Final Study Report: January 20, 2022

An Independent Review and Evaluation of the Economic Analyses of the US. Army Corps of Engineers (USACE) Papillion Creek and Tributaries Lakes, Nebraska General Reevaluation Report (GRR).

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<u>Project Sponsors</u>[1]

1) Washington County NE Board of Supervisors
   (Provided funding)

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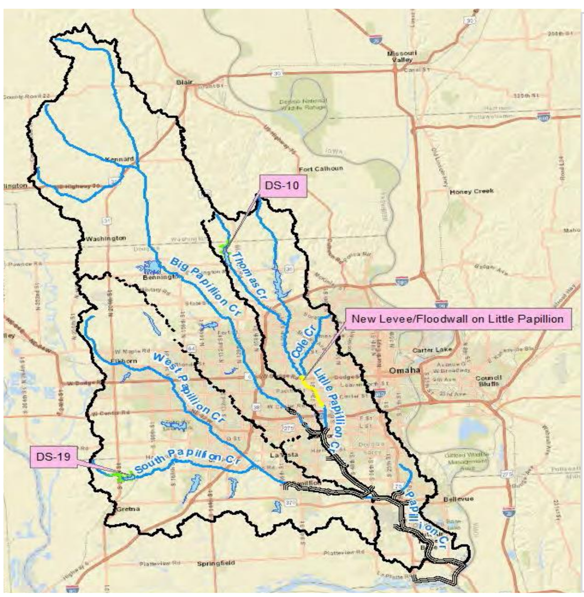
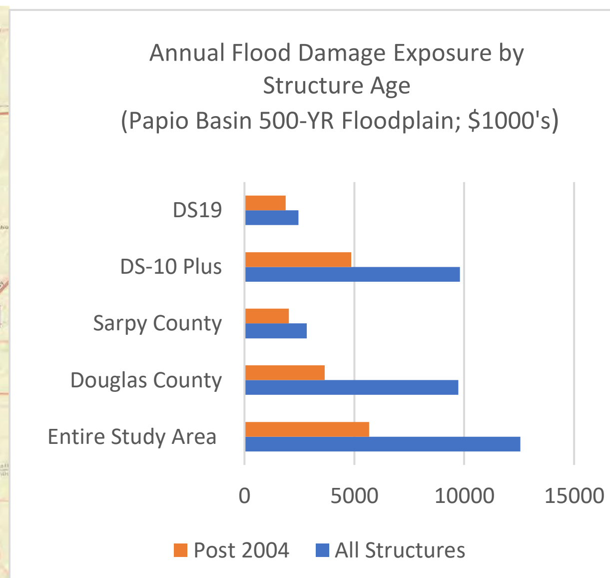




[1]. *The conclusions, comments and suggestions in this report are solely attributable to the author and do not necessarily reflect the opinions of project sponsors.*

EXECUTIVE SUMMARY

This report is an independent review and evaluation of the economic analyses of the USACE Papillion Creek General Reevaluation Report (GRR) and the tentatively selected plan (TSP): a dry dam (DS 10) combined with levees/floodwalls in Douglas County (referred to in this review as 'DS-10 Plus'); a wet dam near Gretna in Sarpy County (DS-19); and non-structural floodproofing measures throughout the Papillion Creek Basin.

Conclusions:

Based on documented and rigorous analyses this review concludes that that the GRR has:

1) Reported incorrect and misleading benefit-cost ratios (BCR's) that are already marginally low and unlikely to receive Federal Funding

2) Utilized inflated, inconsistent and incorrect damage exposure data

3) Violated Section 308 of the Federal Water Resources Development Act (WRDA) of 1990 with regards to the inclusion of recently built structures in the 100-year floodplain as National Economic Development (NED) benefits.

4) Relied on highly inaccurate and inflated structural inventory data.

5) Double counted non-structural and structural flood mitigation benefits.

6) Used Inflated content-to-structure value ratios.

7) Ignored flood proofing measures in recently built structures

8) Overestimated recreation benefits for Dam Site 19.

9) Violated the Federal Data Quality Act intended to ensure that Federal Agencies disseminate accurate information to ensure the quality utility, objectivity and integrity of utilized data.

The Impact of Discovered Errors and Omissions on TSP Feasibility

Individually, each of these discovered errors and omissions are sufficient to reduce the already low and marginally feasibility measures of the structural components of the tentatively selected plan (TSP). Considered jointly, these errors definitively expose that the TSP (with a current price tag of $132 million) to be economically infeasible with benefit-cost ratios of less than one. To ensure the wise use of scarce Federal and local tax dollars for cost-effective flood mitigation plans in the Papillion Creek Basin, it is suggested that the USACE postpone final approval of the current TSP until the GRR authors (USACE employees) can confirm or refute the findings of this review.

More specific details of the major findings of this study are contained on the next 4 pages of this Executive Summary, while and discussed in greater detail in the report itself.

Continuation of the Executive Summary

Specific Findings:

1) Reporting Incorrect/Misleading Benefit Cost Ratios (BCRs) for Structural Measures.

The reporting of a single BCR for a diverse mix of distinct plan components (incorrectly reported as 1.51 but shown to actually be **1.39** due to a transparent math error), obscures the fact that the non-structural components of the plan (floodproofing measures) have a higher BCR (1.83) than the proposed structural measures: Either DS-10 combined with a levee/floodwall (i.e. DS-10 Plus) with a BCR of 1.21; or DS-19 with recreation (BCR of 1.4) or 0.96 (cost ineffective) without recreation. It will be challenging to obtain congressional funding for structural flood mitigation activities with such low BCRs particularly without major ecosystem restoration components being part of the TSP.

2) Utilization of Inflated and Inconsistent Estimated Annual Damage Values.

The GRR appears to want to inflate flood damage exposure in the Papillion Creek Basin by highlighting that 4,100 structures are in the 0.2% floodplain with $4.5 Billion of total investment values. In fact, 1/4 of these structures have no flood risk at all and expected annual flood damages (EADs) are only 0.3% of investment values. Lower damage exposure levels associated with specific TSP components are not clearly highlighted. Finally, the GRR inconsistently reports two different total (Basin-wide) EAD values, each of which are higher (between 11% and 33%) from structure specific EAD data contained in their inventory database which if relied on, would lower BCR ratios substantially making DS-10 Plus and DS-19 economically infeasible.

3) WRDA Violations: Including Recently Built Floodplain Structures as NED Benefits

The GRR violates Section 308 of the Federal Water Resource Development Act of 1990, which states that new or improved structures built within the regulatory 100-year floodplain be excluded from the structures used to calculate National Economic Development (NED) benefits for flood damage reduction projects. Instead of identifying and excluding such floodplain structures from NED analyses as done in other USACE flood mitigation studies, the GRR ‘assumed’ these prohibited structures do not exist because government entities in the study area maintain good standing with the National Flood Insurance Program.

An analysis of USACE-GRR structural damage inventory data (obtained via a Freedom of Information Act request) finds that 45% of expected annual flood damage (EAD) in the study area is associated with structures built since 2005 when the most recent FEMA 100-year floodplain maps were established in the Papillion Creek Basin. And, more than 50% of damage exposure associated with (i.e. downstream of) DS-10 Plus has occurred since 2005 versus 76% with DS-19. And, 83% of structures in Douglas County that were granted exemptions from 100-year floodplain building restrictions (through letters of map amendments or LOMAs) by the Federal Emergency Management Agency (FEMA) generate significant flood damage exposure. This questions the logic of the GRR local partner: the Papio-Missouri River Natural Resources District (PMNRD) has spent half a million dollars since 2016 on studies intended to shrink the 100-year floodplain boundaries.

To formally quantify potential violations of Section 308 of the WRDA, an analysis was performed on GRR inventory structures built since 2005 in the Little Papillion sub-basin '7' (LP7) that includes the recently developed Aksarben Village area. It turns out that 8 of 19 structures in the LP7 100-year floodplain were built since 2005, and which are not exempted by FEMA LOMAs, **are** illegally included as flood damage exposure benefits in the GRR NED analyses. The EADs of these structures is $715,000 (or $20.3 million over the 40-year full horizon GRR analysis) which represents 7.3% of all EAD's associated with the proposed DS-10 Plus. A similar (but less in-depth) analysis was conducted for sub-basin PC1, which represents the confluence of the Big and West Papillion Creeks (in the City of Bellevue) shows at least 4 WRDA violations with EADs of $118,000 or $3.5 million over the full 50-year project life cycle.

These WRDA result in the BCR ratios of DS-10 Plus being inflated by 4.37% meaning that they are in the range of 0.78 to 1.11 depending on the extent of overall EAD over-estimates as hypothesized in the earlier section of this Report. This indicates that DS-10 Plus is in the range of economically infeasible to just slightly feasible (actually very close to a break-even-point). The WRDA violations in sub-basin PC1 result in DS-19 EAD inflation by 4.37% meaning that BCRs for DS-19 are in the 0.99 to 1.34 range instead of the 1.4 value reported by the GRR.

These were the only two sub-basins in the study area where WRDA violations were researched. A basin wide analysis of this phenomena will require GIS (spatial) analyses of building structures along with floodplain maps and LOMAs which can potentially impact BCRs further.

4) Relying on highly inaccurate and inflated structural inventory data effecting the accuracy of TSP economic feasibility measures

The GRR structural inventory needs to be accurate because DSRVs represent 93% of the flood damage exposure in the Papillion Creek Basin study area.

The GRR inventory is unconventional (compared to other recent USACE structural inventories) and it contains very serious problems and errors with respect to documentation, data, approaches, and final results. The 5 inter-related problems identified with the inventory include:

i) Poorly documented data sources, approaches, intermediary results

ii) A Pronounced Ignorance of Douglas and Sarpy County Assessor Valuation Approaches

iii) Not Utilizing Existing DSRV Data and Assuming GRR Estimates are Superior.

iv) Invalid and Inaccurate Valuation/Indexing Estimation Approaches Used by the GRR

v) Missing and/or Incomplete/Incorrect Structural Inventory Data (inputs and Outputs)

It is recommended that the GRR structural inventory be corrected and improved and used to re-calculate TSP feasibility measures. In lieu of that happening, it is estimated that DS-10 Plus DSRVs have been inflated by 12% due to an inaccurate GRR structural inventory while DS-19 DSRVs were inflated by 7%. This means that the DS-10 plus reported BCR of 1.21 is actually 1.08 while the DS-19 BCR falls from 1.40 to 1.32.

5) Double counting non-structural and structural flood mitigation benefits.

The double counting of flood mitigation benefits when calculating NED benefits is highly discouraged in USACE flood mitigation study guidance but appears to have occurred with the GRR. It takes a lot of complex work to ensure that the benefits of different mitigation components in the same sub-basins are not double counted and if the GRR had done this it was expected that they would clearly report it. The first concern was with not removing non-structural benefits associated with floodproofing 386 structures across the basin from dam construction related benefits. The second concern was with the double counting of dam and downstream floodwall levee mitigation which is associated only with DS-10 Plus.

By reviewing GRR summary tables it was determined that non-structural avoided damage benefits were not removed from DS-10 Plus and DS-19 analyses. This double counting inflated BCRs by 11% (DS-10 Plus) and by 13% (DS-19). If this double counting was corrected (i.e. avoided) the BCRs for both structural components change from marginally feasible (1.21 and 1.40) to a range of infeasible to a break-even point (0.74 to 1.08 for DS10 and from 0.9 to 1.22 for DS-19).

Surprisingly, the double counting of avoided flood damage benefits was tentatively not found to have occurred with structural components of DS-10 Plus (the dam and downstream floodwall/levee construction). The GRR never explicitly states what was done to avoid double counting of these two inter-related components, but a review of two key GRR summary tables found that that that DS-10 Plus total annual benefits used in final BCR calculation (Table 38, GRR) was $766,000 less than the sum of dam and floodwall/levee annual benefits reported earlier in Table 20. But since this effort nor the results were explicitly written in the GRR, this conclusion is considered provisional until confirmed or refuted by the USACE.

6) The Use of Inflated content-to-structure value ratios.

Content to structure value ratios (CSRVs) are an important to flood mitigation feasibility studies since contents (in the GRR study area and most areas of country) make up about 45% of total flood damage exposure. However, the GRR and most other USACE feasibility studies appear to be using suspect CSRV data based on vaguely documented expert opinion studies rather than actual flood damage data. Comparing the GRR CSRVs to the average values of 4 other USACE studies and CSRVs recommended for use by FEMA and the NSI (USACE), it appears that GRR content values are inflated by 10% meaning that GRR BCRs are inflated by 4.5%. Correcting for this CSRV inflation reduces the BCR of the entire TSP from 1.39 to 1.33, reduces the BCR of DS-10 Plus from 1.21 to 1.16, while the BCR of DS-19 is reduced from 1.40 to 1.34.

7) Ignoring flood proofing measures in recently built structures.

Recent research by FEMA and others indicated large reductions in flood damage to recently built structures with improved construction approaches yet the GRR (and most USACE studies) rely on stage damage curves that are 20 years old. Since between 50% and 76% of structural annual flood damage exposure in the 500-year floodplain study are associated with structures built since 2004, it is suspected that the GRR has reported inflated food damage exposure by not accounting for flood proofing measures of recently built structures. At this time, it is not possible to quantify the extent of this inflation but it should be noted by the GRR and taken into consideration when evaluating the already marginally low BCR's of TSP components.

8) Over-estimating recreation benefits for Dam Site 19.

Dam Site 19 in western Sarpy County was not found cost effective for flood control purposes even with potentially inflated flood damage exposure measures. However, with the inclusion of recreation benefits its feasibility increases to very marginal level (BCR ratio of 1.40).

This means that feasibility of the Dam Site 19 is entirely dependent on the accuracy of net recreation benefits which is problematic for two reasons: 1) Recent reservoir drainage maintenance costs to deal with sedimentation issues have been ignored; these costs observed at the nearby Walnut Creek Reservoir are estimated at $22,100 per year; 2) Future recreation benefits are inflated under the assumption that Sarpy County population will grow over the next 25 years at 1.5% without an accompanying increase in outdoor recreational facilities which inflates recreation benefits by $95,644 per year. Accounting for these true costs and benefits decreases the BCR for DS-19 from 1.40 to 1.30 or by 7%.

9) Violations of the Federal Data Quality Act

The Federal Data Quality Act is intended to ensure that Federal Agencies disseminate accurate information as part of their studies and reports.

