundation models for eight flood recurrence intervals, which are the 50-percent- (2-year), 20-percent- (5-year), 10-percent- (10-year), 4-percent- (25-year), 2-percent- (50-year), 1-percent- (100-year), 0.5-percent- (200-year), and 0.2-percent- (500-year) recurrence interval flood events, to estimate future damages from flooding within the study area.

Under the No Federal Action alternative, the dam would not be brought up to current federal standards and many of the underlying issues would remain. Therefore, there is still a chance for the dam to failure from a seismic, hydraulic, or static event. A seismic failure in conjunction with a flood event was estimated to be the event with the highest probability of occurring. As a result, a one-time seismic failure with a probability of 0.1³ percent was evaluated and incorporated into the average annual damages (AAD) for the No Federal Action alternative. Therefore, the No Federal Action alternative assumed that the existing flooding conditions would continue until the dam fails.

D.3 BENEFIT ANALYSIS

The following describe the analyses used to evaluate the benefits of the FWFI alternatives. The benefits represent damage reduction from future flooding and are evaluated in average annual terms. The benefit categories considered were:

- Residential and nonresidential structures
- Automobiles
- Debris removal
- Infrastructure
- Recreation
- Agriculture
- Operations and maintenance (O&M) costs avoided.

¹ U.S. Water Resources Council, 1983. *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, March.

² *Principles, Requirements and Guidelines for Federal Investments in Water Resources*, 2014.

³ The runoff associated with a 50-percent-recurrence interval flood event is sufficient to fill the reservoir to the PS crest. A full reservoir combined with the probability of a seismic event provides a probability of 0.001-percent-recurrence interval for a seismic failure of the dam. A lower probability of failure may be considered to account for the length of time that the reservoir is full following a flood event.

D.3.1 Residential and Nonresidential Structures

Knowledge of existing development located in a floodplain is essential when evaluating a flood-risk-management measure. An inventory was conducted of residential and nonresidential structures located in the study area, which serves as the base data for the economic analysis. The structure inventory comprises residential and nonresidential structures that are within the area of inundation associated with a hydraulic failure of the dam (see Figure 1 in Appendix A), which is estimated to be the worst-case scenario and therefore included all structures that could be potentially impacted (the estimated number of structures impacted varies by flood event). Data from the Sonoma County Assessor was obtained, cleaned, and used as the basis for the structure inventory. Detailed descriptions of the data cleaning process can be found in Appendix A. A total of 8,752 properties were identified based on the data cleaning process performed in GIS. Of that total, 9 properties were then further excluded from the analysis as the Property Code was not identified in the Sonoma County Assessor database, leading to a total of 8,743 properties examined for this analysis.

The structures were assigned a building class and structure type based on the structure descriptions in the Assessor data. Table 2 list the building classes, structure types, and number of structures in the inventory assigned each class.

Table 2. Structure Type and Number of Structures in Inventory

Building Class	Structure Type	Number of Structures
Apartment	Nonresidential	778
Convenience Store	Nonresidential	35
Fast Food	Nonresidential	3
Grocery	Nonresidential	9
Hospital	Nonresidential	8
Hotel	Nonresidential	22
Industrial Light	Nonresidential	68
Medical Office	Nonresidential	58
Mobile Home	Residential	27
Non-Fast Food	Nonresidential	16
Office One-Story	Nonresidential	238
Recreation	Nonresidential	21
Religious Facility	Nonresidential	22
Residential-NB (no basement)	Residential	7,117
Retail-Clothing	Nonresidential	43
Retail-Electronics	Nonresidential	2
Retail-Furniture	Nonresidential	2
Schools	Nonresidential	47
Service Station	Nonresidential	119
Vacant	Nonresidential	4
Warehouse - Non-Refrigerated	Nonresidential	104
	Total	8,743

The foundation height was subtracted from the flood depth at each structure to estimate the depth of inundation in relation the first-floor elevation (FFE). Structure types and their respective foundation heights are listed in Table 3.

Table 3: Assumed Foundation Heights

Structure Type	Foundation Height (Feet Above Ground Level)
Nonresidential	0.5
Residential, no basement	0.5

Each structure was assigned a depth-damage function (DDF) based on the structure type that estimates an economic loss as a percentage of the value of the structure based on the building class and depth of flooding. DDFs were sourced from the U.S. Army Corps of Engineers' (USACE's) Economic Guidance Memorandum (EGM) 01-03, *Generic Depth-Damage Relationships*.⁴ DDFs for nonresidential buildings were sourced from FEMA's Benefit-Cost Analysis Toolkit.⁵ Within each DDF are the percentage damage for the structure and its contents. Because the DDFs estimate damages at 1-foot intervals, straight-line interpolation was used to estimate damages in 0.1-foot intervals. The structure and content DDFs for the structure types are provided in Appendix B.

Data from the H&H analysis and GIS were used to estimate the depth of flooding at each structure for each recurrence interval. Using an Excel-based model developed for this analysis, the foundation height was subtracted from the depth of flooding to estimate the depth of inundation in relation to the FFE, which was then correlated to the DDF to calculate the percent damage to each structure. The percent damage was then multiplied by the structure improvement value⁶ to estimate the damages. Similarly, the analysis uses the depth of inundation to calculate the percent damage to contents per flood recurrence interval, which was then multiplied by the contents' value to estimate the content damages. The total damages from each recurrence interval were annualized to estimate the average annual damages for each alternative.

D.3.2 Automobiles

The damages to automobiles were determined using the USACE EGM 09-04, *Generic Depth-Damage Relationships for Vehicles*.⁷ In accordance with the guidance, the elevation of each automobile was assumed to be the mean ground elevation estimated at each structure. The damages to vehicles at residences depends on the following: the average number of vehicles per household and the percentage of vehicles that are likely to be at the residence at the time the flood waters reach the property.

In 2019, the median number of vehicles per household in Santa Rosa, CA, was two. As suggested by the guidance, the average vehicle value was obtained from Edmunds. According to the Edmunds Used Car

⁴ USACE, 2000. *Generic Depth-Damage Relationships*, EGM 01-00. December 4.
<https://planning.erdc.dren.mil/toolbox/library/EGMs/egm01-03.pdf>

⁵ FEMA, 2019. *Benefit-Cost Analysis Toolkit, Version 6.0*. <https://www.fema.gov/media-library/assets/documents/179903>.

⁶ For properties without improvement values identified in the Sonoma County Assessor database, the improvement value of such a property were estimated by applying the replacement value (\$/sqft) suggested by RS Means to the size of the structure.

⁷ USACE, 2009. *Generic Depth-Damage Relationships for Vehicles*, EGM 09-04. June 22.
<https://planning.erdc.dren.mil/toolbox/guidance.cfm?Option=BL&BL=OnlyInlandFlood&Type=None&Sort=Default>.

Market Report, the average retail value for used vehicles was \$22,448 in the third quarter of 2019 (adjusted to 2022 dollars).

The length of potential warning time and the access to a safe evacuation route to a flood-free location were considered to estimate the percentage of vehicles that would likely remain in the flood-prone location. For Sonoma County, the analysis assumes that the warning time would be less than 6 hours; therefore, 50.5 percent of the vehicles in the flood area would be evacuated according to USACE EGM 09-04 and 49.5 percent would remain.

Because only those vehicles not used for evacuation can be included in the damage calculations, an adjusted average vehicle value of \$21,084 ($\$21,297 \times 2 \times 0.495$) was assigned to each individual residential structure. The analysis calculated automobile damages for each flood recurrence interval. No automobiles were assigned to nonresidential structures.

D.3.3 Debris Removal

When flooding occurs, debris can accumulate from flood damage, requiring efforts to bring debris to the street for pickup and removal. The costs associated with debris removal were estimated based on guidance from the Federal Emergency Management Agency (FEMA) and were grouped with structure damages for the purposes of this analysis.