There are many aspects of the GRR which violate the Act including: 1) Insufficient description of data, methods and intermediate results; misleading readers by leaving out (or hiding in obscure places of the report) key information regarding the results. For example, that structural measures, the two proposed dams in particular, have markedly lower BCRs than non-structural measures (and the overall TSP); 2) Not releasing key data used for the study (the structural inventory) and not ensuring that this data was properly documented (i.e. meta-data descriptions) and accurate and complete.

STUDY OBJECTIVES

1) Review and critique the methods and data used in the economic analyses of the USACE Papillion Creek General Reevaluation Report (GRR).

2) Evaluate the accuracy of conclusions regarding the economic feasibility of the GRR Tentatively Selected Plan (TSP): A dry dam (DS-10) combined with levees/floodwalls in Douglas County (i.e. 'DS-10 Plus'), a wet dam near Gretna in Sarpy County (DS-19), and non-structural measures proposed throughout the basin.

3) Identify how data and analyses collected by the GRR (a 3-year study costing $3 million paid for by Papillion Creek Basin residents and Federal taxpayers) can be improved and used for the evaluation of a wide variety of flood mitigation projects and plans in the Papillion Creek Basin in the coming decade.

BACKGROUND AND RELEVANT EXPERIENCE OF THE STUDY AUTHOR (STEVEN SHULTZ, PH.D.)

I have undertaken the study as a private consultant, completely independent from my regular employment at the University of Nebraska at Omaha where since 2005 I have been a Professor of Real Estate and Land Use Economics. Prior to that I was an Associate Professor of Natural Resource Economics at North Dakota State University.

My research specialty over the last 20 years has focused on the economic evaluation of flood control projects in Central America (for USAID) and across the U.S. (for county governments, state agencies, and Federal interests). In recent years (2012-17) I was funded by the USACE (via their Institute of Water Resources) to conduct research on the accuracy of flood mitigation feasibility studies with a focus on structural inventories and the depreciated replacement cost of buildings and content damages. This research collaboration with the USACE first involved an Inter-personal Agreement with the IWR followed by a Competitive Research Fellowship which resulted in two USACE IWR white papers and multiple peer reviewed journal articles.

In 2008, I received funding from the USGS and the Douglas County Board of Commissioners, to evaluate flood mitigation issues in the Papillion Creek Basin. The study focused on: the extent of residential housing floodplain risk in the Papillion Creek Basin, the impact of floodplain status on property values, and homebuyer preferences for Low Impact Development.

I have extensive experience creating and using structural inventory databases required for flood mitigation planning and I have been employed as expert witness for a recent USACE flood damage litigation case. My 2-page resume describing these experiences in greater detail with a reference list of my recent peer reviewed research articles are contained in **Appendix B**

Even though I am now critiquing a USACE study, I have the utmost respect for the agency's mission and the dedication and expertise of its employees. In a 2018 article appearing in the Omaha World Herald at the start of the Papio GRR, I was quoted as saying: "The involvement of the Corps of Engineers in this study should better guarantee that the results will be reliable, said Steven Shultz, a Professor of Real Estate and Land Use Economics at the University of Nebraska at Omaha. “It’s a positive sign,” he said. “They (The corps) has well established and sound methodology for evaluating these projects."

BACKGROUND AND JUSTIFICATION FOR THE REVIEW STUDY

In June of 2021, the Omaha District of the U.S. Army Corps of Engineers (USACE) completed a three-year, $3 million feasibility study in partnership with the Papio-Missouri River Natural Resources District (PMNRD) intended to evaluate alternative flood strategies in the Papillion Creek Basin which could potentially become a Federally sponsored project. The report titled the ‘Papillion Creek and Tributaries Lakes, Nebraska General Reevaluation Report’ is referred to hereafter as the ‘GRR’. It recommends a tentatively selected plan (TSP) that includes: 1) a 74 acre dam and reservoir on the West Papillion Creek near Gretna in Sarpy County (DS- 19); 2) a larger dry dam on Thomas Creek in rural Douglas County (DS-10) extending into Washington County, combined with floodwalls and levees all within the Little Papillion Creek reach of the Basin ; and 3) non-structural actions (basement fills, dry proofing, and elevation increases) on 386 structures in 7 distinct stream reaches of the Papillion Creek Basin. The locations of the structural components of the TSP are shown in **Figure 1** while the Papio sub-basins that comprise the GRR study area (the 500-year floodplain) are shown in **Figure 2**. Both of these maps were taken directly from the GRR report.

The cost of the recommended plan is $134 million with a 65%-35% Federal-Local cost share. However, most recent USACE flood control projects in other locations have ended up costing significantly more than initially estimated. The GRR plan has a benefit-cost-ratio of 1.51 and final approval of the project by the Secretary of the Army and its transmission to Congress for funding considerations is (as of December, 2021), still pending. A more complete summary of the GRR can be found in the 6-page Draft Approval Letter of the GRR prepared by Secretary of the Army in **Appendix D.**

A BCR of 1.51 is relatively low for most federally sponsored projects as summarized in a recent General Accounting Office review of USACE flood risk management projects (GAO 2019) and Office of Budget and Management guidelines as summarized by the American Society of Civil Engineers (ASCE, 2018). An example of the Federal Government’s reluctance to fund large scale flood mitigation projects with BCRs below 3 is the USACE Fargo-Moorhead Diversion flood mitigation project which had an estimated BCR of 1.7 in 2011 with a $1.8 billion price tag, which as of November 2021 has risen to $3.2 billion meaning that the project has clearly become economically infeasible.

The relatively low BCR of the Papillion Creek Basin GRR justifies a thorough and objective review of the GRR economic analyses prior to committing scarce taxpayer funds.

Figure 1. Location of TSP Structural Measures (taken from the GRR)

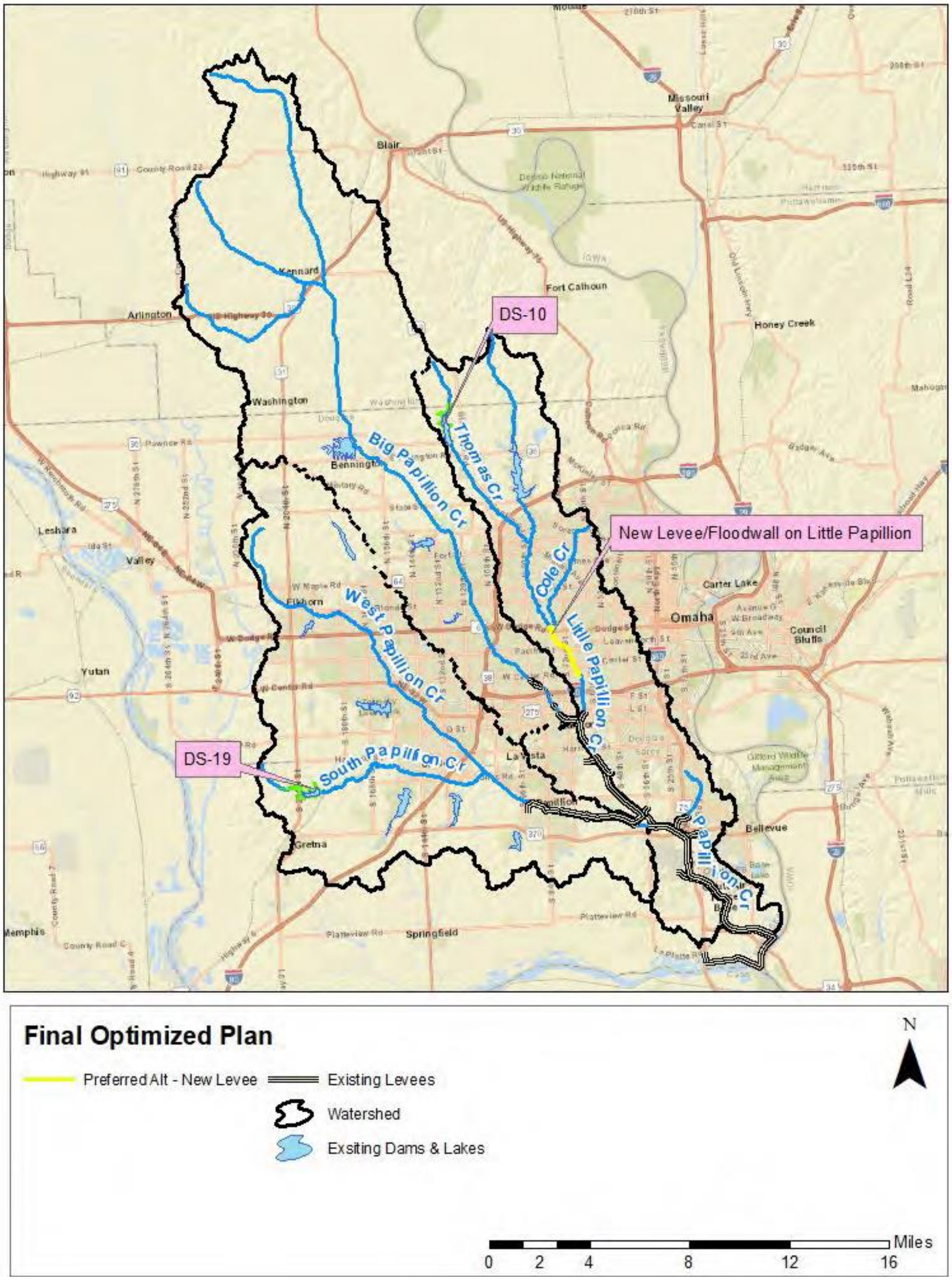
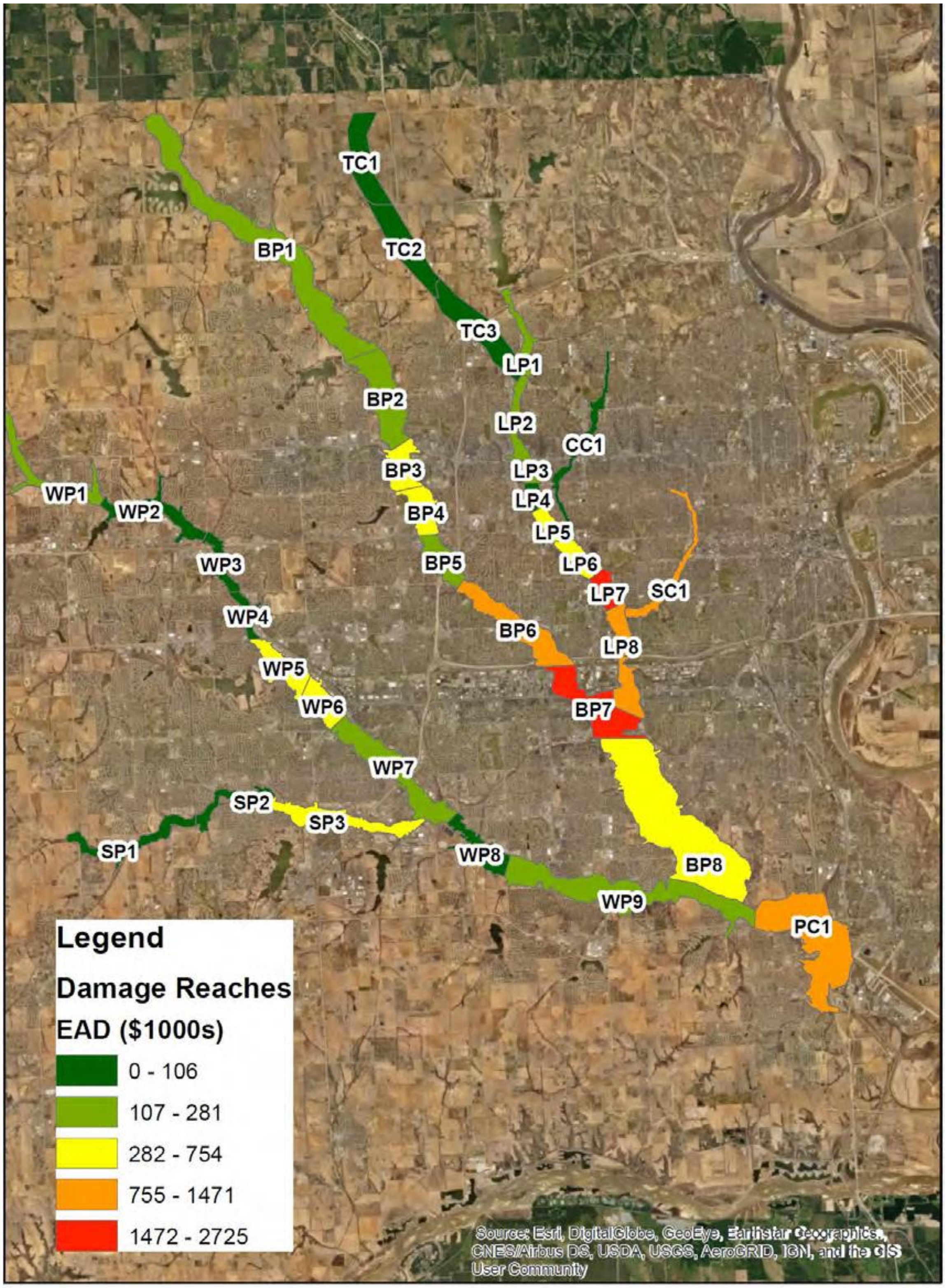


Figure 2. Flood Damage Exposure by Sub-Basins in the GRR Study Area (the 500-Yr floodplain). Taken from the GRR.



METHODS AND PRIMARY DATA SOURCES USED FOR THIS REVIEW STUDY:

The three documents making up the completed GRR study (the preliminary draft, the final draft and the most recent final report) have been carefully reviewed and compared to 10 other recent USACE flood mitigation feasibility studies and two other feasibility studies (the Fargo/Moorhead Diversion Study and the Minot, ND Study).

The review focusses on the economic analyses of the GRR based on the publicly available GRR document, particularly the main report, its Appendix F (Economics) and Appendix G (Non-Structural Measures). This is supplemented by a detailed review and analysis of the actual structural inventory data used for the GRR economic analyses. A request for this data was rejected by the USACE in December of 2019. In May of 2020 the USACE provided this data in the form of Microsoft Excel spreadsheet to a Papio Valley Preservation Association member who requested it via a Freedom of Information Act (FOIA) request who then forwarded it to me. The data was found to be incomplete; and thus, a second FOIA request, with usable data, was obtained from the USACE in April of 2020.