Debris costs were estimated for structures located in the reaches evaluated. Debris removal costs were assigned for every residential structure that incurred flood damages. The debris costs per structure include the hauling cost, tipping fee, and labor to remove debris and break it into pieces that could be hauled to the street for pickup.

FEMA has estimated there are 25 to 30 cubic yards of debris for a flooded residential structure without a basement. The cost to load and haul away debris was estimated using the average cost per cubic yard of \$40 from the Homewyse Debris Removal Cost Calculator (August 2021); in addition, the disposal cost of \$1.25 per cubic yard results in a total debris removal cost of \$41.25 per cubic yard. The FEMA Debris Estimation Field Guide conversion factor of 4 cubic yards of debris per ton was used to convert the total debris removal cost per cubic yard to debris removal cost per ton; resultantly, a debris removal cost of \$163 per ton was incorporated into the analysis.

Using the Homewyse Debris Removal Cost Calculator (August 2021), the number of labor hours to break down debris and move it from the structure to the street was estimated to be 1.4 hours for every cubic yard of debris. Because homeowners are forgoing other activities to clean up debris, including work and leisure, the opportunity cost was applied to value this time. The value of time was estimated using the 2019 median household income for Sonoma County from the Census (adjusted to 2022 dollars) and dividing by 2,080 hours to get \$41.44, representing the hourly opportunity cost of work per household. For leisure time, an opportunity cost of \$27.62 was assigned based on the common practice used in economics literature to value recreation time as a fraction of the wage. In literature, this fraction ranges from one-third the wage to the full wage; therefore, a fraction of two-thirds was used to estimate the opportunity cost of leisure. During the flood aftermath, owners were assumed to forego recreation two-thirds of the time and forego work one-third of the time, for an average opportunity cost of time of \$32.23 per hour. Table 4 presents the average cost of debris removal from a flooded residential structure with and without a basement.

Table 4. Summary of Residential Debris Costs – Structure with No Basement

Structure Description	Cubic Yards of Debris	Debris Removal Labor and Disposal Costs	Owner Opportunity Cost of Time	Total Debris Cost
Without Basement	25 to 30	\$1,116	\$1,241	\$2,356

Note: 2022 price level

If a structure received damages above the FFE for flooding at any of the recurrence interval, the debris cleanup costs were applied and annualized.

D.3.4 Infrastructure

Due to the urban environment downstream of the Matanzas Creek Dam, there are many roads, bridges, and other infrastructure that could be impacted by flooding. However, the H&H analysis indicated little difference in depths of flooding between the alternatives. As a result, any damages or related impacts (e.g., road detours) would be similar for all alternatives. As a result, infrastructure impacts were not quantified for this analysis.

D.3.5 Recreation

The existing reservoir is dry and no recreation opportunities/benefits to the community were identified upstream of the dam during the scoping process. Downstream of the dam there is a golf course that has been prone to flooding. The size of the existing PS conduit (5' x 5' box) and limited capacity of Matanzas Creek through the golf course are driving factors for this flooding. However, due to site constraints at the reservoir, none of the considered alternatives included reducing the size of the PS and as a result, the existing level of flooding that the golf course experiences in the existing condition would be similar for all alternatives. As such, recreation impacts were not quantified for this analysis.

D.3.6 Agriculture

There is very little agricultural land between the Matanzas Creek Dam and the developed area of Santa Rosa. As a result of the small amount of agricultural land and the limited impacts of the alternatives described in the previous section, agricultural land damages and benefits were not quantified for this analysis.

D.3.7 Benefit Summary

This section summarizes the benefits analysis, which includes comparisons of the impacts to structures from the alternatives.

Table 5 presents the number of structures flooded above the FFE for each recurrence interval. It should be noted that for the 1-percent-recurrence interval flood event only two of the structures flooded above the FFE are located adjacent to Matanzas Creek. All other impacted structures are located adjacent to Santa Rosa Creek. The number of structures flooded is significantly lower than the number of structures inventoried because the inventory was based on a worst-case breach scenario.

Table 5. Number of Structures Flooded Above the First Floor Elevation (FFE)

Annual Probability Event		Alternative 1	Alternative 2	Alternative 3	No Federal Action
50%	2-Year	0	0	0	0

20%	5-Year	0	0	0	0
10%	10-Year	0	0	0	0
4%	25-Year	2	2	2	2
2%	50-Year	33	33	33	34
1%	100-Year	150	148	148	150
0.5%	200-Year	410	410	412	417
0.2%	500-Year	751	740	736	802

Structure-related benefits include damage reductions to structures, contents, automobiles, and debris removal. A summary of damages for all alternatives by recurrence interval is provided in

Table 6. The damages for the No Federal Action consider the damages related to the existing dam until a breach occurs, therefore the damage estimates for the recurrence intervals are similar to those of the FWFI alternatives. While the damage for the seismic event are the estimated damages of the failure scenario.

Table 6. Summary of Damages by Recurrence Interval (2022\$)

Annual Probability Event		Building	Contents	Auto Damages	Debris Removal	Total Damages
Alternative 1 (FWFI)						
50%	2-year	\$0	\$0	\$0	\$0	\$0
20%	5-year	\$0	\$0	\$0	\$0	\$0
10%	10-year	\$0	\$0	\$0	\$0	\$0
4%	25-year	\$160,000	\$51,000	\$7,000	\$2,000	\$219,000
2%	50-year	\$2,039,000	\$1,088,000	\$149,000	\$57,000	\$3,332,000
1%	100-year	\$8,570,000	\$5,339,000	\$751,000	\$254,000	\$14,914,000
0.5%	200-year	\$23,929,000	\$17,791,000	\$2,149,000	\$667,000	\$44,536,000
0.2%	500-year	\$47,079,000	\$32,649,000	\$4,248,000	\$1,298,000	\$85,274,000
Alternative 2 (FWFI)						
50%	2-year	\$0	\$0	\$0	\$0	\$0
20%	5-year	\$0	\$0	\$0	\$0	\$0
10%	10-year	\$0	\$0	\$0	\$0	\$0
4%	25-year	\$160,000	\$51,000	\$7,000	\$2,000	\$219,000
2%	50-year	\$2,018,000	\$1,081,000	\$148,000	\$57,000	\$3,304,000
1%	100-year	\$8,539,000	\$5,330,000	\$747,000	\$250,000	\$14,866,000
0.5%	200-year	\$23,826,000	\$17,761,000	\$2,141,000	\$667,000	\$44,395,000
0.2%	500-year	\$45,106,000	\$31,991,000	\$4,148,000	\$1,282,000	\$82,527,000
Alternative 3 (FWFI)						
50%	2-year	\$0	\$0	\$0	\$0	\$0
20%	5-year	\$0	\$0	\$0	\$0	\$0
10%	10-year	\$0	\$0	\$0	\$0	\$0
4%	25-year	\$160,000	\$51,000	\$7,000	\$2,000	\$219,000
2%	50-year	\$2,018,000	\$1,081,000	\$148,000	\$57,000	\$3,304,000
1%	100-year	\$8,385,000	\$5,281,000	\$740,000	\$250,000	\$14,656,000

Annual Probability Event		Building	Contents	Auto Damages	Debris Removal	Total Damages
0.5%	200-year	\$23,803,000	\$17,755,000	\$2,136,000	\$667,000	\$44,361,000
0.2%	500-year	\$44,750,000	\$31,869,000	\$4,133,000	\$1,272,000	\$82,025,000
No Federal Action (FWOP)						
50%	2-year	\$0	\$0	\$0	\$0	\$0
20%	5-year	\$0	\$0	\$0	\$0	\$0
10%	10-year	\$0	\$0	\$0	\$0	\$0
4%	25-year	\$160,000	\$51,000	\$7,000	\$2,000	\$219,000
2%	50-year	\$2,137,000	\$1,119,000	\$154,000	\$59,000	\$3,469,000
1%	100-year	\$8,702,000	\$5,389,000	\$762,000	\$257,000	\$15,109,000
0.5%	200-year	\$24,190,000	\$17,872,000	\$2,159,000	\$667,000	\$44,888,000
0.2%	500-year	\$50,720,000	\$34,127,000	\$4,569,000	\$1,395,000	\$90,811,000
Seismic Failure	1000-year	\$313,000	\$93,000	\$21,000	\$2,000	\$429,000

*Note: This alternative assumes that no action would be taken and that the existing condition would remain until the time in which a seismic failure occurs. The damages related to seismic failure event would be relatively small, as the failure is assumed to occur when the water level is at the PS crest (approximately a 50-percent-recurrence interval).