The description of methodologies and approaches for the GRR structural inventory in both the main document and the appendices of the GRR are extremely brief and poorly referenced making it almost impossible to fully understand the details and validity of the GRR data collection, manipulation, analyses and results. However, by reviewing the FOIA obtained structural inventory data (a large collection of around 28 different Microsoft Excel spreadsheet tabs) and integrating the data with additional building data from Douglas and Sarpy County Assessors offices, I have been able to reverse engineer and 'decipher' the approaches the USACE utilized for creating and using this data. Hereafter this will be called 'Inventory' which contains detailed characteristics of the building structures in the Papillion Creek Basin Study Area (the 500-year floodplain), their estimated annual damage estimates associated with those structures, and content damage likely to occur in 8 hypothetical future flood events (ranging from a 2-year flood to a 500-year flood) using the very established and respected USACE HEC-FDA flood modeling framework.

The number of structures in this inventory ranges from 3,986 to 4,400 depending on which worksheet tab is being accessed since certain data (in certain worksheet tabs) are missing. In the GRR, a sample size of 4,100 structures is used to characterize the number of structures in the study area (the 500-year flood plain across the Papillion Creek Basin) but again, the Inventory obtained through the FOIA does not include complete data for all of these 4,100 properties

A conclusion of this Review is that the GRR inventory is highly flawed and currently unreliable. But it also contains other highly useful (and likely accurate) data, so it is recommended that this inventory be corrected and improved rather than abandoned. If corrected and made publicly available the inventory will be essential to the quality of many other future Papillion Creek Basin flood mitigation studies and policy making decisions in the coming decades. It contains critically important damage exposure data and in particularly annual probabilistic flood risk estimates for specific structures based on USACE HEC-FSA modelling, which public and private sector stakeholders can and should be used for use for a variety of flood mitigation planning studies and projects in the coming decades.

I also integrated the GRR inventory data with detailed building cost approach data obtained from both the Douglas and Sarpy County Assessor offices. This includes linking GRR estimated structural replacement data for the 1,071 structures that they themselves estimated. It is important to note that the USACE did not provide the data summarizing the inputs they used for these cost estimations as one typically sees with a structural inventory (data fields dealing with building features used for the cost estimates as well as specific cost replacement and depreciation data from the Private cost approach data Vendor 'RS Means'. But the majority of the key data inputs and outputs and assumptions used are missing from the GRR inventory. This includes the reporting of replacement costs on a square foot basis, and building condition and applied depreciation were missing from the data they supplied.

The GRR structural values for the all properties (the 1,071 structures they valued and the approximately 3,030 structures they did not value) for which they estimated replacement costs using indexes and Assessor improvement values were also joined to the various Douglas and Sarpy County Assessor databases, which I obtained directly from the Counties. This has led to the discovery of multiple errors associated with the GRR inventory which will be summarized in different sections of this report. Often errors are a result of county Assessor parcels containing multiple (different) structures which is a recurring and major challenge faced by many recent USACE flood mitigation studies since the USACE flood damage modeling procedures (the HEC-FDA modeling approach) requires data specific to individual structures while county Assessor data often is summarized (aggregated) over single parcels. Other GRR inventory errors appear to have occurred and are hypothesized to have been caused by inaccurate joins of unique databases by a common structural id number created by the GRR, and/or a reliance on USACE employees manually collecting and transcribing complex data from a variety of sources.

The Order of the Review and Evaluation Process of this Report

This review and evaluation begins with a summary of the economic analyses of the tentatively selected plan (TSP) that is comprised of the dry dam (DS-10 Plus) and DS-19. Of particular interest are GRR estimates of annual economic damages (EADs) for particular structures associated with 8 alternative hypothetical future flood events ranging from a 2-year event with a 50% probability of occurring every given year all the way up to a 500-year flood event with a 0.2% probability of occurring in any given year.

The GRR structural inventory database actually does not contain expected annual flood damage estimates (EADs) for each structure but instead reports AEP event damage data sometimes referred to as single event damages for each of the 8 alternatively hypothetical flood events. These values are based on structural replacement cost and structure content values and HEC-FDA modeling which highly dependent on (i.e. influence by) streamflow gauge data associated with particular stream reaches (sub-basins), expected rainfall and precipitation patterns, the ground floor elevation of particular structures, structure characteristics particular whether a structure has basement and its number of stories, and staged damage curves estimating the amount of damage to structures under alternative flooding events.

I converted structure specific AEP values to annual damage estimates by multiplying AEP values for each of the 8 flood events by the probability of each event occurring in a given year and then summing them. I have assumed that the GRR used this same approach for converting AEP to EAD values even though this was not explicitly described in the GRR. Also, it is important to note that structural damage data which was obtained from the GRR spreadsheet tab named 'Struc_Detail_Out.01Dam' only had data that could be joined to the main structural data for 3,986 structures. In other words, structural damage data was missing for 413 properties in the GRR database. The implications of this missing data is discussed in several later parts of this Review. If more information is sought regarding the GRR estimation of annual flood damage estimates, readers should refer to the GRR main document and its Appendix F (Economics).

RESULTS

Result #1: Misleading, Incorrect, and Low Benefit Cost Ratios of Structural Measures.

The six-page executive summary of the GRR and the proposed summary of the study by the Secretary of the Army, report a single benefit cost ratio (1.51) for the 3 distinct components of the TSP combined (DS-10 Plus, DS-19, and non-structural measures).

As mentioned earlier this multi-component BCR is relatively low and below the BCR's of recent federal flood control projects with the exception of project that included extensive ecosystem restoration activities (GAO, 2019).

The clear goal of the GRR is to present readers with a single BCR statistic for the TSP that obscures the fact that that the proposed structural measures have even lower BCRs than the overall project BCR (1.21 for DS-10 Plus and 1.4 for DS-19). The fact that these BCRs for individual structural components are omitted entirely from the six-page executive summary of the GRR and are not discussed or evaluated using words in the main report clearly indicates that the USACE does not want readers to be explicitly aware of how low the BCRs are for the dam building components of the TSP.

In fact, the BCR value of 1.21 of Dam Site 10 combined with levees and a floodwall is only made known to readers by reviewing a non-emphasized final column in Table 38 of the main report (page 91). The only related written discussion of this BCR is the following:

"It was determined that due to the required elevation raises without a dam, that a new levee or floodwall project on Little Papillion Creek would only be feasible in conjunction with the construction of DS10. Therefore, the water surface elevations (WSE's) provided for optimization were the unsteady flow modeling results with DS10 constructed" (page 88) And…. "The economic analysis (Table 38) determined the greatest net benefits and would be the recommended, optimal structural plan for Little Papillion Creek and its tributaries is the elevation of the 1 percent AEP energy grade line with an additional three feet" (page 89).

Similarly, the GRR authors never state in writing anywhere in the entire main report that the BCR for Dam Site 19 is 1.40. To learn this BCR value a reader needs to interpret some complicated (not clearly highlighted and/or conclusive) columns in Tables 32 and 33.

And as expected the BCR of the non-structural measures (floodproofing activities) throughout the Basin, is not mentioned in any written text, but its calculated value of 1.83 is listed in Table 45.

The closest the GRR comes to demonstrating the relative (i.e. varied) BCR of different components of the TSP is in Table 48 ("Recommended Plan with Recreation Costs"). But while the annual cost of the different plan components is listed there, their annual benefits and hence BCRs are not. The only occurrence of TSP benefits and costs (and BCRs) being reported is in Table 1 where all the TSP components are combined. Here (finally), the GRR discusses the resulting BCR on 1.51 in the text.

In summary, the GRR has gone out of its way to avoid highlighting the fact that the structural components of the TSP (DS-10 Plus and DS-19) have lower BCRs than non-structural measures and the entire TSP. This opaque reporting of the true BCR or dam building clearly indicates that the USACE does not want readers of the GRR or Congress to be aware of the relatively low economic feasibility of dam and levee/floodwall construction for flood mitigation purposes in the Papillion Creek Basin. One would expect that after spending $3 million to evaluate the feasibility of flood mitigation benefits the USACE would want to explicitly describe and promote the details (BCRs) of palatable recommended flood mitigation plans.

However, the ‘opaque’ presentation of TSP economic feasibility described above is not the only problem with BCRs in the GRR. It turns out that reported BCRs of the overall TSP and one of the structural components (DS-10 Plus) are actually lower than reported in the GRR.

The key annual benefits and costs for TSP components contained in Tables 32, 45 and 48 of the GRR are joined together (verbatim) in Table 1. Using this data, calculated BCR for different plan components are identical to most BCR values inferred from GRR tables. However, in the GRR final cost table (Table 48) the calculated BCR for the combined (total) TSP is actually 1.39 rather than 1.51 as reported in Table 49 of the GRR. This is because the GRR reports a total TSP annual benefit value of $8,213,690 (in Table 49) when this value is actually $8,057,521 based on reported GRR benefit values for individual TSP components in Tables 32, 45, and 48.

If the GRR authors were not so intent of opaquely hiding the BCR’s of individual TSP components and presented both annual costs and benefits for TSP components in a single Table (for example adding a single line of annual benefits to Table 48), they would not have made this TSP BCR reporting error.

Table 1. Verbatim Annual Cost, Benefit and BCR Data (Summarized with Reported Data from the GRR Main Report)

	Table	Cost	Table	Benefit	Benefit	BCR
South Papillion DS 19	32	1,001,046	32	966,390	(34,656)	0.97
South Papillion DS 19 - recreation	32	266,765	32	805,801	539,036	3.02
South Papillion DS 19 (monitoring)	48	729		-	(729)	
		1,268,540		1,772,191	503,651	1.40
Thomas Creek DS10 + Little Papio Levee / Floodwall	38	3,046,430	38	3,699,860	653,430	1.21
Nonstructural	48	1,481,538	F-129	2,585,470	1,103,932	1.75
Totals		5,796,508		8,057,521	2,261,013	1.39

<u>Result #2: Inflated, Inconsistent and Incorrect Damage Exposure Data.</u>

A) Inflated Damage Exposure Reporting

The GRR highlights in its executive summary (page ii) that:

"There are approximately 4,100 structures in the 0.2% annual exceedance probability (AEP) floodplain with an approximate total investment value of $4.5B and expected annual damages (EAD) of over $14M"

From this, some readers might get the impression that GRR proposed mitigation components (the TSP) costing $134 million are going to prevent $4.5 billion of flood damage but that is clearly not the case. In fact, based on the GRR HEC-FDA modeling, 25% of all these 4,100 structures would not have any flood damage even during an extremely low probability 500-year catastrophic flood event. In other words, technically these 1,025 structures should not even be in the 500-year floodplain or the GRR study area let alone highlighted by the USACE in their executive summary. Instead, the GRR should state that there are about 3,075 structures in Papillion Creek Basin facing varying levels of future flood risk.

And, from the GRR's own HEC-FDA modeling it is clear that not all of the structures and contents of these structures have much chance of being damaged during future flood events. In fact, using the GRRs own statistics, expected annual flood damages of $14.5 million are only 0.3% of all Papio 500-year floodplain investment values.

And, since the GRR is focused on a particular TSP (two dams, levees and structural components and non-structural measures) their discussion of total property at risk from flooding should focus just on the areas impacted by these proposed mitigation projects. Basin wide statistics which include areas and structures where the TSP is not going to be focused are an irrelevant distraction. It is unclear why the GRR chooses to inflate flood damage exposure risks in the Papillion Creek Basin unless its goal is to obscure the relatively low economic feasibility of the TSP.

B) Inconsistent and Incorrect EADs

There are two more serious potential problems with damage exposure data reported by the GRR:

First, estimated annual damages (EADs) which are really the most relevant flood damage exposure metric in the GRR, and are associated with structures and contents across the entire study area, are reported in the GRR executive summary to be over $14 million. But in Table F-14 (page 27 of Appendix F-Economics), non-residential and residential EADS are reported to total $16.7 million. This discrepancy might be a result of Table F-14 data including vehicle damages while the reported EAD values in the executive summary might be leaving vehicle values out. However, this discrepancy is unclear and poorly documented, and indicates that the GRR may not have an accurate handle on the key economic data they are have collected.

Second, both of the above two EAD's <u>values reported in the GRR greatly exceed EAD calculations based on the raw data contained in the GRR inventory database supplied via the</u>

FOIA request. When the EADs for structure and content in the GRR inventory data (the Microsoft Excel spreadsheet tab named 'Struc_Detail_Out.01Dam') are summed, their value only calculates to $12,588,443 which is 11% lower than EAD values reported in the executive summary and 25% lower than the EAD values reported in Table F-14 of the Appendix F (page 27).

These discrepancies between EADs reported by the GRR and the raw data actually contained in the FOIA supplied databases they used for their analyses may be influenced by two factors:

1) There is the possibility that the GRR used a different approach to calculate EAD's than how I calculated them: I multiplied expected damages associated with a particular flood event by the probability of such an event occurring in any given year and summed these across the 8 flood events evaluated by the HEC-FDA modeling.

2) The Excel data the GRR provided via the FOIA request had no damage related data (i.e. no EAD data) for 413 structures, yet this data actually exists and was reported by the GRR and was included in their EAD estimate.

But until the USACE can explain and/or correct these possible causes for discrepancies between flood damage data exposure they reported (and likely used) for their economic analyses versus the raw data provided in the Excel spreadsheet in response to the FOIA request, it must be assumed that they have overestimated (i.e. inflated) the potential annual flood damages (EADs) by between 11% and 33%. Since structure and content values are reported to be 90% of total flood damage exposure in several different sections of the GRR (in particular table F-14) this means that true flood damage exposure and related TSP benefits are inflated by between 10% and 30% which means that the overall BCRs of the TSP is actually in the range of 0.98 to 1.25 (instead of the reported/corrected BCR of 1.39). The corresponding BCRs for DS-10 Plus is in the range of 0.85 to 1.09 while the BCRs of DS-19 would be in the range of 1.04 to 1.2 (including recreation) (Table 2).

Table 2. The Effects of Incorrect (inflated) GRR EAD Data on TSP BCRs

GRR EAD Reporting	Difference from Raw EAD Data	Effect on TSP BCR	Effect of DS-10/FW/Levees BCR	Effect on DS19 BCR
$14 Million Executive Summary (Pg. ii)	$1.4 Million (11%)	1.25	1.09	1.26
$16.7 million (Appendix F Table 14, Pg. 27)	$4.2 Million (33%)	0.98	0.85	1.04

Until the USACE can confirm or correct the discrepancies between their reported estimated annual damages (EADs) and in particular why they do not correspond directly and correctly to their raw inventory data (provided by the FOIA request), it must be assumed that the already marginally low BCR's for the TSP are actually even lower than reported and in two cases are below 1.0 indicating they are economically infeasible.

<u>Result #3: WRDA Violation - Including Recently Built Floodplain Structures a NED Benefits.</u>

The GRR violates Section 308 of the Federal Water Resource Development Act of 1990, which states that new or improved structures built within the regulatory 100-year floodplain be excluded from the structures used to calculate National Economic Development (NED) benefits for flood damage reduction projects. The Act passed in 1990 states that compliance is intended for structures built after 1991 but is likely that it should be interpreted as being applicable to structures built after a community formally establishes 100-year floodplain maps through involvement with the National Flood Insurance Program (NFIP). In other words it is likely that the language of the Act using 1999 and the compliance start data only because the Act was passed in 1991. And it would be illogical to enforce such compliance before a particular communities floodplain maps have been established.

Most of the recently conducted USACE flood mitigation studies have reported compliance with the Act. Below are two examples of this compliance language:

"*According to the Water Resources Development Act of 1990 (WRDA90) Section 308, new or improved structures built within the 100-year (0.01 AEP) floodplain after July 1, 1991 should be excluded from the structures used to calculate NED benefits for flood damage reduction projects. Structures that met these criteria were removed from the structure inventory."*

"According to the Water Resources Development Act of 1990 (WRDA90) Section 308, new or improved structures built within the 100-year (0.01 ACE) floodplain after July 1, 1991 with first floor elevations lower than the 100-year flood elevation, should be excluded from the structures used to calculate NED benefits for flood damage reduction projects. To ensure this study is compliant with Section 308, the Federal Emergency Management Agency's (FEMA's) 100-year floodplain from Flood Insurance Rate Map (FIRM) data was gathered from ArcGIS online and analyzed in ArcMap 10.3.1. Of the three structures in the Westminster floodplain that were built since 2013, none are located within the FEMA 100-year floodplain. For the portion of the structure inventory that was developed prior to 2013, it was determined that the majority of the structures were constructed prior to 1990, and that any remaining structures posed trivial risk to the study's overall findings. *This factor, combined with the frequency of missing date of construction data in the tax Assessor records, was reason to make no further attempt in identifying or structures built between 1991 and 2013. (USACE, Lansing, IL 2021)*

Section 308 of the Water Resource Development Act (WRDA) 1990 limits structures built or substantially improved after July 1, 1991 in designated floodplains not elevated to the 1% AEP flood elevation from being included in the benefit base of the economic analysis.

To ensure compliance with the Act, the economist reviewed the county assessed parcel data provided by DeSoto County and relied on the year-built attribute field. For parcels inside the designated floodplain with a year built post-1991, structures were flagged for further analysis. Flagged structures were evaluated for ground surface elevation, foundation heights, and first floor elevations to determine if the structures were properly built above the base flood elevation. The study found that while not all structures flagged were built above the effective (current) base flood elevation, they were built to the base *flood elevation that was in effect at the time of construction. As a result, there are structures within the HEC-FDA model that were built post-1991 that met all local floodplain ordinances at the time of construction and were outside the floodplain for the known flood risk at the time. Some of these flagged structures currently receive flooding prior to a 1% AEP flood event, but damages are limited to less frequent events given prior effective FIRM maps being enforced by local officials (USACE 2021, Desoto County MS).*

In marked contrast the 1990 WRDA compliance used in most USACE feasibility studies – here is how the USACE Papillion Creek GRR dealt with the issue:

"It should be noted that Section 308 of the Water Resources Development Act (WRDA) of 1990 has been ***observed*** *in this analysis, and structures built since 1991 in the one percent AEP floodplain are* ***assumed to be in compliance*** *with Section 308 due to the study area's communities' participation and good standing in the National Flood Insurance Program (NFIP). Assessor's data was used to determine the age of the structure. Additionally, just over 75 percent of the structures in the study area and analysis are located in the communities of Omaha and Papillion, both of which participate in the Community Rating System (CRS), which is a voluntary incentive program that recognizes and encourages community floodplain management practices that exceed the minimum requirements of the NFIP. Both communities have a rating of 7 on a scale of 1-10 (1 being the best rating) which is better than at least 52 percent of the 1,722 participating communities (as of 1 October 2020). Only 422 of 1,722 (25 percent) participating communities have a rating better than a 7."*

(Page 15 of Appendix F-Economics with bold highlighting provided by Shultz)

So instead of actually complying with Section 308 of the 1990 WRDA by identifying and excluding such floodplain structures from NED, they just "assumed" these prohibited structures do not exist because government entities in the study area maintain good standing with the National Flood Insurance Program.

Flood Damage Exposure Generated Since the Year 2005 FEMA 100-Year Floodplain Maps

Rather than blindly accepting the USACE (GRR) 'assumption/assertion' that recent 100-year floodplain development was not a serious issue worth considering when evaluating current (GRR) floodplain mitigation plans, I used their own inventory data obtained through the FOIA request, to quantify the extent of pre- and post- 2005 flood damage exposure.

The results were completely unexpected: 45% of expected annual flood damage (EAD) in the study area (as modelled and estimated by the USACE) is associated with approximately 500 structures built in the 100 or 500 year floodplains since 2005 when the most recent FEMA 100-year floodplain maps were established in the Papillion Creek Basin. An exact classification of the amount of actual flood damage exposure specific to the 100 versus 500 year FEMA floodplain boundaries is not known because the GRR failed to report such data although they clearly have access to it. In the near future I plan to request a geographic information system (GIS) based coverage of GRR inventory structures and spatially overlay it with FEMA regulatory floodplain maps to quantify this key missing information.

This surprising result regarding the high frequency of flood damage exposure in the Papillion Creek Basin associated post 2005 development clarifies for perhaps the first time that most of the need for hundreds of millions of taxpayer dollars for flood mitigation projects being pursued in the Papillion Creek Basin is a direct result of recent building activity that has taken place after flood risk knowledge (i.e. FEMA floodplain maps) have been established.

It also directly challenges the ‘assumption’ that governments in the Basin (mostly cities) are competently dealing with sustainable floodplain management practices.

It also brings into question the merits of FEMA allowing LOMA floodplain building permit extensions when it turns out that in Douglas County 83% of these structures have been modeled by the USACE (GRR) to have flood damage risk and are actually responsible of the highest levels of flood damage exposure in the Basin.

These findings also beg the question as to why the local counterpart of the USACE GRR study, the Papio-Missouri Natural Resource District (PMNRD), has in the last 4 years been promoting their efforts to shrink of the 100-year floodplain boundaries in the Papillion Creek Basin? In recent years the PMNRD has spent almost half a million dollars of taxpayer money funding studies with the specified purpose of reducing FEMA 100-year floodplain map boundaries (Omaha World Herald OWH, 2016).

It is illogical (i.e. counterproductive) as to why the PMNRD would be promoting development in the 100-year floodplain while at the same time pursuing structural flood mitigation projects costing billions of dollars. And, the USACE itself (through the GRR) appears to be enabling this paradox of allowing and/or promoting risky floodplain development to justify costly and possibly ineffective structural mitigation measures since the GRR does not in any way or form report the true nature and causes of flood damage exposure in the Papillion Creek Basin.

The relative magnitude of post 2005 annual flood damage exposure (GRR estimated annual estimated flood damage) by building type and sub-basin location are summarized by Figure 1. Again, 45% of total damage exposure for the entire study area (the 500-year floodplain in the Papillion Creek Basin) is associated with structures built since 2005, versus 38% in Douglas County, 71% in Sarpy County, 50% in the areas downstream of DS-10 Plus, and 71% in the areas downstream of DS-19. This clearly demonstrates that the flood damage exposure used to justify the construction of both DS-10 Plus and DS-19 (as well as levees and floodwalls) has been driven by post-2005 building and development. Of particular interest is Sarpy County, which appears to have recently (since 2005) allowed very substantial development that is suspectable to flood damage risk while at the same time being actively pursuing dam projects

The estimated annual flood damage associated with different types of structures before and after post-2005 is shown below in Figure 2. From this it appears that recreation structures are generating the highest amount of post-2005 flood damage. It is important to note that there is a huge variation in the nature of recreation structures ranging from movie theatres to hockey arenas, and concession stands and bathrooms at soccer field and baseball fields. Restaurants and office structures also make up a great deal of post-2005 flood damage exposure; whereas a relatively low proportion of post 2005 damage is attributed to residential structures (either single family homes or apartment buildings). Hotels, special use structures and industrial structures represent a relatively small amount of total flood damage exposure in the Basin but a lot their damage exposure has been generated since 2005. Conversely, virtually no mobile home or service station flood damage exposure has been generated since 2005.

Figure 1. USACE Annual Estimated Flood Damage ($1000's) by Location Pre-Post 2005

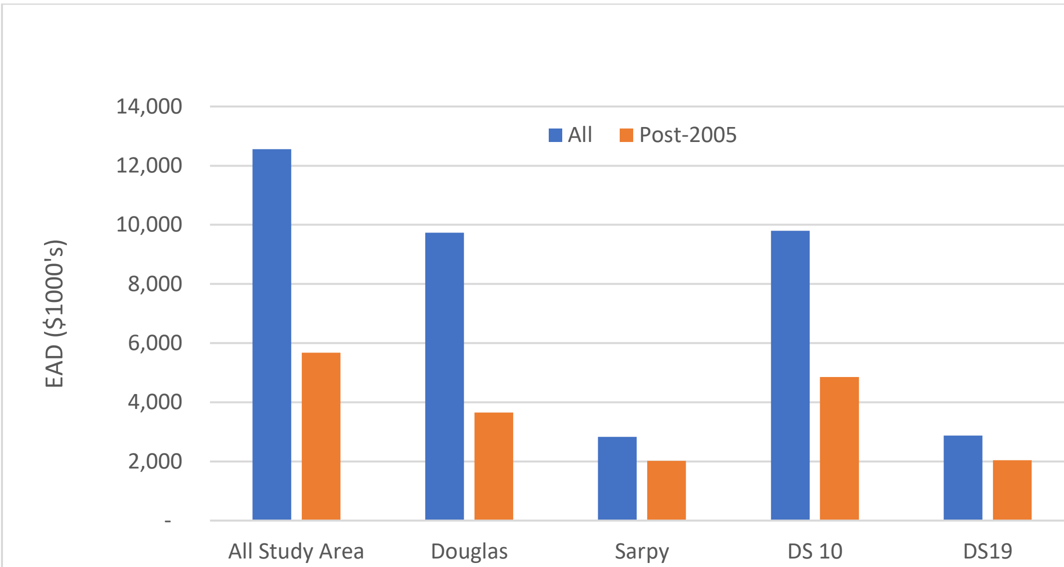
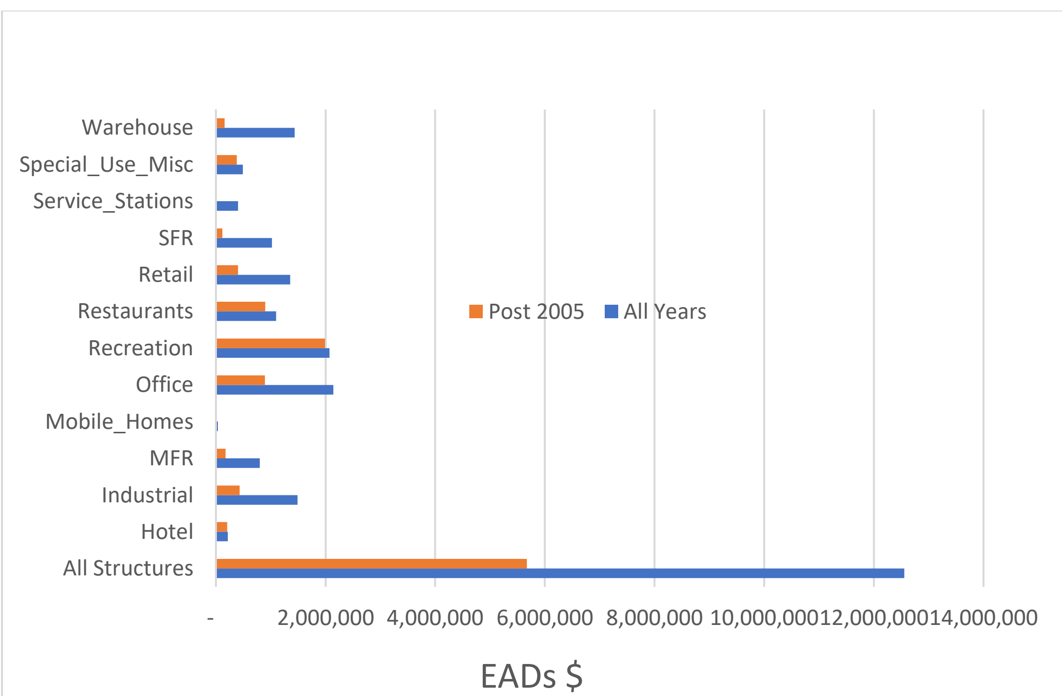


Figure 2. Estimated Annual Flood Damage by Structure Type, Before/After 2005.



Verifying the Existence of WRDA Violations by the GRR

Even though most of the flood damage exposure in the Papillion Creek Basin is associated with post-2005 development, this does not prove the GRR violated Section 308 of the 1990 WRDA. Instead it is necessary to confirm that the post-2005 structures included in the GRR inventory and used for calculating NED benefits were built in the 100-year floodplain and have not received a FEMA floodplain exemption (a LOMA). However, the fact that the GRR never explicitly states that their analyses excluded such structures even though they had full possession of the required data to make such a statement raises the suspicion that WRDA violations did occur.

To identify WRDA violations, I had to undertake a manual process using a variety of different data sources. In particular, I did not have access to a geographic information system (GIS) database coverage of GRR inventory building footprint boundaries necessary to undertake an automated classification of the floodplain status of all 4,100 GRR structures. Instead, I had to use internet based online mapping platforms to manually quantify the extent of post 2005 built GRR inventory structures that were both within the 100-year floodplain and also included with GRR flood damage exposure estimates (defined as structures with calculated EAD values).

This required cross referencing GRR structural inventory data with FEMA National Flood Hazard Layer (NFHL) Viewer data representing the regulatory floodplain status of parcels, and FEMA LOMA data from the GOHUB Heartland/MAPA GIS webpage (https://gohu.mapacog.org) indicating whether FEMA had exempted particular parcels from the regulatory floodplain. Additional FEMA LOMA data with parcel identification numbers was utilized from a database maintained by the Omaha Planning Department and provided to me by the Douglas County GIS department.