The following summarizes the total annual average damages avoided (benefits) for each project alternative. To estimate the average annual damages associated with each alternative, the total damages averaged between each recurrence interval and applied to the incremental probability between the respective flood events. To estimate the total average annual damages associated with the seismic failure under the No Federal Action alternative, the total damages for the seismic failure was applied a probability of occurrence of 0.1%. This probability was estimated assuming the 475-year seismic event occurs simultaneously during a 50-percent recurrence interval flood event. The 50-percent flood event is the minimum event required to raise the reservoir level to the principal spillway crest, which was assumed for the seismic failure per NRCS TR-210-60 guidelines. The average annual damages avoided (benefits) for Alternatives 1, 2 and 3 were estimated by comparing the damages that would occur under each of the alternative with those that would occur under the No Federal Action alternative.

A summary of total average annual damages avoided is provided in Table 7. The average annual damage avoided is based on the breach scenario evaluated, however it does not represent the benefits of having the dam in place. The dam retards the timing of floodwaters, which significantly reduces downstream damages (especially through downtown Santa Rosa) when taking into account the timing of the floodwaters from other streams in the watershed.

Table 7. Summary of Total Average Annual Damages Avoided (2022\$)

Alternative	Total Average Annual Damages	Total Average Annual Damages Avoided
Alternative 1	\$477,000	\$14,000
Alternative 2	\$471,000	\$19,000
Alternative 3	\$469,000	\$22,000
No Federal Action	\$490,000	NA

Note: all values rounded to the nearest thousand

D.4 COST ANALYSIS

The average annual operation and maintenance (O&M) costs for each alternative were estimated. The net O&M costs for each FWFI alternative is the difference between the cost for the No Federal Action and the FWFI alternatives (Table 8).

Table 8. Average Annual O&M Costs

Alternative	Annual O&M Costs	Net O&M Costs
Alternative 1	\$21,000	-\$130,000
Alternative 2	\$27,000	-\$124,000
Alternative 3	\$28,000	-\$123,000
No Federal Action	\$151,000	NA

The average annual costs associated with the alternatives and operation & maintenance (O&M) costs of implementation for the alternatives are summarized in Table 9.

Table 9. Design and Construction Cost of Alternative Implementation (2022\$)

Alternative	Construction Costs	Average Annual Construction Costs	Average Annual O&M Costs	Average Annual Costs
Alternative 1	\$43,706,000	\$1,541,000	-\$130,000	\$1,411,000
Alternative 2	\$29,647,000	\$1,045,000	-\$124,000	\$921,000
Alternative 3	\$32,025,000	\$1,129,000	-\$123,000	\$1,006,000

Note: 2022 price level, 52-year period of analysis, and 2.5% discount rate. All values rounded to the nearest thousand.

D.5 RESULTS OF THE ECONOMIC ANALYSIS

Benefits and costs over the period of analysis were annualized to allow for a direct comparison of average annual benefits to average annual costs. The benefits and costs used a price level of 2022 dollars and amortized using a discount rate of 2.5 percent over a 52-year period of analysis. Alternative 1 has the greatest net national economic benefits (i.e., less negative net national economic benefits). Table 10 summarizes the analysis results.

The limited benefits of the Alternatives 1 and 2 is related to the small changes in the WSE between these alternatives and the No Federal Action alternative. Also, the WSE between Alternative 3 and the other alternatives is similar, even though it is designed to store more floodwaters. For a more in-depth discussion the H&H conditions across the recurrence intervals refer to *TM008 - Frequency Flood Routing*.

Table 10. Benefit-Cost Analysis Summary (2022\$)

Category	Alternative 1	Alternative 2	Alternative 3
Costs			
Average Annual Construction Costs	\$1,541,000	\$1,045,000	\$1,129,000
Average Annual O&M Costs	-\$130,000	-\$124,000	-\$123,000
Total Average Annual Costs	\$1,411,000	\$921,000	\$1,006,000
Benefits			

Total Average Annual Damages Avoided	\$14,000	\$19,000	\$22,000
Total Average Annual Benefits	\$14,000	\$19,000	\$22,000
Evaluation			
Average Annual Net Benefits	-\$1,397,000	-\$902,000	-\$984,000
Benefit-Cost Ratio (BCR)	0.01	0.02	0.02

Note: 2022 price level, 52-year period of analysis, and 2.5% discount rate. All \$ values rounded to the nearest thousand.

D.6 APPENDIX A – STRUCTURE INVENTORY

D.6.1 Extent of Structure Inventory

An inventory was conducted for structures located within the inundation area associated with a hydraulic failure of the Matanzas Creek Dam (Figure 1).

D.6.2 Structure Inventory Cleanup

INITIAL PARCEL/STRUCTURE CLEANUP

Methodology:

1. Cleaned up the dataset for inundation so it was selectable.
2. Selected parcels that fell in the inundation zone to narrow the search.
3. Selected the buildings that fell on those parcels from step 2 to create a smaller dataset of buildings.
 - a. Removed any buildings less than 700 sq ft
4. Selected the buildings from step 3 that intersected the inundation zone.
5. Re-selected the parcels that were associated with the buildings from step 4.
 - a. Removed any parcels that did not fall in the use code list
6. Created centroids of the parcels from step 5 to create a “dot” of each impacted parcel.

Reducing selection set from above:

1. Clipped inundation layer to the impacted buildings.
2. Removed parcels with inundation less than 10 sq ft. impacting a structure.
3. Removed parcel records that had a “LevelNum” attribute of 2 or greater.

Spatial Join (Parcels):

1. Joined the parcel records from step 3 above and the buildings to get a count of structures per owner.
2. Created a field called “AECOM_Stru” to populate with the structure count by parcel. (This was done using the spatial join and intersect. Therefore, this resulted in multiple structures being listed as the structure(s) overlapped multiple parcels.)

Spatial Join (Buildings):