The above interactive analyses were very time intensive and therefore were only undertaken within two Papio sub-basins (LP7 and PC1) both of which were known to contain a relatively large amount of post-2005 floodplain development as well as having high damage exposure values as calculated by the GRR. The Little Papillion sub-basin '7' (LP7) which includes the recently developed Aksarben Village area as well as the adjacent University of Nebraska at Omaha Baxter Hockey Arena (which is technically in the adjacent sub-basin LP8). The sub-basin PC1 represents the confluence of the Big and West Papillion Creeks (in the City of Bellevue) just west of the Kennedy Freeway (Highway 75) along the Highway 370 corridor. This basin actually extends a little south of Highway 370 but mostly covers agricultural areas upon which I did not focus. Less detailed 100 versus 500-year floodplain analyses were conducted in PC1. Instead, the focus was to find and measure the impact of WRDA violations.

Floodplain Development in LP7 (Aksarben Village)

Based on raw GRR inventory data, LP7 (Aksarben Village area plus Baxter Arena) contains 51 structures with combined total (structure and content) values of $398 million and EADs of $1.45 million. Of these 51 structures, 30 are in the 500-year floodplain with EADs $601,625 versus 21 structures that are in the 100-year floodplain with EADs of $847,238 or 58% of all flood damage exposure in the Basin (Table 3). But this metric is a little misleading since many of the 100-year floodplain structures are assigned $0 EAD values by the GRR not necessarily because they are without flood damage risk but because the GRR did not assign annual exceedance probability (AEP) values – most likely so as to not violate Section 308 of the WRDA Act (although they never formerly stated this in the GRR). And in other cases, damage exposure values may not have been assigned to some of these structures because they are multi-storied concrete parking garages unlikely to receive any flood damage.

The clear majority (19 of 21 or 90%) of these LP7 100-year floodplain structures were built in 2005 or later and make up 9% of all EADs in the sub-basin. There were 5 structures originally in the 100-year floodplain that received FEMA (LOMA) exemptions and their combined EADs are $55,938 or 0.7% of all damage exposure in this sub-basin. That is a lot of damage for 5 structures and this finding warrants additional Basin-wide research (in all of the sub-basins) regarding the accuracy and merits of the FEMA/LOMA floodplain exemption process.

Since 2005, 40 structures have been built in the 100 and 500-year floodplain areas of Aksarben Village (19 of which are in the 100-year floodplain) and have had many positive impacts of the economic development and quality of life measures for midtown Omaha and the expansion of the South (Scott) Campus of the University of Nebraska at Omaha. However, this development (which was legally undertaken and in fact promoted using Tax Increment Financing Incentives) directly contributes 18% of total flood damage exposure used to justify the proposed DS-10 Plus flood mitigation measures. Local government agencies and elected officials in the Papillion Creek Basin may want to more closely evaluate potential flood damage exposure impacts when evaluating future development projects within 500-year floodplain boundaries in the Basin.

Violations of the WRDA in LP7 and its Impacts on the Feasibility of DS-10 Plus

There are 19 structures in the 100-year floodplain of LP7 (Aksarben Village) built since 2005 which **if** included in the calculation of NED benefits by the GRR would constitute a violation of Section 308 of the 1990 WRDA. This does not include the 5 structures originally in the 100-year floodplain but later exempted by FEMA via the LOMA process.

After reviewing raw GRR data of reported flood damage for buildings (annual exceedance probabilities or AED's), only 8 of these 19 structures were found to have GRR damage data.

They include 2 recreation structures (the Aksarben Cinema and Baxter Arena), 2 office/retail mix structures, and 3 multi-family residential structures of which only some of the units are in the 100-year floodplain. There is an additional structure, the HDR Headquarters office building which is also potentially a violation of the WRDA as it is in the 100-year floodplain but no damage data was reported for it (i.e. all damage data was missing; a problem also noted for 412 other structures in the GRR database, which is an issue discussed in a later section of this Report).

These 8 structures have total (structure and content) values of $147 million and EADs of $714,674 which represents 7.3% of all EADs associated with DS-10 Plus (Table 3). Over the 50 years (the TSP analysis) this damage has present value of $20.3 million.

Table 3. Floodplain Development and Flood Damage Exposure in LP7 (Aksarben Village) *

	#	Total Value (millions)**	Estimated Annual Damage	% of All Estimated Annual Damage
Sub-Basin Wide Data				
All Structures	51	$ 398	$ 1,448,000	
In the 100-Year FP	21	$ 186	$ 847,000	9.0%
In the 500-Year FP	30	$ 212	$ 601,600	6.0%
FEMA (LOMA) Exempted	5	$ 13.5	$ 56,000	0.6%
Post-2005	40	$ 337	$ 1,100,000	18.0%
Post-2005 & 100-Year FP	19	$ 17	$ 831,000	9.0%
WRDA Related Data				
100-Year FP, Post-2005	19	$ 178	$ 835,000	9.0%
Excluded from the GRR	11	$ 31.4	$ 120,000	1.2%
Included in the GRR	8	$147	$715,000	7.3%

**Based on raw GRR data if and when Annual Exceedance Probability (expected damage) data was reported by the GRR*

*** Structure and Content Values Combined (as reported by the GRR)*

The inclusion of these 8 structures (built in the 100-year floodplain since 2005) in the calculation of NED benefits by the GRR is clear violation of Section 308 of the WRDA. The implications of these WRDA violations on the BCR ratios of the DS-10 Plus TSP component is discussed in a later section after a review of potential WRDA violations in the PC1 sub-basin in Bellevue.

An Evaluation of WRDA Violations in PC1 (Bellevue)

A similar (but less in-depth) analysis was conducted sub-basin PC1 representing the confluence of the Big and West Papillion Creeks (in the City of Bellevue) just west of the Kennedy Freeway (Highway 75) along the Highway 370 corridor. This basin actually extends a little south of Highway 370, but in that area most of the structures are single-family residential and/or rural residential or agricultural and were not evaluated; both because the structures were relatively less valuable and/or because for the most part not a lot of structures in the 100-year floodplain were noted via a quick review of FEMA floodplain maps overlaid with these structures.

This analysis was not as in-depth, and in particular 500 versus 100-year floodplain analyses were not conducted. Instead it was verified if a random selection of GRR structures in the sub-basin with and without EAD values were in/out of the 100-year floodplain and/or were FEMA (LOMA) exempted. From this, 4 structures were identified as WRDA violations (in the 100-year floodplain and built after 2004). Two were hotels and two were office/retail buildings. Their combined total (content and structure) values are $7.1 million and their EADs are $118,052 or $3.5 million over the full 50 years of the TSP analysis.

The Impact of WRDA Violations on the Feasibility of TSP Structural Measures

A) DS-10 Plus

The proposed DS-10 Plus of the TSP is upstream of (i.e. impacted) both the LP7 and PC1 sub-basins. Therefore, to calculate the impact of WRDA violations (including post-2005 100-year structure damage values in NED benefits) on the BCR of this component, it is necessary to add inflated EAD values from each of the two sub-basins - $714,674 for LP7 and $118,052 for PC1 for a combined inflated EAD value of $832,726 (Table 4)). This corresponds to 8.5% of all EADs for DS-10 Plus (Table 4) and represents a present value over a 50-year project of $23.6 million.

Since the GRR reports (Table F-63, page 64 of Appendix F-Economics) that only 93% of DS-10 Floodwall/Levee damage exposure is associated with structures and content the actual level of overall GRR flood damage exposure benefits are only 7.9%. This means that the original reported BCR for DS-10 Plus of 1.21 should actually be 1.11 and if EAD benefits are proven to be inflated by between 11% and 33% (as hypothesized in Section 2 of this Study Report) then the DS-10 Plus BCRs should be in the 0.78 to 1 range (from infeasibility to a break-even point).

B) DS-19

The 4 structures violating the WRSA in PC1 with EADs of $118,000 represents 4.8% of all EADs associated with DS-19, or 4.% after adjusting for the content/structure contribution to total flood damage exposure. This means that the originally reported BCR for DS-19 of 1.40 should be reduced to 1.34 and if overall GRR EADs are actually inflated by between 11% and 33%, the BCRs for DS-19 are in the 0.99 to 1.20 range.

There are two important caveats to these conclusions regarding the GRR apparently violating Section 308 of the 1990 WRDA and inflating BCRs on both DS-10 Plus and DS-19.

First, it is assumed that both the regulatory floodplain maps and the publicly available FEMA LOMA data correctly represents the 100-year floodplain status of these structures.

Second, I have assumed the GRR included the flood damage exposure (EADs of these structures in their NED benefit calculations) since the EAD data is reported for them (in contrast to 10 other post-2005 structures in the 100-year floodplain with $0 EAD values), and because the GRR makes no mention of excluding any of these structures from their NED analyses.

But at the same time, it is also possible that additional WRDA violations exist in the GRR analyses. I only focused on two sub-basins for this current review albeit in areas where significant floodplain development has occurred in recent years. Going forward the GRR should formerly quantify possible WRDA violations as related to their calculation of NED benefits across the entire Papillion Creek Basin study area by performing GIS spatial overlays of all structure footprints with FEMA regulatory floodplain maps and LOMA exceptions.

Table 4. The Impact of WRDA Violation on the BCR Ratios of DS-10 Plus and DS-19.

	Inflated EADs	Original BCRs	Revised BCRs
Inflated EADS with DS-10 Plus			
LP7	$714,674		
PCI	$118,052		
Combined	$832,908		
Combined as % of Total EADS for DS-10 Plus ($9,801,908)	8.5%		
After Adjusting for Content and Structure Values (93%)	7.9%		
BCRS DS-10 Plus			
Original		1.21	1.11
With 11% Inflated EADs		1.09	1.00
With 33% Inflated EADs		0.85	0.78
Inflated EADS with DS-19 including Recreation			
Inflated EADs PC1	$118,052		
Inflated EADs as a % of Total Eads for DS-19 ($2.46 million)	4.8%		
After Adjusting for Content and Structure Values (93%)	4.37%		
BCRS DS-19 including Recreation			
Original		1.40	1.34
With 11% Inflated EADs		1.26	1.20
With 33% Inflated EADs		1.04	0.99

Result #4: A Highly Problematic GRR Structural Inventory.

A USACE structural inventory is a database describing the physical characteristics of structures at risk of flooding as well as their depreciated structural replacement costs and directly related content values. They are used to estimate the largest component of flood damage exposure in most flood mitigation study areas (structure and content damage) and are crucial for calculating accurate national economic development (NED) benefits feasibility measures.

Below is brief summary of how the USACE typically creates and uses structural inventories for flood mitigation feasibility studies which is then followed by a summary a recent alternative to traditional USACE inventories (the USACE National Structural Inventory or NRI) and the summary of two specific case study examples of recent USACE inventories: 1) The Fargo/Moorhead Diversion Inventory (2009) and 2) the Desoto, Memphis MS Inventory (2021). This is followed by a discussion of the strategies used by the Douglas and Sarpy County Assessors to estimated improvement and DSRVs which is highly relevant since the GRR relied on this data.

Following the background introductory material is a summary of how the GRR undertook and used its structural inventory. Then, its many problems and mistakes are evaluated followed by specific recommendations for correcting/improving the inventory.

A) An Overview of USACE Structural Inventories

A structural inventory for USACE flood feasibility studies can be loosely defined as a database describing the physical characteristics of structures at risk of flooding as well as their depreciated structural replacement costs and directly related content values. They are used to estimate the largest component of flood damage exposure in most flood mitigation study areas (generally 50-year floodplain boundaries) and are therefore crucial for calculating national economic development (NED) benefits and related economic feasibility measures (i.e. benefit cost ratios) .

For example, with the case of the example the Papio GRR, it is reported that 91% of the flood damage exposure data across the entire is associated with building structures and their contents (Table F-64, page 63 of Appendix F-Economics). An exception to the dominance of structure and content damage exposure might occur with a flood mitigation study focused on primarily agricultural areas with high valued crops and relatively few buildings.

Unlike many aspects of USACE flood mitigation feasibility studies, explicit guidance on how to conduct structural inventories (except that depreciated structural replacement values are the key damage exposure metric) does not exist yet several of white papers most often written by USACE contractors and/or employees of the USACE Institute of Water Resources often contain guidance and suggestions (see FEMA/URS 2012, URS 2009, URS 2011, URS 2012, Shultz, 2015a and Shultz 2015b).

Structural inventory database collection tasks have historically been contracted out to private sector companies particularly URS and Tetra Tech , but in recent years (post 2010) it seems that inventories are more often created directly by USACE employees (usually economists).

Regardless of who does them, inventories usually begin with the creation of a baseline database directly linked to County Assessor parcel databases (often called CAMA systems) which are then geo-spatially intersected with FEMA 500-year floodplain boundaries to identify the inventory ‘population’ or ‘study area’. Single family residential (SFR) and commercial structures are then usually separated and key structural building characteristics, location identifiers, and assessed improved (building) values are then used to create a baseline database of structure exposure.

Structural inventories are also relied on for key information about structures necessary for HEC-FDA flood damage modelling including structure: age, building material and foundation types, the existence and types of basements, numbers or stories, and perhaps most importantly first flood elevation at which flood damage is expected to start. If and when this critical information is not included in Assessor databases they need to be collected by manual surveys of structures.

The key structural damage estimate that needs to be generated by an inventory is the depreciated structural replacement value (DSRV) of the structure. That is the cost to rebuild it if damaged while accounting for the structures' current condition (i.e. depreciation). DSRV calculations are based on the 'cost approach' appraisal technique. This requires calculating the reproduction cost, or more commonly the replacement cost new, of a structure before subtracting depreciation (either physical or economic), and then adding the resulting DSRV to the value of the lot/land plus additional improvements. Replacement costs can be estimated through a variety of approaches ranging from highly generalized dollar-per-square-foot estimates to unit-in-place calculations in which specific structural characteristics and their current condition are accounted for. In both appraisal and tax assessment practice, the cost approach is often limited to special-use properties that do not have comparable sales and/or do not generate rental income, and to newer single-family residential construction, which is relatively easy to depreciate

In recent years, the cost approach has been refined and promoted by the three major vendors of cost replacement data: Marshal and Swift (now owned by Core-Logic), RS Means, and X-Estimate, all of which now offer online cost approach valuation services. These firms base their cost estimates on periodic regional surveys of home builders and material suppliers, or insurance companies. Marshal and Swift cost data are embedded within many Assessor computer-assisted mass appraisal (CAMA) systems and are also the most common data used by appraisers valuing single-family residential housing.