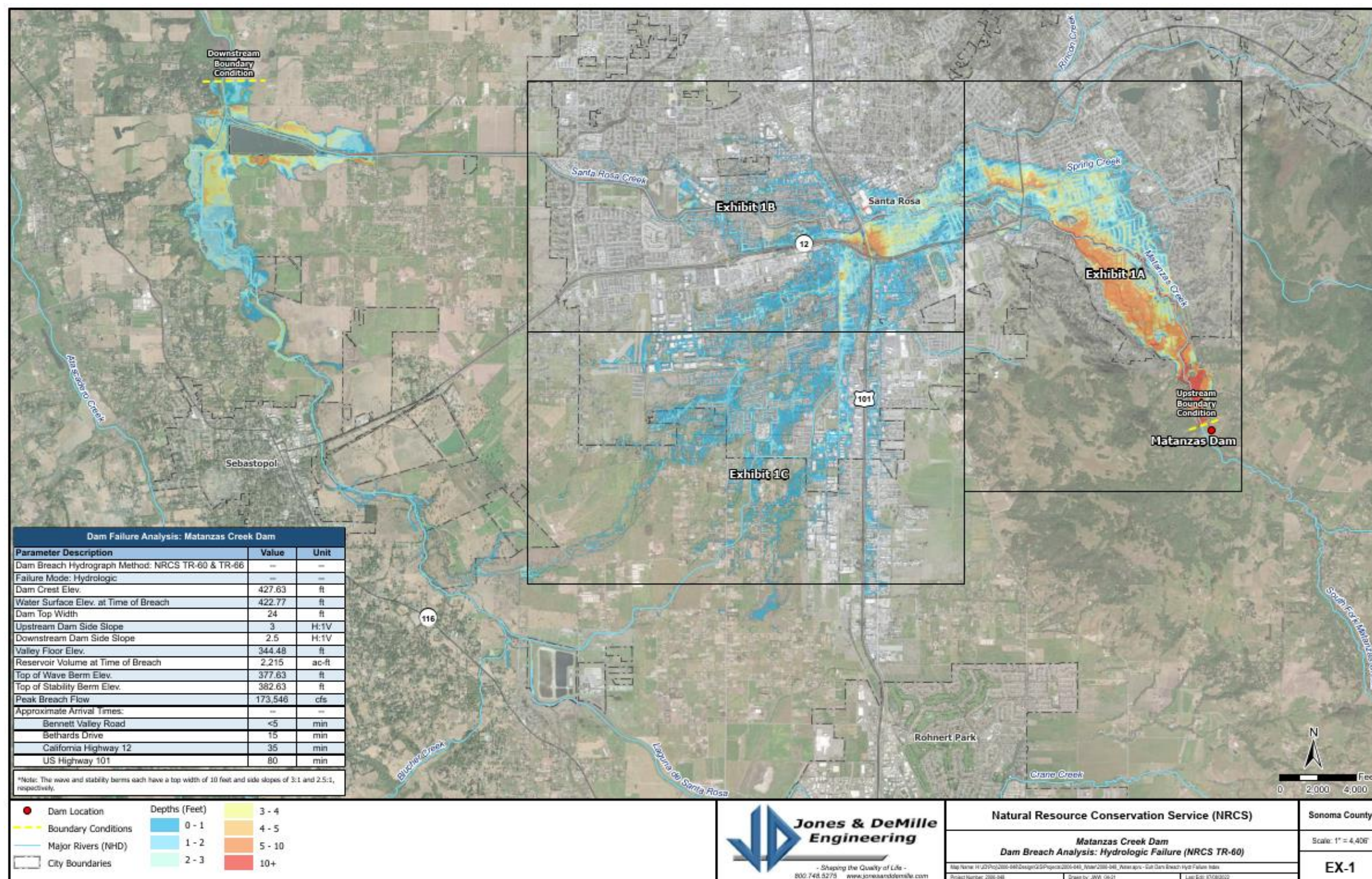
1. Created a spatial join between the building and the parcel(s) it intersects.
2. Created centroids of the buildings.
3. Jointed the building centroid with the dataset created in step 1.

STRUCTURE CLEANUP AND FLOOD DEPTHS

Methodology for Exhibit 2A structure points and “others” structure points:

1. Area “2A” was identified from Figure 1.
2. The structure points were separated to be those within the area identified in Exhibit 2A and those that are not. They are identified as “others”.
3. To clean up the structure points in the Exhibit 2A area, aerial imagery was used, and the points were either moved to the primary structure or removed. This was done by using Esri default imagery and the point data sets.
4. Points were moved to the primary structures on a parcel. Points removed that were on sheds, garages, or other unoccupied structures.
5. None of the points for the “other” dataset were moved. They remained in their location and parcel as per the original structure dataset.

Figure 1. Matanzas Creek Dam - Dam Breach Analysis: Hydraulic Failure



Source: JDE, 2021. TM004 – Hazard Classification

D.7 APPENDIX B – DEPTH-DAMAGE FUNCTIONS (DDFs)

Figure 2. DDFs – Building Residential

Depth Inundation (feet)	Slab	Residential-NB	Residential-2NB	Split Level-NB	Residential-2B	Mobile Home	Auto
-2.00	0%	0%	0%	0%	10%	0%	0%
-1.90	0%	0%	0%	1%	10%	0%	0%
-1.80	0%	1%	1%	1%	11%	0%	0%
-1.70	0%	1%	1%	2%	11%	0%	0%
-1.60	0%	1%	1%	2%	12%	0%	0%
-1.50	0%	2%	2%	3%	12%	0%	0%
-1.40	0%	2%	2%	4%	12%	0%	0%
-1.30	0%	2%	2%	4%	13%	0%	0%
-1.20	0%	2%	2%	5%	13%	0%	0%
-1.10	0%	3%	3%	5%	14%	0%	0%
-1.00	0%	3%	3%	6%	14%	0%	0%
-0.90	1%	4%	4%	6%	14%	1%	0%
-0.80	2%	5%	4%	6%	15%	2%	0%
-0.70	4%	6%	5%	6%	15%	2%	0%
-0.60	5%	7%	5%	6%	16%	3%	0%
-0.50	6%	8%	6%	7%	16%	4%	0%
-0.40	7%	9%	7%	7%	16%	5%	0%
-0.30	8%	10%	7%	7%	17%	6%	0%
-0.20	10%	11%	8%	7%	17%	6%	0%
-0.10	11%	12%	8%	7%	18%	7%	0%
0.00	12%	13%	9%	7%	18%	8%	0%
0.10	13%	14%	10%	7%	18%	12%	1%
0.20	15%	15%	10%	7%	19%	15%	3%
0.30	16%	16%	11%	8%	19%	19%	4%
0.40	17%	17%	11%	8%	20%	22%	6%
0.50	19%	18%	12%	8%	20%	26%	7%
0.60	20%	19%	13%	8%	21%	30%	11%
0.70	21%	20%	13%	9%	21%	33%	15%
0.80	22%	21%	14%	9%	21%	37%	20%
0.90	24%	22%	15%	9%	22%	40%	24%
1.00	25%	23%	15%	9%	22%	44%	28%
1.10	28%	24%	16%	10%	23%	46%	30%
1.20	30%	25%	16%	10%	23%	48%	32%
1.30	33%	26%	17%	10%	24%	50%	33%
1.40	35%	27%	17%	11%	24%	52%	35%
1.50	38%	28%	18%	11%	25%	54%	37%
1.60	40%	29%	19%	12%	25%	55%	39%
1.70	43%	29%	19%	12%	26%	57%	41%
1.80	45%	30%	20%	12%	26%	59%	42%

Depth Inundation (feet)	Slab	Residential-NB	Residential-2NB	Split Level-NB	Residential-2B	Mobile Home	Auto
1.90	48%	31%	20%	13%	27%	61%	44%
2.00	50%	32%	21%	13%	27%	63%	46%
2.10	53%	33%	21%	13%	27%	64%	48%
2.20	55%	34%	22%	14%	28%	65%	49%
2.30	58%	35%	23%	14%	28%	66%	51%
2.40	60%	35%	23%	15%	29%	67%	52%
2.50	63%	36%	24%	15%	29%	68%	54%
2.60	65%	37%	24%	16%	30%	69%	56%
2.70	68%	38%	25%	16%	30%	70%	57%
2.80	70%	39%	25%	17%	31%	71%	59%
2.90	73%	39%	26%	17%	31%	72%	60%
3.00	75%	40%	26%	17%	32%	73%	62%
3.10	78%	41%	27%	18%	32%	74%	63%
3.20	80%	42%	27%	18%	33%	74%	65%
3.30	83%	42%	28%	19%	33%	75%	66%
3.40	85%	43%	28%	20%	34%	75%	68%
3.50	88%	44%	29%	20%	34%	76%	69%
3.60	90%	44%	29%	21%	35%	76%	70%
3.70	93%	45%	30%	21%	35%	77%	72%
3.80	95%	46%	30%	22%	36%	77%	73%
3.90	98%	46%	31%	22%	36%	78%	75%
4.00	100%	47%	31%	23%	37%	78%	76%
4.10	100%	48%	32%	23%	37%	78%	77%
4.20	100%	48%	32%	24%	38%	78%	78%
4.30	100%	49%	33%	25%	38%	79%	79%
4.40	100%	50%	33%	25%	39%	79%	80%
4.50	100%	50%	34%	26%	39%	79%	82%
4.60	100%	51%	34%	26%	40%	79%	83%
4.70	100%	51%	35%	27%	40%	79%	84%
4.80	100%	52%	35%	28%	41%	80%	85%
4.90	100%	53%	36%	28%	41%	80%	86%
5.00	100%	53%	36%	29%	42%	80%	87%
5.10	100%	54%	37%	30%	42%	80%	88%
5.20	100%	54%	37%	30%	43%	80%	89%
5.30	100%	55%	38%	31%	43%	80%	90%
5.40	100%	55%	38%	32%	44%	80%	91%
5.50	100%	56%	38%	32%	44%	81%	92%
5.60	100%	56%	39%	33%	45%	81%	93%
5.70	100%	57%	39%	34%	45%	81%	94%
5.80	100%	58%	40%	34%	46%	81%	95%
5.90	100%	58%	40%	35%	46%	81%	96%
6.00	100%	59%	41%	36%	47%	81%	97%

Figure 3. DDFs - Building Commercial

Depth Inundation (feet)	Retail- Furniture	Retail- Electronics	Retail- Clothing	Hotel	Fast Food	Non-Fast Food	Hospital	Medical Office	Protective Services	Correctional Facility	Recreation	Religious Facilities	Schools	Service Station	Office One- Story	Convenienc e Store	Grocery	Apartment	Industrial Light	Warehouse, Refrig.	Warehouse - Non- Refrigerated	Government	Vacant
-2.00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-1.90	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-1.80	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-1.70	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-1.60	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-1.50	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-1.40	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-1.30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-1.20	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-1.10	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-1.00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-0.90	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-0.80	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-0.70	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-0.60	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-0.50	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-0.40	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-0.30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-0.20	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-0.10	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
0.00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
0.10	1%	1%	1%	1%	2%	2%	1%	1%	1%	1%	1%	2%	1%	1%	1%	2%	1%	1%	1%	1%	1%	0%	0%
0.20	2%	2%	2%	2%	3%	4%	3%	2%	2%	2%	3%	3%	3%	2%	3%	3%	2%	2%	2%	2%	2%	0%	0%
0.30	3%	4%	4%	3%	5%	6%	4%	4%	3%	3%	4%	5%	4%	3%	4%	5%	3%	4%	3%	4%	3%	0%	0%
0.40	4%	5%	5%	4%	6%	7%	5%	5%	4%	4%	5%	6%	5%	4%	5%	6%	4%	5%	4%	5%	4%	0%	0%
0.50	6%	6%	6%	5%	8%	9%	7%	6%	5%	5%	6%	8%	7%	5%	6%	8%	5%	6%	6%	6%	5%	0%	0%
0.60	7%	7%	7%	7%	9%	11%	8%	7%	6%	6%	8%	9%	8%	6%	8%	9%	6%	7%	7%	7%	7%	0%	0%
0.70	8%	8%	9%	8%	11%	13%	10%	9%	7%	7%	9%	11%	10%	7%	9%	11%	8%	8%	8%	9%	8%	0%	0%
0.80	9%	10%	10%	9%	12%	15%	11%	10%	8%	8%	10%	12%	11%	8%	10%	12%	9%	9%	9%	10%	9%	0%	0%
0.90	10%	11%	11%	10%	14%	17%	12%	11%	9%	9%	11%	14%	12%	9%	12%	14%	10%	11%	10%	11%	10%	0%	0%
1.00	11%	12%	12%	11%	15%	19%	14%	12%	10%	11%	13%	16%	14%	10%	13%	15%	11%	12%	11%	12%	11%	0%	0%
1.10	12%	13%	13%	12%	16%	20%	15%	13%	10%	11%	14%	17%	15%	11%	13%	16%	12%	12%	12%	13%	12%	0%	0%
1.20	12%	13%	14%	12%	18%	21%	16%	14%	11%	12%	15%	18%	15%	12%	14%	17%	12%	13%	13%	14%	12%	0%	0%
1.30	13%	14%	14%	13%	19%	22%	17%	15%	12%	13%	15%	19%	16%	12%	15%	18%	13%	14%	13%	15%	13%	0%	0%
1.40	14%	15%	15%	13%	20%	23%	18%	15%	12%	14%	16%	20%	17%	13%	15%	18%	14%	15%	14%	15%	14%	0%	0%
1.50	14%	15%	16%	14%	21%	25%	19%	16%	13%	15%	17%	21%	18%	14%	16%	19%	14%	15%	15%	16%	15%	0%	0%
1.60	15%	16%	16%	14%	22%	26%	20%	17%	14%	16%	18%	22%	19%	14%	16%	20%	15%	16%	15%	17%	15%	0%	0%