In contrast, RS means has traditionally enjoyed a dominant market share among the nonresidential construction industry, while X-estimate is heavily utilized by the property insurance industry. The USACE has historically used both RS means and Marshall and Swift for their structural inventories but after recent litigation associated with the use of Marshall and Swift (settled out of court), they have in recent years relied more heavily on RS means.

Historically, depreciation has proven to be a major challenge to the accuracy of DSRV estimates. The simplest and most common approach to calculating depreciation is to divide a building's effective age (chronological age adjusted for upgrades and improvements) by its expected typical life. But calculating effective age for buildings without detailed interior inspections is highly problematic. In 2012, Marshall and Swift undertook a major effort to refine depreciation estimates based on its internal (and not fully disclosed) research on depreciation observed in the marketplace and the assumption that many structures follow nonlinear depreciation life cycles. These nonlinear depreciation rates have also been demonstrated to be estimated with improved accuracy through multiple regression modelling (Shultz, 2018). It is much more difficult to depreciate commercial buildings using modelling or formulas meaning that they should be site visited and given quality/condition rankings for depreciation estimates.

The National Structural Inventory (NSI) which is an attempt to estimate DSRVS nationally, assumes that the depreciation rate of all structures is 1% per year of structure age up to year 20 when it depreciation remains constant at 20% for structures remaining life.

B) How a typical USACE Feasibility Study Creates and Uses a Structural Inventory

When USACE feasibility studies have access to County Assessor databases that actually estimate depreciated structural replacement values for individual structures they will usually use those as the basis of the structural inventory. But this is rare and is most commonly seen in several studies in the Houston Area of Texas post Harvey.

More commonly, a USACE structural inventory will manually estimate the depreciated structural replacement value of a sample of single-family residential structures and then derive an index of these cost approach values to the County Assessor reported 'improvement' values which in most cases (i.e. in most parts of the country, are primarily based on the comparable sales valuation).

This tends to work fairly well because SFR structures do not have as much variation in building costs and rates of depreciation as other property types do. However, it has been concluded in a USACE-Whitepaper evaluating inventory values in three midwestern locations (Shultz, 2015a) that this indexing approach could be improved either by estimating and using indexes for sub-sets of SFR properties (for example by housing values or age and/or by increasing the sample size of indexes for some types of properties; particularly for older and more valuable properties). And it was also shown that an even more accurate and easier approach would be to or better yet by use simple multiple regression models in lieu of simple ratios where the depreciated structural replacement value of structures is regressed against structure characteristics that are widely available in most Assessor and inventory databases (Shultz, 2017a).

However, it is very rare (I am not aware of any cases) for USACE feasibility studies to apply sampling indexes to non-residential (i.e., commercial) properties since their characteristics and replacement cost values are highly building specific. This can be seen in Table 5 which summarizes the variation in key structural characteristics values in the Fargo/Moorhead 500-year floodplain area (2009 data from the USACE structural inventory). From this one can see that the variation in commercial building characteristics is extremely high indicated by outrageously high standard deviations indicating that the use of mean statistics to characterize these properties in meaningless. This table is also useful to understand the key structural building variables contained in typical USACE structural inventory databases. As will be discussed later most of these key variables are missing from the Papio GRR structural inventory data provided via the FOIA request.

This explains the high variance in ratios of depreciated structural replacement values and improvement (assessment) values in the Fargo/Moorhead USACE Study area (Table 7). There is too much variation in the ratios even within individual property types for mean ratios to generate accurate results. In particular the standard deviations of the ratios compared to their means are hugely different. In other word the use of simple mean ratios of replacement costs to improvement values does not work – it generates unreliable results. That is why almost all USACE inventories avoid this approach (including in Fargo/Moorhead where the USACE surveyed and valued themselves almost 100% of the commercial structures in the inventory). In fact I can find no recent USACE inventories that used sampled ratios to value commercial structures – except that is for the Papio GRR study that used single ratio for all commercial properties – although they did create a separate index for Douglas and Sarpy Counties.

Table 5. The Variability of Commercial Structural Characteristics in the Fargo/Moorhead (ND/MN) USACE Study Area (2009)*

	Mean	Std. Dev.
Full Property Value ($)	794,710	1,651,971
Replacement Cost New ($)	15,868	31,007
DSRV ($)	147	2,106
Additional Improvements ($)	45	39
Total Sq. Feet	22	74
RCN per Sq. Ft ($/SFT)	3.0	0.2
DSRV per Sq. Ft ($/SFT)	3.0	0.3
Stories	1.2	1.1
Age (years)	3%	16%
Quality (M&S, 10-60)	10%	30%
Condition (M&S, 10-50)	6%	23%
Depreciation (phys. & func.)	61%	49%

Table 6 Ratios of Commercial DSRVs to Assessed (Improved Values) by Property Type and in the Fargo/Moorhead (ND/MN) USACE Study Area (2009)*

Property Type	Mean	Median	Std. Deviation
Retail	2.7	1.5	7.1
Office	4.6	2.3	4.6
Multi-Family	4.9	2.4	14.6
Warehouse/Storage	2.7	2.4	2.2
Industrial	11.7	3.2	31
Special Use	3.49	1.81	12

C) A Recent Alternative: The USACE National Structure Inventory

In recent years the USACE in close collaboration with FEMA has been developing the National Structural Inventory (NSI) which is basically a structural inventory containing depreciated structural replacement values (point structure specific) for the entire Country. A full description of the project and data can be found at: https://www.hec.usace.army.mil/confluence/nsidocs/nsi-technical-documentation-50495938.html

The creation of the NSI is major effort by some of the most experienced and talented USACE employees (engineers, GIS specialists and economists) who have access to the fullest possible array of USACE and FEMA data and have partnered with and/or purchased a wide array of key year 2019 building cost data from RS means and other data from different commercial vendors). Their methodological approaches to creating depreciated replacement cost data is clear and appears logical and it is highly likely that the NSI team has been conducting internal tests of the accuracy of the NSI data - although these have not been publicly released yet. The most recent NSI data is called NSI 2.0 and is available only for use by Federal employees due to proprietary data agreements with several of their data suppliers. A less detailed (block level of analysis) NSI product named NSI 1.0 is available for the public to download and use but it has key data omitted is not at sufficiently detailed level of geographic specific (i.e. parcels) for it to be useful for comparing NSI DSRVS data to other data sources in order to evaluate its accuracy.

While NSI 2.0 may not have been available to the Papio GRR at the time the study began. It was definitely available to them throughout 3 year the course of the study and in fact other USACE feasibility studies occurring during this same 3-year period (2019-2022) have relied on the NSI for key data. An example of this will be discussed in the next section.

D) A Summary of Two Recent USACE Structural Inventories for Comparative Purposes

Before evaluating the details of the Papio GRR Structural Inventory, a summary of two other recent USACE inventories is presented below to provide readers with a sense of traditional and evolving USACE inventory approaches. The studies are associated The Fargo/Moorhead Diversion Feasibility Study (2009) and the Memphis-Desoto County USACE flood feasibility study (2021)

The Fargo/Moorhead Diversion Inventory:

In 2011, the USACE (St. Paul District) completed a feasibility study to evaluate a diversion-based flood mitigation project in Fargo, ND and Moorhead, MN, which border each other across the Red River of the North. The diversion project is hereafter referred to as the F/M Diversion Project.

As part of the feasibility study, URS Group Inc. (URS) conducted a structural inventory of most of the community that included estimating the depreciated structural replacement values of both SFR and commercial structures and damage surveys of commercial structures (URS, 2009). This is a very standard/typical USACE inventory in locations when Assessors do not collect accurate cost approach data and before the USACE NSI existed. The cost of the structural inventory, which included inventories of 3,200 SFR structures and 7,200 commercial structures, was approximately $200,000. The inventory included the following tasks:

1. Through site reconnaissance, collect structure details for all non-SFR structures and a random sample of SFR structures within the study area (the 500-year floodplain on both sides of the river).

2. Estimate the depreciated structure value for each structure inventoried in the field using Marshall and Swift (M&S) estimating software.

3. Calculate an adjustment factor based on the difference between the tax assessment value (for buildings) and M&S depreciated structural value for the SFR structure inventories. Mostly all the commercial structures were valued but not 100% of them because identical structures on the same parcels were not necessary to value.

The field database was constructed using a parcel-level tax assessment database for the City of Fargo, Clay County, and Cass County. Inventories were conducted on individual building structures even though many parcels in the study area contained multiple buildings. This was accomplished through the use of a building footprint database. During site visits, survey teams confirmed data contained in the Assessor database and collected additional exterior-based building characteristics (associated with foundations, exterior walls, roofs, first floor elevation, construction quality and current condition). Structure sizes were also confirmed through the use of aerial photographs. Finally, depreciation was estimated by dividing effective age by the expected typical life of structures. Effective age was estimated by a combination of factors including: house style, quality, appearance, and improvements noticeable from the exterior. Estimates also relied on Assessor estimates for basement and finished basement square footage.

M&S 3-digit occupancy codes were assigned to each structure and the M&S SFR and commercial estimator programs were used to calculate depreciated structural replacement values (DSRVs) based on effective age, quality, condition and structural parameters. Heating, cooling, plumbing and other interior structural characteristics were not included in the estimates. M&S

SFR value estimates were based on fourth quarter, 2008 data while non-SFR estimates were based on first quarter, 2009 data. The sampling rates for different property types are shown in a later section when comparing the GRR inventory to this and another inventory.

The Memphis-Desoto County Inventory:

The Memphis Metropolitan Stormwater-North DeSoto Feasibility Study completed in 2021 by the Mississippi Valley Division of the USACE evaluated 21 different structural and non-structural flood management measures relied on new National Structure Inventory (NSI). No County Assessor data was relied on for the inventory (USACE, 2021A)

The NSI was used for baseline structural data but alternative depth damage relationships were used for particular structures (using 'professional judgement') and many of the cost approach estimates for structures were done manually using RS means data specific to 21 different structure types and depreciation schedules combined with field survey of structure conditions. In the end a total 5,586 structures were valued manually (80% SFR and 20% commercial). No sampling was used and no indexes of calculated values to assessment values were used.

The description of the structural inventory is very detailed (8 pages) and contains clearly described assumptions, data sources, and mathematical formulas used for the inventory. Its unknown how much this hybrid inventory cost to complete. It is unfortunate the hybrid approach compare structural inventory values was not directly compared to an inventory based solely on NSI 2.0 data in order to justify the need for the hybrid approach.

E) Background: County Assessor Data and USACE Inventories

The majority of USACE feasibility studies rely on County Assessor databases for baseline inventory data and in some cases they also use Assessor estimates of either depreciated structural replacement values (a relatively rare occurrence) and/or improvement values (buildings and other improvements) that are derived from a variety of approaches. Assessor data only tends to be ignored as the main source for USACE studies in parts of the country with relatively poor assessment data available for public review.

The majority of County Assessors around the country do NOT rely on the cost approach (depreciated structural replacement values) for all or even most of their properties (Shultz 2017b and Shultz 2018). But there are some exceptions to this particularly in areas with relatively new building developments making the cost approach and in particular estimating depreciation much more straightforward, and in States (such as Texas) with non-disclosure laws where Assessors do not have access to property transaction data (used for the ubiquitous comparable sales approach). It so happens that Sarpy County NE Assessors office is such a rare case - where the cost approach has been relied on heavily for all property types for the last 20 years.

It is more common for County Assessors to only rely or partially rely on the cost approach for valuing single family properties and/or special use properties which do not have many comparable sales and/or do not have income generating history (like with apartment buildings and office and retail buildings where the income approach is often used for valuation). This is shown in Table 7: a summary of Assessor valuation approaches used for different property types based on a 2010 survey of the International Association of Assessment Officers.

Table 7. Assessors Rankings of Valuation Approaches (IAAO, 2010)

	Cost Approach	Sales Comparison Approach	Income Approach
SFR	2	1	3
Multi-family	3	1,2	1,2
Commercial	3	2	1
Industrial	1,2	3	1,2
Non-agricultural land	---	1	2
Agricultural	---	2	1
Special-purpose*	1	2,3	2,3

**Includes institutional, governmental, and recreation properties*

Valuation Approaches Used by the Douglas and Sarpy County Assessor Offices

Despite relying heavily on the Douglas and Sarpy County Assessors databases for improved value data, the Papio GRR completely avoids explaining how each of these two independent Assessors office value their structures (differently). Since this is so important in understanding the strengths and weaknesses of the GRR Inventory, these details are explained here:

Both Assessors office collect similar physical characteristic data for structures at the parcel level of analysis which is managed in their Computer Automated Mass Appraisal (CAMA systems). But the Sarpy County Assessor seems to have slightly more data particularly with respect to building improvements and structure condition than the Douglas County Assessor has.

Both offices also report three types of values in their property tax record databases available online and distributed digitally when requested: Total assessed value which is made up of improvement value plus land (lot) value. Improvement values themselves are depreciated structural replacement values (DSRVs) plus other improvements on the parcel meaning that improvement values may differ from DSRVs. This means that by assuming that reported improvement values by each Assessor are actual DSRVs then DSRVs are actually inflated or over-estimated.

The Sarpy County Assessor has for the last 20 years or more relied heavily on the cost replacement approach to assess all classes of properties but particularly for SFR and special use properties, whereas the income approach is relied on more for office, large retail, and multi-family properties. Marshall and Swift cost estimation software is included in the county's CAMA system to generate structural replacement costs based on relatively detailed structural characteristics and condition data collected by the Assessor's office. Depreciation rates are calculated using a market extraction approach where sale prices of properties with varying conditions and improvements are compared. Finally, in theory, Sarpy County utilizes a hybrid approach to assessment since economic depreciation values are used to decrease cost approach assessments for SFR properties so that they are closely in line with recent market sales. This means that economic depreciation rates can be interpreted as the differential between DSRVs and market values. For example, an average economic depreciation rate of 8% in a particular neighborhood would indicate that DSRVs are on average 8% higher than average market values based on sales. Finally, the income approach-based assessments are calculated for all commercial properties and can therefore be compared to DSRVs for the same properties.