Depth Inundation (feet)	Retail- Furniture	Retail- Electronics	Retail- Clothing	Hotel	Fast Food	Non-Fast Food	Hospital	Medical Office	Protective Services	Correctional Facility	Recreation	Religious Facilities	Schools	Service Station	Office One- Story	Convenienc e Store	Grocery	Apartment	Industrial Light	Warehouse, Refrig	Warehouse - Non- Refrigerated	Government	Vacant
1.70	15%	17%	17%	15%	24%	27%	21%	18%	14%	17%	19%	23%	20%	15%	17%	21%	16%	17%	16%	18%	16%	0%	0%
1.80	16%	17%	18%	16%	25%	28%	22%	18%	15%	18%	20%	24%	21%	15%	17%	22%	17%	17%	17%	19%	17%	0%	0%
1.90	17%	18%	18%	16%	26%	30%	23%	19%	15%	18%	21%	25%	22%	16%	18%	23%	17%	18%	18%	19%	18%	0%	0%
2.00	17%	19%	19%	17%	27%	31%	24%	20%	16%	19%	22%	27%	23%	17%	18%	24%	18%	19%	18%	20%	18%	0%	0%
2.10	18%	19%	19%	17%	28%	32%	25%	21%	16%	20%	23%	27%	23%	17%	19%	24%	19%	19%	19%	21%	19%	0%	0%
2.20	18%	20%	20%	18%	29%	32%	26%	21%	17%	20%	23%	28%	24%	18%	20%	25%	19%	20%	19%	21%	19%	0%	0%
2.30	19%	20%	20%	18%	30%	33%	27%	22%	17%	21%	24%	29%	24%	18%	20%	26%	20%	20%	20%	22%	20%	0%	0%
2.40	19%	21%	21%	19%	30%	34%	28%	22%	18%	21%	25%	29%	25%	18%	21%	27%	20%	21%	20%	23%	20%	0%	0%
2.50	20%	21%	21%	19%	31%	35%	28%	23%	18%	22%	25%	30%	26%	19%	21%	28%	21%	21%	21%	23%	21%	0%	0%
2.60	21%	22%	22%	20%	32%	35%	29%	24%	18%	22%	26%	31%	26%	19%	22%	28%	21%	22%	21%	24%	21%	0%	0%
2.70	21%	23%	22%	20%	33%	36%	30%	24%	19%	22%	27%	31%	27%	20%	22%	29%	22%	22%	22%	25%	22%	0%	0%
2.80	22%	23%	23%	21%	33%	37%	31%	25%	19%	23%	27%	32%	27%	20%	23%	30%	22%	23%	22%	25%	22%	0%	0%
2.90	22%	24%	23%	21%	34%	38%	32%	26%	20%	23%	28%	33%	28%	21%	23%	31%	23%	23%	23%	26%	22%	0%	0%
3.00	23%	24%	24%	22%	35%	39%	33%	26%	20%	24%	29%	33%	28%	21%	24%	31%	23%	24%	23%	27%	23%	0%	0%
3.10	23%	25%	25%	22%	36%	39%	34%	27%	21%	25%	29%	34%	29%	22%	24%	32%	24%	24%	24%	27%	23%	0%	0%
3.20	24%	25%	25%	23%	37%	40%	35%	28%	21%	26%	30%	35%	30%	22%	25%	33%	25%	25%	24%	28%	24%	0%	0%
3.30	25%	26%	26%	23%	38%	41%	36%	29%	22%	26%	31%	35%	30%	23%	25%	34%	25%	25%	25%	29%	25%	0%	0%
3.40	25%	27%	26%	23%	39%	42%	37%	30%	22%	27%	31%	36%	31%	23%	26%	34%	26%	26%	25%	30%	25%	0%	0%
3.50	26%	27%	27%	24%	40%	43%	38%	31%	23%	28%	32%	37%	32%	24%	26%	35%	27%	26%	26%	30%	26%	0%	0%
3.60	27%	28%	28%	24%	41%	44%	39%	31%	23%	29%	33%	37%	32%	25%	27%	36%	27%	27%	27%	31%	26%	0%	0%
3.70	27%	28%	28%	25%	42%	44%	40%	32%	24%	30%	33%	38%	33%	25%	27%	37%	28%	27%	27%	32%	27%	0%	0%
3.80	28%	29%	29%	25%	43%	45%	41%	33%	24%	31%	34%	39%	34%	26%	28%	37%	29%	28%	28%	32%	27%	0%	0%
3.90	28%	29%	29%	26%	44%	46%	42%	34%	25%	32%	35%	39%	34%	26%	28%	38%	29%	28%	28%	33%	28%	0%	0%
4.00	29%	30%	30%	26%	44%	47%	43%	35%	25%	33%	35%	40%	35%	27%	29%	39%	30%	29%	29%	34%	28%	0%	0%
4.10	29%	30%	30%	27%	45%	48%	44%	35%	26%	33%	36%	41%	35%	27%	29%	39%	30%	29%	29%	34%	29%	0%	0%
4.20	30%	31%	31%	27%	46%	48%	44%	36%	26%	33%	36%	41%	35%	27%	29%	39%	30%	29%	29%	35%	29%	0%	0%
4.30	30%	31%	31%	27%	46%	49%	45%	36%	27%	33%	37%	42%	36%	28%	30%	40%	31%	30%	30%	35%	30%	0%	0%
4.40	31%	32%	32%	28%	47%	50%	46%	37%	27%	34%	37%	42%	36%	28%	30%	40%	31%	30%	30%	35%	30%	0%	0%
4.50	31%	32%	32%	28%	47%	50%	46%	37%	28%	34%	37%	43%	36%	28%	30%	41%	31%	30%	30%	36%	30%	0%	0%
4.60	31%	32%	32%	28%	48%	51%	47%	37%	28%	34%	38%	43%	37%	29%	31%	41%	32%	31%	31%	36%	31%	0%	0%
4.70	32%	33%	33%	29%	48%	52%	48%	38%	29%	35%	38%	44%	37%	29%	31%	41%	32%	31%	31%	37%	31%	0%	0%
4.80	32%	33%	33%	29%	49%	52%	48%	38%	29%	35%	39%	45%	37%	29%	31%	42%	32%	31%	32%	37%	31%	0%	0%
4.90	32%	34%	34%	29%	49%	53%	49%	39%	30%	35%	39%	45%	38%	30%	32%	42%	33%	31%	32%	37%	32%	0%	0%
5.00	33%	34%	34%	30%	50%	54%	50%	39%	30%	35%	39%	46%	38%	30%	32%	43%	33%	32%	32%	38%	32%	0%	0%
5.10	33%	34%	34%	30%	50%	54%	51%	40%	30%	36%	40%	46%	38%	30%	33%	43%	33%	32%	33%	38%	32%	0%	0%
5.20	33%	35%	35%	30%	51%	55%	52%	41%	31%	37%	40%	47%	39%	31%	33%	44%	34%	32%	33%	39%	33%	0%	0%
5.30	34%	35%	35%	31%	51%	56%	53%	42%	31%	37%	41%	47%	39%	31%	33%	44%	34%	33%	34%	39%	33%	0%	0%
5.40	34%	35%	35%	31%	52%	57%	54%	43%	31%	38%	41%	48%	39%	32%	34%	45%	35%	33%	34%	40%	34%	0%	0%

Depth Inundation (feet)	Retail-Furniture	Retail-Electronics	Retail-Clothing	Hotel	Fast Food	Non-Fast Food	Hospital	Medical Office	Protective Services	Correctional Facility	Recreation	Religious Facilities	Schools	Service Station	Office One-Story	Convenience Store	Grocery	Apartment	Industrial Light	Warehouse, Refrig	Warehouse - Non-Refrigerated	Government	Vacant
5.50	35%	36%	36%	31%	52%	57%	55%	44%	31%	39%	42%	48%	40%	32%	34%	45%	35%	33%	35%	40%	34%	0%	0%
5.60	35%	36%	36%	31%	53%	58%	56%	45%	32%	39%	42%	49%	40%	32%	35%	46%	36%	33%	35%	41%	34%	0%	0%
5.70	35%	36%	37%	32%	53%	59%	57%	46%	32%	40%	43%	49%	41%	33%	35%	46%	36%	34%	35%	41%	35%	0%	0%
5.80	36%	36%	37%	32%	54%	59%	58%	47%	32%	40%	43%	50%	41%	33%	36%	47%	37%	34%	36%	42%	35%	0%	0%
5.90	36%	37%	37%	32%	55%	60%	59%	48%	32%	41%	44%	50%	41%	33%	36%	47%	37%	34%	36%	43%	36%	0%	0%
6.00	36%	37%	38%	33%	55%	61%	60%	49%	33%	42%	44%	51%	42%	34%	37%	48%	38%	35%	37%	43%	36%	0%	0%

Figure 4 DDFs - Contents Residential

Depth Inundation (feet)	Slab	Residential-NB	Residential-2NB	Split Level-NB	Residential-2B	Mobile Home
-2.0	0%	0%	0%	0%	8%	0%
-1.9	0%	0%	0%	0%	8%	0%
-1.8	0%	0%	0%	0%	8%	0%
-1.7	0%	1%	0%	1%	9%	0%
-1.6	0%	1%	0%	1%	9%	0%
-1.5	0%	1%	1%	1%	9%	0%
-1.4	0%	1%	1%	1%	9%	0%
-1.3	0%	2%	1%	2%	9%	0%
-1.2	0%	2%	1%	2%	10%	0%
-1.1	0%	2%	1%	2%	10%	0%
-1.0	0%	2%	1%	2%	10%	0%
-0.9	1%	3%	1%	2%	10%	1%
-0.8	2%	4%	2%	2%	10%	2%
-0.7	3%	4%	2%	2%	11%	4%
-0.6	4%	5%	3%	2%	11%	5%
-0.5	5%	5%	3%	3%	11%	6%
-0.4	6%	6%	3%	3%	11%	7%
-0.3	7%	6%	4%	3%	11%	8%
-0.2	8%	7%	4%	3%	12%	10%
-0.1	9%	8%	5%	3%	12%	11%
0.0	10%	8%	5%	3%	12%	12%
0.1	12%	9%	5%	3%	12%	17%
0.2	14%	9%	6%	3%	12%	23%
0.3	16%	10%	6%	3%	12%	28%
0.4	18%	10%	6%	4%	13%	34%
0.5	20%	11%	7%	4%	13%	39%
0.6	22%	11%	7%	4%	13%	44%
0.7	24%	12%	8%	4%	13%	50%
0.8	26%	12%	8%	4%	13%	55%
0.9	28%	13%	8%	5%	14%	61%
1.0	30%	13%	9%	5%	14%	66%
1.1	32%	14%	9%	5%	14%	68%

Depth Inundation (feet)	Slab	Residential-NB	Residential-2NB	Split Level-NB	Residential-2B	Mobile Home
1.2	33%	14%	9%	5%	14%	71%
1.3	35%	15%	10%	6%	14%	73%
1.4	36%	15%	10%	6%	15%	76%
1.5	38%	16%	10%	6%	15%	78%
1.6	39%	16%	11%	6%	15%	80%
1.7	41%	17%	11%	7%	15%	83%
1.8	42%	17%	12%	7%	15%	85%
1.9	44%	17%	12%	7%	16%	88%
2.0	45%	18%	12%	8%	16%	90%
2.1	48%	18%	13%	8%	16%	90%
2.2	51%	19%	13%	8%	16%	90%
2.3	54%	19%	13%	9%	16%	90%
2.4	57%	20%	14%	9%	17%	90%
2.5	60%	20%	14%	9%	17%	90%
2.6	63%	20%	14%	10%	17%	90%
2.7	66%	21%	15%	10%	17%	90%
2.8	69%	21%	15%	10%	17%	90%
2.9	72%	22%	15%	11%	18%	90%
3.0	75%	22%	16%	11%	18%	90%
3.1	78%	22%	16%	12%	18%	90%
3.2	80%	23%	16%	12%	18%	90%
3.3	83%	23%	16%	12%	18%	90%
3.4	85%	23%	17%	13%	19%	90%
3.5	88%	24%	17%	13%	19%	90%
3.6	90%	24%	17%	14%	19%	90%
3.7	93%	25%	18%	14%	19%	90%
3.8	95%	25%	18%	14%	19%	90%
3.9	98%	25%	18%	15%	20%	90%
4.0	100%	26%	19%	15%	20%	90%
4.1	100%	26%	19%	16%	20%	90%
4.2	100%	26%	19%	16%	20%	90%
4.3	100%	27%	19%	17%	20%	90%
4.4	100%	27%	20%	17%	21%	90%
4.5	100%	27%	20%	18%	21%	90%
4.6	100%	28%	20%	18%	21%	90%
4.7	100%	28%	20%	19%	21%	90%
4.8	100%	28%	21%	19%	22%	90%
4.9	100%	28%	21%	20%	22%	90%
5.0	100%	29%	21%	20%	22%	90%
5.1	100%	29%	22%	21%	22%	90%
5.2	100%	29%	22%	21%	22%	90%
5.3	100%	30%	22%	22%	23%	90%
5.4	100%	30%	22%	22%	23%	90%
5.5	100%	30%	23%	23%	23%	90%
5.6	100%	30%	23%	23%	23%	90%
5.7	100%	31%	23%	24%	24%	90%

Depth Inundation (feet)	Slab	Residential-NB	Residential-2NB	Split Level-NB	Residential-2B	Mobile Home
5.8	100%	31%	23%	24%	24%	90%
5.9	100%	31%	24%	25%	24%	90%
6.0	100%	32%	24%	25%	24%	90%

Figure 5. DDFs – Contents Commercial

Depth Inundation (feet)	Retail-Furniture	Retail-Electronics	Retail-Clothing	Hotel	Fast Food	Non-Fast Food	Hospital	Medical Office	Protective Services	Correctional Facility	Recreation	Religious Facilities	Schools	Service Station	Office One-Story	Convenience Store	Grocery	Apartment	Industrial Light	Warehouse, Refrig	Warehouse - Non-Refrigerated	Government	Vacant
-2.0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-1.9	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-1.8	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-1.7	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-1.6	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-1.5	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-1.4	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-1.3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-1.2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-1.1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-1.0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-0.9	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-0.8	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-0.7	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-0.6	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-0.5	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-0.4	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-0.3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-0.2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-0.1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
0.0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
0.1	5%	2%	3%	2%	2%	3%	1%	1%	1%	1%	3%	3%	2%	2%	2%	2%	3%	2%	2%	3%	2%	0%	0%
0.2	9%	5%	6%	3%	4%	6%	3%	3%	3%	3%	5%	6%	4%	3%	4%	5%	6%	4%	4%	6%	4%	0%	0%
0.3	14%	7%	9%	5%	6%	8%	4%	4%	4%	4%	8%	9%	7%	5%	6%	7%	9%	7%	6%	9%	6%	0%	0%
0.4	19%	9%	12%	6%	9%	11%	6%	6%	6%	5%	10%	12%	9%	7%	8%	9%	12%	9%	8%	12%	8%	0%	0%
0.5	23%	12%	15%	8%	11%	14%	7%	7%	7%	7%	13%	15%	11%	8%	10%	12%	15%	11%	10%	15%	10%	0%	0%
0.6	28%	14%	17%	10%	13%	17%	9%	9%	9%	8%	15%	18%	13%	10%	12%	14%	18%	13%	12%	18%	12%	0%	0%
0.7	33%	16%	20%	11%	15%	19%	10%	10%	10%	9%	18%	21%	15%	12%	14%	16%	22%	15%	14%	21%	15%	0%	0%
0.8	37%	18%	23%	13%	17%	22%	12%	11%	11%	11%	21%	23%	17%	13%	16%	19%	25%	17%	15%	24%	17%	0%	0%
0.9	42%	21%	26%	15%	19%	25%	13%	13%	13%	12%	23%	26%	20%	15%	18%	21%	28%	20%	17%	27%	19%	0%	0%