The Douglas County Assessor, like most assessment districts in the country, has historically relied on the comparable sales approach for single family residential properties, the income approach for income producing properties, and the cost approach for special use properties. However since 2016 they have begun applying the cost approach for all property types to both evaluate and improve their other valuation approaches and also because more accurate cost approach data information has been provided to them (and many other Assessors around the country) in recent years by their CAMA (tax database) vendors. However since the cost approach is a relatively new activity area for Douglas County it has been applied most rigorously (and most accurately) for single family residential and multi-use properties (personal Communication, Brian Grimm, Chief Field Deputy Douglas County Assessor, November, 2021)

F) Problems with the GRR Structural Inventory:

<u>Background:</u>

The dual objectives of the GRR structural inventory were to obtain structural characteristic data for all the structures in the study area (the Papio 500-yer floodplain) which is needed for HEC-FDA modelling of potential (i.e. probabilistic) future flood damage to structures and to use this same structural characteristic data to estimate Depreciated Structural Replacement Values (DSRVs) for structures (i.e. the cost to rebuild them). DSRVs are subsequently used with HEC-FDA modelling to estimate annual damage exposure for structures (which on average is 0.3% of DSRVs.) These DSRVs make up 93% of all flood damage exposure in the Basin which necessitates the need for a highly accurate structural inventory.

The GRR surveyed and manually estimated DSRV values of 26% of all structures in the study area (Table 8) using County Assessor data and the RS Means cost approach data. They then then calculated 4 indexes which were used to estimate DSRVs for the 84% of non-sampled properties.

Indexes were calculated by dividing GRR DSRV estimates by corresponding Douglas and Sarpy County improvement values for single family residential (SFR) and commercial structures (including apartments). The resulting SFR indexes 1.172 (Douglas) and 0.996 (Sarpy) and corresponding commercial indexes (1.045 and 1.055) were then applied to the assessor improvement values of non-sampled structures to estimate their DSRVs (Table 9).

Table 8. Structure Sample Summary: GRR Study Area

	Total Structures	Structures Sampled	% of Total Structures
Douglas County Residential	1,689	353	21%
Douglas County Nonresidential	1,512	307	20%
Douglas County Total	**3,470**	**660**	**21%**
Sarpy County Residential	622	239	38%
Sarpy County Nonresidential	308	172	56%
Sarpy County Total	**931**	**411**	**44%**
Study Area Total	**4,131**	**1,071**	**26%**

Table 9. GRR DSRV to Assessor Value Indexes Used by the GRR

County	Structure Type	Index Value
Douglas County	Single-Family Residential	1.172
	Nonresidential and Apartments	1.045
Sarpy County	Single-Family Residential	0.996
	Nonresidential and Apartments	1.055

Problems Discovered

The GRR structural inventory is unconventional (compared to other recent USACE structural inventories including the two summarized in a prior section of this Review) and it contains very serious problems and errors with respect to documentation, data, approaches, and final results. This in turn affects the reliability of GRR feasibility measures since 93% of flood damage exposure in the Study Area is related to structural damage data quantified by the inventory.

The 7 inter-related problems identified are listed below. This is followed by set of recommendations on how to correct the GRR structural inventory. It is believed that it can be corrected, and that correction is essential to ensure the integrity of the $3 million GRR study and the evaluation of hundreds of millions of dollars in flood mitigation projects being evaluated in the Papillion Creek Basin.

The 7 Inter-related Problems with the GRR Structural Inventory

1*)* Poorly documented data sources, approaches, intermediary results.

2) A Pronounced Ignorance of Douglas and Sarpy County Assessor Valuation Approaches.

3) Not Utilizing Existing DSRV Data and Assuming GRR Estimates are Superior.

4) Invalid and Inaccurate Valuation/Indexing Estimation Approaches Used by the GRR.

5) Missing or Suspect Structural Inventory Data (Inputs and Outputs).

6) Suggestions to Correct the GRR Structural Inventory.

7) What to do with a Corrected Structural Database.

1) Poorly documented data sources, approaches, intermediary results

The entire description of the structural inventory process undertaken by the GRR is described in less than two pages (main report and economic index combined) despite that fact that it deals with the primary economic benefit (avoid damage to structures and content) of a $3 million feasibility study and $130 million proposed flood mitigation project. In comparison, the structural inventory description in the USACE Fargo/Moorhead Diversion Project (2011) is over 20 pages and the corresponding write-up for the 2021 USACE Memphis (North Desoto County) Feasibility study described their structural inventory using 8 pages of text, even though they relied on an existing USACE structural inventory database (the National Structure Inventory or NSI 2.0) which has its own technical descriptions.

And what documentation the Study provided is poorly and/or incorrectly described and in most cases without clear and specific references making it basically impossible to understand inventory procedures used for the GRR. This again is in stark contrast to the two, case study USACE inventories mentioned above and described in an earlier section. The methodological details for Desoto inventory is particularly detailed and well written. They describe how key data fields are prepared for RS Means software for valuing different types of buildings and the related assumptions used. They discuss how structure condition was rated and used to calculate depreciation. When the GRR leaves out such critical information about their inventory they make it impossible for anybody (either within or outside the USACE) to scientifically replicated their calculations. That is unacceptable considering the financial implications of this project and is likely a violation of the Federal Data Quality Act intended to ensure that Federal Agencies disseminate accurate information (to ensure the quality, utility, objectivity, and integrity of utilized data). This issue is discussed in more detail in a later section of this Review.

The same GRR reports very few useful intermediate inventory results. For example, they do not report basic descriptive statistics (means and standard deviation) of the DSRVs either overall or by different structure types. This makes it impossible to evaluate the relative accuracy and usefulness of these estimates by reviewing their statistical distributions and comparisons with to similar date generated by other USACE studies, or more importantly, similar data collected by the County Assessors in the Papillion Creek Basin.

And, instead of reporting key intermediary inventory results, useful for evaluating the integrity of estimated DSRVs, the GRR provides the reader with Table 68 (Economics Appendix F) that highlights Structure Value Errors by Occupancy Type from a completely different study (the Sacramento 2015 American River Watershed General Evaluation Report), which the GRR analysts in their professional judgment (not supported by any data in the GRR report) used to justify somewhat magically to correct potentially inaccurate GRR DSRV data. Since the GRR did not analyze and report DSRV variability (i.e., reliability) metrics for their own data, one can conclude that it is most likely problematic and/or inaccurate and is not something they want readers and potential critics to be made aware of.

In summary, the GRR basically says to readers: ‘We do not describe how we actually made DSRV estimates for structures in our inventory, nor do we report any of our intermediate results that could be used to assess the accuracy of our approaches, but we do pretend to deal with the issue of possible errors in our results via poorly explained and mysterious correction factors (based on data from another study), rather than using the data from our own study to prove its reliability’.

The lack of information regarding methods and data analysis used in the structural inventory conducted for the Papio GRR is without precedent in the many USACE flood feasibility studies that I have reviewed. The GRR does correctly establish that depreciated replacement value for buildings is the correct measure to include in HEC-FDA modelling; but after that, virtually nothing of the GRR structural valuation process is properly documented or correctly implemented. There are two possible reasons for this: 1) Either the GRR employees working on the inventory did not understand the data and issues at play or 2) They wanted to make sure that readers were left in the dark regarding the possible inaccuracy of the reported DSRV estimates.

Thus, the main problem with not having accurate estimates of DSRVs, using transparent and correctly estimated procedures, is the likelihood of having bad damage exposure data in the GRR feasibility analysis that is suspect. The GRR authors should have explained their approach to structural inventory data assessment properly to ensure the integrity of the GRR study.

2) A Pronounced Ignorance of Douglas and Sarpy County Assessor Valuation Approaches
(Not recognizing that DSRV data already existed in lieu of improvement values)

The GRR directly relies on County Assessor data for their estimates of DSRV (via indexing). But the authors never explicitly define the exact components of the assessor improvement values they utilized or explain how Douglas and Sarpy County Assessors generated this data. The County Assessors do use different approaches to generated improved values for different property types.

In general, Sarpy County relies on the cost approach to calculate very reliable and accurate assessments. However, the GRR relies on Sarpy County 'improvement values' for about half of the structures in their inventory which can and often do differ from the sought after DSRVs. The GRR appears to have never obtained the structure specific cost approach DSRV database from Sarpy County. Instead, it relied on parcel aggregated data (the general data released for public requests and/or by interactively searching for on the Sarpy County Assessor's website).

With regards to Douglas County, improvement value data the GRR makes no mention of how the County estimated these values for different property types or that there existed a separate database maintained by the county with building specific DSRV estimates for all structures from (2016-2021). As mentioned earlier in this report, the Douglas County DSRV data is not as accurate as the Sarpy County DSRV data. However, the Douglas County DSRV data for specific structures appears reliable for SFR and some special use properties. The GRR should have been aware of this Douglas County DSRV data and used it where applicable.

The inability of the GRR to accurately describe the county Assessor data they utilized, indicates either the differences between improvement values and DSRVs were not fully comprehended, or that they did not intend to let the reader (and potential critics) to know the limitations of how they used county data for GRR DSRV estimates.

The GRR also completely failed to address how they dealt with parcels from each County Assessor that had multiple structures located within them. This is highly relevant since the GRR inventory requires building specific DSRVs; whereas, the data the GRR obtained and used from the Assessors only reported parcel wide structural values.

Through reverse engineering it appears the GRR utilized improvement values for parcels within only single structures and DSRVs (from online Sarpy County Assessor Property Card Record files) for parcels with multiple structures. But, it appears that for Douglas County they estimated improvement values for individual structures located on multi-structure parcels by simplistically dividing parcel reported improvements values (for all structures in the parcel) by the total square footage of all parcels to get an improvement value per square foot value ($/SFT) and then multiplied this by the size of each structure. This approach while appropriate for highly similar structures within parcels (for example storage buildings or identical MFR buildings) generates highly inaccurate results when there are building of different types, sizes and values within a single parcel. This occurs with a lot of commercial property types and is even more of an issue with properties at risk of flooding where owners often place low valued buildings (even though they may be large in size) in the 100-year floodplain portion of the property and higher valued buildings on higher ground floor elevations out of the 100-year floodplain boundary. Not accounting for this phenomenon has likely greatly inflated flood damage exposure estimates by the GRR and will be quantified in a future research project in particular, since this problem impacts the accuracy of flood mitigation studies in many other locations of the Country.

The GRR also does not mention anything about tax exempt properties for which neither County Assessor has calculated assessment values for. There were 160 such exempt structures in the study area and also quite a few additional structures (estimated around 20) that are temporarily tax exempt under tax increment financing programs, which also do not have assessment values. Additionally, only 7 of these tax-exempt structures (less than 1%) are listed as being surveyed/valued by the GRR in their raw inventory data in spite of them being assigned DSRVs by the GRR.

3) Not Utilizing Existing DSRV Data and Assuming GRR Estimates are Superior.

Closely related to the first mistake, of the GRR not understanding County Assessor Data (discussed in the prior section), is that the GRR : i) Did NOT evaluate and/or use existing DSRV data that already existed for most (65%) of structures in the study area and they did not take advantage of existing national structure inventory (NSI) and ii) the GRR assumed without justification that their own DSRV estimates were superior to County Assessor estimates, which they used to justify their use of indexing to value non-sampled/valued properties.

Each of these two inter-related GRR mistakes are discussed in greater detail below.

A) The Impacts of the GRR Not Relying on More Accurate Assessor DSRV Data

Although not documented nor explained in the GRR, I have surmised by comparing the raw structural inventory data (that the USACE supplied by a FOIA request data) against Douglas and Sarpy County data, that the GRR did not know of and/or did not use any actual structure specific DSRV data collected by the Douglas County Assessor; and in Sarpy County, only used DSRVs for multiple structure parcels. This means that they ignored existing and likely accurate DSRV data for 65% of the structures in the study area (Douglas County SFR structures and all single structure parcels in Sarpy County).

It is surprising that an USACE structural inventory would not take advantage of such DSRV estimates; and if they had doubts about the accuracy of the estimates and chose not to use them, that they would not explain within their GRR document any potential problems with the Assessor DSRV through quantitative analyses. However, this was not done with the GRR inventory. Instead, the existing County Assessor DSRV data was just ignored (never mentioned) with the implicit (but never formally stated assumption) that DSRVs are equivalent to reported improvement values. Later in this report I document that this is not the case (i.e., in most cases DSRVs are lower than improvement values in Douglas and Sarpy Counties).

The fact that the GRR collected actual DSRV data for multi-structure parcels in Sarpy County was probably a result of GRR workers using a property card search function on the Sarpy

Assessors website which provided them with DSRVs for specific structures. This means that unlike with the Douglas County multi-structure data, they had to try to calculate average structure values across parcels for Sarpy County. It is also curious as to why the GRR did not also use DSRVs instead of improvement values for single-structure parcels in Sarpy County.

Under the assumption that the Sarpy County Assessor DSRV data is more accurate than GRR estimates of DSRVs (based on sampled valuations and indexing), it is possible to quantify the extent to which the GRR inflated (or deflated) actual DSRV and content damages in the County (Table 10). For all structures in the 500-year floodplain Sarpy County Study Area the GRR inflated DSRVs estimates by $9.4 million or 5.5% by conducting their own problematic sampling/index based valuations of structures. The inflation for commercial structures was 9.3% and for SFR structures it was -1 % meaning that the GRR under-estimated SFR DSRVs.

GRR Sarpy County DSRV inflation metrics by specific structure types are summarized in the bottom part of Table 10. It appears that GRR inaccuracies in estimating commercial DSRVs is highly varied by structure type ranging from under-estimating retail DSRVs by 26% to over-estimating hotel DSRVs by 100%. Such data could be used to identify potential problems with GRR cost approach-based valuations for particular types of commercial structures the most problematic being hotels, service station, and recreation structures.

For Douglas County such direct evaluations of GRR inaccuracies estimating DSRVs could be made directly only with single family residential (SFR) structures since these (and some special use structures) are the only structure types for which reliable and consistent DSRVs are generated by the Assessor. The GRR over-estimated Douglas County SFR structures by 20% (Table 11). To determine an estimate of how much the GRR may have mis-estimated commercial structures in Douglas County the overall Sarpy County mis-estimation statistics of 9.3% is assumed. Then to estimate mis-estimates for all structures in the Study Area of the County a weighted average of SFR and Com mis-estimates is made based on the distribution of 19% SFR structures and 81% commercial structures and results in a mis-estimate calculation of 11%. That is assuming that GRR errors estimating commercial structures in Douglas County are overall the same as observed in Sarpy County, on average the GRR over-estimated the DSVRS of all Douglas County structures by 11%. This should be considered a provisional estimate. Ideally, the GRR will correct DSRV estimates for Douglas County commercial structures in a future revised structural inventory attempt.