Depth Inundation (feet)	Retail-Furniture	Retail-Electronics	Retail-Clothing	Hotel	Fast Food	Non-Fast Food	Hospital	Medical Office	Protective Services	Correctional Facility	Recreation	Religious Facilities	Schools	Service Station	Office One-Story	Convenience Store	Grocery	Apartment	Industrial Light	Warehouse, Refrig	Warehouse - Non-Refrigerated	Government	Vacant
1.0	47%	23%	29%	16%	21%	28%	15%	14%	14%	13%	26%	29%	22%	16%	20%	23%	31%	22%	19%	30%	21%	0%	0%
1.1	48%	24%	31%	17%	23%	30%	16%	16%	15%	14%	28%	31%	23%	18%	21%	25%	32%	23%	20%	32%	22%	0%	0%
1.2	50%	25%	32%	18%	25%	32%	17%	17%	16%	15%	29%	33%	23%	19%	23%	26%	33%	23%	22%	33%	23%	0%	0%
1.3	51%	26%	34%	19%	26%	34%	18%	18%	17%	16%	31%	35%	24%	20%	24%	28%	34%	24%	23%	35%	25%	0%	0%
1.4	53%	27%	36%	20%	28%	36%	20%	19%	18%	16%	33%	37%	25%	21%	26%	30%	35%	25%	24%	37%	26%	0%	0%
1.5	54%	29%	38%	21%	30%	38%	21%	21%	20%	17%	35%	39%	26%	23%	27%	32%	36%	26%	25%	39%	27%	0%	0%
1.6	56%	30%	39%	22%	32%	40%	22%	22%	21%	18%	37%	41%	27%	24%	29%	33%	37%	27%	26%	41%	29%	0%	0%
1.7	57%	31%	41%	23%	33%	43%	23%	23%	22%	19%	38%	43%	28%	25%	30%	35%	38%	28%	27%	43%	30%	0%	0%
1.8	59%	32%	43%	24%	35%	45%	25%	24%	23%	20%	40%	45%	29%	26%	31%	37%	39%	29%	29%	44%	31%	0%	0%
1.9	60%	33%	45%	25%	37%	47%	26%	26%	24%	20%	42%	47%	30%	28%	33%	38%	40%	30%	30%	46%	32%	0%	0%
2.0	62%	34%	46%	26%	39%	49%	27%	27%	25%	21%	44%	48%	30%	29%	34%	40%	41%	30%	31%	48%	34%	0%	0%
2.1	62%	35%	47%	27%	40%	50%	28%	28%	26%	22%	46%	50%	31%	30%	35%	41%	42%	31%	32%	49%	35%	0%	0%
2.2	63%	36%	48%	28%	41%	51%	29%	30%	27%	23%	48%	51%	32%	31%	37%	42%	43%	32%	33%	50%	36%	0%	0%
2.3	64%	37%	49%	29%	43%	51%	30%	31%	28%	24%	49%	52%	33%	33%	38%	44%	45%	33%	34%	51%	38%	0%	0%
2.4	64%	38%	50%	29%	44%	52%	31%	32%	30%	25%	51%	53%	34%	34%	39%	45%	46%	34%	36%	52%	39%	0%	0%
2.5	65%	39%	51%	30%	46%	53%	32%	34%	31%	26%	53%	54%	35%	35%	40%	46%	47%	35%	37%	54%	41%	0%	0%
2.6	66%	40%	52%	31%	47%	54%	33%	35%	32%	27%	55%	55%	36%	36%	41%	48%	48%	36%	38%	55%	42%	0%	0%
2.7	66%	41%	53%	32%	48%	55%	34%	36%	33%	28%	57%	57%	36%	37%	42%	49%	49%	36%	39%	56%	43%	0%	0%
2.8	67%	42%	54%	33%	50%	56%	35%	38%	34%	29%	59%	58%	37%	38%	43%	50%	50%	37%	40%	57%	45%	0%	0%
2.9	68%	43%	55%	33%	51%	56%	36%	39%	36%	30%	61%	59%	38%	40%	44%	52%	52%	38%	41%	58%	46%	0%	0%
3.0	68%	44%	55%	34%	53%	57%	37%	40%	37%	31%	63%	60%	39%	41%	45%	53%	53%	39%	42%	59%	47%	0%	0%
3.1	69%	47%	57%	35%	54%	59%	39%	42%	38%	32%	64%	61%	40%	43%	46%	55%	54%	40%	43%	60%	48%	0%	0%
3.2	70%	49%	58%	35%	55%	60%	40%	44%	39%	34%	65%	62%	40%	44%	47%	56%	55%	40%	44%	60%	49%	0%	0%
3.3	71%	51%	60%	36%	56%	62%	42%	45%	40%	35%	66%	63%	41%	46%	48%	58%	56%	41%	45%	61%	50%	0%	0%
3.4	73%	53%	61%	36%	57%	63%	44%	47%	41%	36%	67%	64%	41%	48%	49%	60%	57%	41%	46%	62%	51%	0%	0%
3.5	74%	56%	63%	37%	58%	65%	45%	49%	42%	38%	68%	65%	42%	49%	50%	62%	58%	42%	47%	62%	52%	0%	0%
3.6	75%	58%	64%	37%	59%	66%	47%	50%	43%	39%	69%	66%	43%	51%	51%	64%	60%	43%	48%	63%	53%	0%	0%
3.7	76%	60%	66%	38%	60%	67%	48%	52%	44%	40%	70%	67%	43%	53%	52%	65%	61%	43%	49%	64%	54%	0%	0%
3.8	77%	62%	67%	39%	61%	69%	50%	54%	45%	42%	71%	67%	44%	54%	53%	67%	62%	44%	50%	64%	55%	0%	0%
3.9	78%	65%	69%	39%	62%	70%	52%	55%	46%	43%	72%	68%	44%	56%	54%	69%	63%	44%	51%	65%	56%	0%	0%
4.0	79%	67%	70%	40%	63%	72%	53%	57%	47%	44%	73%	69%	45%	58%	55%	71%	64%	45%	52%	66%	57%	0%	0%
4.1	80%	68%	71%	41%	64%	73%	55%	58%	47%	45%	74%	70%	45%	58%	56%	72%	65%	45%	53%	67%	58%	0%	0%
4.2	80%	69%	72%	42%	65%	73%	57%	59%	48%	46%	74%	71%	46%	59%	57%	72%	66%	46%	54%	67%	59%	0%	0%
4.3	81%	70%	73%	42%	66%	74%	58%	60%	49%	47%	75%	71%	46%	59%	58%	73%	67%	46%	55%	68%	59%	0%	0%
4.4	82%	71%	74%	43%	67%	75%	60%	61%	50%	48%	76%	72%	46%	60%	59%	74%	69%	46%	56%	69%	60%	0%	0%
4.5	82%	72%	75%	44%	68%	76%	62%	62%	51%	49%	76%	73%	46%	61%	59%	75%	70%	46%	57%	70%	61%	0%	0%
4.6	83%	73%	75%	45%	69%	77%	63%	63%	52%	49%	77%	74%	47%	61%	60%	76%	71%	47%	57%	71%	62%	0%	0%
4.7	84%	75%	76%	46%	70%	77%	65%	64%	53%	50%	78%	74%	47%	62%	61%	77%	72%	47%	58%	72%	63%	0%	0%

Depth Inundation (feet)	Retail- Furniture	Retail- Electronics	Retail- Clothing	Hotel	Fast Food	Non-Fast Food	Hospital	Medical Office	Protective Services	Correctional Facility	Recreation	Religious Facilities	Schools	Service Station	Office One- Story	Convenienc e Store	Grocery	Apartment	Industrial Light	Warehouse, Refrig	Warehouse - Non- Refrigerated	Government	Vacant
4.8	84%	76%	77%	47%	71%	78%	67%	65%	54%	51%	79%	75%	47%	62%	62%	78%	73%	47%	59%	73%	64%	0%	0%
4.9	85%	77%	78%	48%	72%	79%	68%	66%	54%	52%	79%	76%	48%	63%	63%	78%	74%	48%	60%	73%	65%	0%	0%
5.0	86%	78%	79%	49%	73%	80%	70%	67%	55%	53%	80%	76%	48%	63%	64%	79%	75%	48%	61%	74%	66%	0%	0%
5.1	86%	79%	80%	49%	74%	80%	71%	68%	56%	54%	80%	77%	48%	64%	65%	80%	77%	48%	62%	75%	66%	0%	0%
5.2	87%	80%	81%	49%	74%	81%	72%	69%	57%	55%	81%	77%	49%	65%	66%	81%	78%	49%	63%	75%	67%	0%	0%
5.3	87%	80%	82%	50%	75%	81%	73%	70%	58%	56%	81%	78%	49%	66%	67%	82%	79%	49%	64%	76%	68%	0%	0%
5.4	88%	81%	83%	50%	76%	82%	74%	71%	58%	57%	82%	78%	49%	66%	68%	83%	80%	49%	65%	76%	69%	0%	0%
5.5	88%	82%	84%	51%	76%	82%	75%	71%	59%	58%	82%	79%	50%	67%	69%	84%	81%	50%	66%	77%	70%	0%	0%
5.6	89%	83%	85%	51%	77%	83%	75%	72%	60%	59%	82%	79%	50%	68%	70%	85%	83%	50%	67%	78%	70%	0%	0%
5.7	89%	84%	86%	51%	77%	83%	76%	73%	61%	59%	83%	80%	51%	68%	70%	85%	84%	51%	69%	78%	71%	0%	0%
5.8	90%	85%	87%	52%	78%	84%	77%	74%	61%	60%	83%	80%	51%	69%	71%	86%	85%	51%	70%	79%	72%	0%	0%
5.9	90%	86%	88%	52%	79%	84%	78%	75%	62%	61%	84%	81%	51%	70%	72%	87%	86%	51%	71%	79%	73%	0%	0%
6.0	91%	87%	89%	52%	79%	85%	79%	75%	63%	62%	84%	81%	52%	71%	73%	88%	87%	52%	72%	80%	74%	0%	0%