Table 10: Sarpy County Structural DSRVs ($): GRR Versus Assessor, by Structure Types

	GRR	Assessor	Difference	GRR Over-Inflation
All	179,100,000	169,700,000	9,400,000	5.5%
SFR	62,100,000	62,700,000	(600,000)	-1%
COM	117,000,000	107,000,000	10,000,000	9.3%
COM by Type				
Hotel	14,600,000	7,270,943	7,329,057	100%
Industrial	10,000,000	8,954,239	1,045,761	12%
MFR	45,700,000	44,800,000	900,000	2%
Office	29,400,000	29,700,000	(300,000)	-1%
Recreation	46,529	30,771	15,758	50%
Restaurants	747,071	769,889	(22,818)	3%
Retail	3,271,144	4,423,457	(1,152,313)	-26%
Service Stations	1,405,136	797,406	607,730	76%
Warehouse	11,700,000	9,898,917	1,801,083	18%

Table 11: Douglas County Structural DSRVs: GRR Versus Assessor, by Structure Types

	GRR	Assessor	Difference	GRR Over-Inflation
SFR Structures (direct comparisons)	$166,000,000	$138,000,000	28,000,000	20%
Commercial Structures (Imputed from Sarpy-GRR Accuracies (Table 10)				9%
All Structures (19% SFR, 81% Commercial)				11%

Evaluating How GRR DSRVS Inaccuracies Impact BCRs of the TSP

Assuming GRR inaccuracies of DSRV estimates for the entire Sarpy County are the same as for DS-19 specific inaccuracies, the DSRVs for DS-19 are inflated by 5.5%. Assuming that 91% of flood damage exposure downstream of DS-19 is associated with structures and content, then DSRV based flood damage benefits are over-estimated by 5.5% meaning that the original BCR of DS-19 of 1.40 is actually only 1.33. For DS-10 Plus, this calculation is more complicated because structures impacted by it are in both Douglas and Sarpy County. But since 88% of DSRVs associated with DS-10 are in Douglas County, then the GRR has over-estimated DS-10 Plus by 10%. This means that the GRR reported BCRs of DS-10 (1.21) Plus and DS-19 (1.40) are inflated by inflated 12% and 7.% respectively meaning that their actual BCRs are closer to 1.08 and 1.32.

National Structure Inventory (NSI) DSRV Estimates Also Ignored

It is also surprising (and disappointing) that the GRR did not take advantage of existing DSRVs estimates for structures in the study area made by the National Structure Inventory (NSI).

While NSI 2.0 may not have been available to the Papio GRR at the time the study first began, it was available throughout the course of the 3 year study; and in fact other USACE feasibility studies occurring during this same 3-year period (2019-2022) have relied on the NSI for key data. At a minimum it would have been interesting to see how closely NSI based DSRV data differed from both GRR estimates and those of the County Assessors.

Without having access to NSI 2.0 data (as I am not a Federal Employee) I cannot quantify these differences myself and in fact I have no idea as to whether NSI DSRVs are different and by how much. If they GRR felt that the NSI data was too unreliable to use as flood damage source they should have stated that in the GRR and explained why. Otherwise, readers are left with the impression that they left the NSI data out of the GRR, because it exposed their own estimates to be inaccurate.

B) Mistaken Assumption that GRR DSRV estimates were superior to Assessor estimates

There is also the issue of why he GRR assumed that indexing (adjusting county improvement values) was necessary at all. Their approach of comparing their own estimates of DSRV to Assessor improvement values can just identify if the two sets of estimates differ. It does not identify what the true DSRVs actually are, and which estimation approach is superior. That would require statistical analyses of the standard deviations of different DSRVS (preferably by structure types), but this was not done by the GRR. Instead, the GRR just assumes that their DSRV estimates are superior to those of the County Assessors.

I disagree strongly with this assumption. For example for all structure types in Sarpy County (and SFR structures), the Sarpy County Assessor devotes much time on these valuation issues year after year and have access to much more detailed data on structure characteristics, and condition (including building permit and remodeling data) than the GRR appears to have obtained. This is like comparing the competence and experience of rookies to seasoned veterans. And, unlike the GRR, the Assessors also have checks in place to ensure the accuracy of their data: if they value structures too high they receive property owner tax protests, if the value properties to low they may be violation of State regulated assessment ratio requirements.

4) Invalid and Inaccurate Valuation/Indexing Estimation Approaches Used by the GRR.

If the GRR had utilized existing County Assessor DSRV data as described in the previous section, the need to conduct indexing to value non-sampled properties may not have been necessary (for at least 65% of the structures in the inventory).

Yet there are still other additional problems with the GRR indexing process that make the inventory results invalid despite the DSRVs not necessarily being needed in the first place: these deal with sampling issues, and lack of specificity with indices.

It turns out that the GRR relied on a very small and poorly designed sampling procedure to generate their DSRV indexes. They state they used a stratified random sample but provide no written details of how the sample was stratified.

It is widely known among the appraisers, County Assessors, and the USACE economists and contractors who regularly conduct USACE structure inventories that there is much more heterogeneity in the characteristics and DSRVs of commercial structures than with SFR structures. That is why USACE structural inventories usually sample close to 100% of commercial properties versus a small fraction of SFR properties (see previous descriptions of typical USACE inventories and the actual sampling rates for the Fargo/Moorhead and Desoto County inventories where close to all of the commercial structures were sampled).

In contrast to a full sample (a full inventory) of commercial structures, the GRR only surveyed 26% of all commercial structures in the study area and most of these (on a percentage basis) were in Sarpy County whereas only 20% of the Douglas County commercial structures in the 500-year floodplain were sampled. In contrast 25% of single-family residential (SFR) structures in the study area were sampled/valued (which is higher than what is typically seen in other USACE inventories due to the relatively lower DSRV variation amount shown within SFR structure valuation).

Making these sampling mistakes even worse is the fact that 48% of Sarpy County structures were sampled versus only 19% in Douglas County (commercial + SFR). This is very problematic considering that the Sarpy County Assessor has already accurately calculated the DSRVs for all the structures in the county, while Douglas County has only estimated them accurately for SFR and some special use properties. In hindsight, the GRR should have not sampled any Sarpy County structures and instead sampled as many commercial structures as possible in Douglas County.

In summary, the GRR way under sampled highly variable commercial structures particularly in Sarpy County where more reliable DSRV data already existed (from the Assessor) and the GRR did not need to estimate DSRVs. Where they really should have focused their sampling//valuations was in Douglas County, particularly with respect to high valued commercial structures with lots of potential flood damage.

Even if the GRR has correctly completed a stratified sampling of structures, there is the issue of the entire indexing approach not being appropriate for commercial structures. This is because simple indexing does not work for the commercial properties, as when they are broken down into different property types, they are too diverse in type, size, value, and DSRVs. This is evidenced by examples from other USACE inventory data (e.g. in North Dakota discussed by Tables 5 and 6 in section 4b). This data demonstrated there is too much variation in commercial structure characteristics across sub-structure types for DSRV indexes to work with these properties.

Interestingly, the GRR did not even use different indexes for different types of commercial structures even though they recognize that the characteristics and DSRVs of these structures vary enormously. Instead, it simplistically uses an index of 1.05 for all commercial structures. As it turns out the GRR calculated this index value by dividing the total DSRVs by total assessment values (for their sampled structures, separately in each county). This is confirmed by a review of the tab titled 'Value Index' in the raw inventory data the USACE supplied via the FOIA request.

This is not a correct way to calculate indexes. They should have calculated the index for each commercial property "type" and then evaluated the mean, median and standard deviation of the indexes. I did complete this and have summarized the results for commercial structures by type in the below Table 12 (Douglas County) and Table 13 (Sarpy County) for each county. This correct calculation approaches generated much different indexes than the 1.05 commercial index calculated and used in the GRR (for example: Douglas County commercial indexes are on average 1.39 versus 0.84 in Sarpy County).

This also demonstrates the inadequacy of using a single commercial index value for all types of commercial structures because the indexes vary dramatically across different commercial property sub-types (from 1.09 to 3.00 in Douglas County and from 0.38 to 0.95 in Sarpy County). This is a problem because HEC-FDA damage exposure modelling is structure specific, and using a single average index value across the county to quantify damage exposure for specific buildings has led to the highly inaccurate estimates within the GRR.

All of these reasons contribute to the very clear conclusion: that the GRR needs to completely redo their structural inventory.

Table 12. Index Ratios (GRR DSRV Estimates Divided by Assessor Improvement values) for GRR Sampled/Valued Commercial Structures: By Structure Type in Douglas County*

Structure Type	n	Mean	Median	Std. Deviation
Hotel	4	3.30	2.70	2.36
Industrial	36	1.09	1.05	0.18
MFR	27	1.62	1.27	1.41
Office	66	1.37	1.16	0.85
Recreation	2	1.45	1.45	0.45
Restaurants	24	1.73	1.23	1.41
Retail	49	1.19	1.08	0.32
Service_Stations	35	1.21	1.12	0.36
Special_Use_Misc.	2	3.00	3.00	0.00
Warehouse	69	1.45	1.04	1.86
Total	314	1.39	1.10	1.18

**Calculated by myself (Shultz) using raw USACE inventory data.*

Table 13. Index Ratios (GRR DSRV Estimates Divided by Assessor Improvement values) for GRR Sampled/Valued Commercial Structures: By Structure Type in Sarpy County*

Structure Type	n	Mean	Median	Std. Deviation
Hotel	2	0.38	0.38	0.15
Industrial	9	0.97	0.95	0.36
MFR	20	0.51	0.48	0.12
Office	23	0.78	0.92	0.31
Recreation	2	0.69	0.69	0.41
Restaurants	8	0.90	0.97	0.21
Retail	15	0.95	0.98	0.22
Service_Stations	12	0.73	0.78	0.32
Special_Use_Misc.	2	0.35	0.35	0.21
Warehouse	71	0.96	0.87	0.88
Total	164	0.84	0.85	0.63

**Calculated by myself (Shultz) using raw USACE inventory data.*

Discussion: Why did the GRR not spend the money and do the GRR Correctly?

It is a mystery why the GRR did not complete valuations for 100% of the 4,400 structures in the study area as was done in the Desoto, MS inventory with 5,586 structures. In the Fargo/Moorhead inventory they surveyed/valued 9,276 structure with an inventory that cost only $200,000 via a highly qualified outside consultant (albeit in year 2009 dollars). Alternatively, they could have sampled a small number of SFR structures (say 20% sample rate or 462 structures across both Counties) and then valued all (100%) of the commercial structures (n=1,820 structures), particularly those on Douglas County, which would have made the total number of structures surveyed very reasonable at 2,282. There really is no excuse that it was too expensive for the GRR to conduct a thorough survey/valuation of this few structures.

It is really confounding as to why the GRR devoted such little effort on their structural inventory (which is the backbone of flood damage estimates) particularly for a study that cost $3 million to complete and has implications for hundreds of millions of public investments for flood mitigation.

5) Missing or Suspect Structural Inventory Data (Inputs and Outputs).

A careful review of the raw GRR inventory (Microsoft Excel database the USACE provide via a FOIA request) was conducted and revealed that key structural inventory data is missing. This Excel database contained 28 different tabs with widely different content (and numbers of observations). Many of the tabs appeared to be linked together and some of the tabs (sub-databases) were clearly previously linked to other data (in other tabs) based on a common field (structure id). However, the tab names were not definitive enough to explain all aspects of the data content and there were no accompanying meta data files included to explain the nature of the data within the 28 different tabs and defining field names.

Since I have a lot of experience working with structural inventory and tax assessor databases, I was able to figure out where most of the key data was located and what it references. During this process and subsequent analyses, I discovered that there are many problems and errors with regards to key missing data (both inputs and outputs) which are listed here and then I have summarized below.

Summary List of Missing/Suspect Structural Inventory Data

A) An incomplete and a-typical inventory file and missing key input/output data.
B) Missing Damage Modelling Data for 413 Structures
C) Missing stream reach classifications for 289 Structures.
D) Incorrect Basement Classifications.
E) Suspect first floor elevation data

A) An incomplete and a-typical inventory file and missing key input/output data.

With all the other USACE structural inventories I have seen and/or reviewed there was always a single official and relatively clean/accurate database provided that clearly listed for each structure in the study its key characteristics, the data inputs and/or assumptions used for calculating replacement cost new values using RS Means, data needed to compute depreciation, and results (both replacement cost new values and DSRVs). Despite specifically asking the USACE for such single/complete structural inventory file, they only provided the mish mash 28 table MS Excel file.

What I could not find for all structures in the database was information concerning the square footage of different area/components of structures, the number of building stories, foundation types and building material, condition, and effective age. Without these key variables for all structures, it is impossible to accurately estimate DSRVs. This leads one to question how the GRR estimated DSRVs and whether anybody could ever replicate their estimations in attempt to verify accuracy and/or identify mistakes for particular structures. This means that there is no 'paper trail' (i.e., evidence) that the GRR even estimated DSRVs for all 1,071 structures they apparently valued and the remaining 3,060 structures they applied index ratios to in order to estimate DSRVs. Again, this is unprecedented, I have never encountered a USACE structural inventory document not having an authoritative and clean/accurate final database product.

B) Missing Damage Modelling Data for 413 Structures

It turns out that there are 413 structures in the GRR inventory that do not have any HEC-FDA damage assessment modelling associated with them. That is 9% of all the structures in the study area, which do not have any HEC-FDA modelling data in the inventory Excel tab named 'Struc_Detail_Out.01Dam'. At first, I suspected that maybe these structures had no potential flood damage risk, but that was not the case after reviewing several of them (including the new Headquarters of HDR in Aksarben Village, which is a high value property and is in the 100-year floodplain).

The GRR should verify why these 413 structures are missing damage data and/or if they were for some reason intentionally excluded from TSP Economic feasibility analyses. If needed they should be found and used to re-calculate (and likely increase) the relatively low TSP BCR ratios.

C) Missing stream reach classifications for 289 Structures.

There were 289 structures in the raw GRR inventory data that did not have the stream reach (sub-basin) classifications, meaning that it would be impossible to determine which particular TSP components are impacted by their flood damage exposure estimates. Some preliminary analyses of the addresses of these structures found that many (but not all of them) should be classified in the LP8 sub-basin (the Little Papillion Creek area from Center Street south to Harrison and to the Douglas/Sarpy County border). If this missing reach data meant that the damage exposure of these structures was not included in TSP feasibility measures, then the DS-10 BCR may be deflated.

D) Incorrect Basement Classifications.

The GRR classifies whether a particular structure has a basement or not using their building occupation code. But after cross listing Douglas County structure characteristic data, with the GRR inventory, it was discovered that 15% of all SFR structures in the GRR inventory actually did not have a basement even though the GRR classified them as having basements. And it was discovered that 0.7% of multi-family structures in Douglas County had their basements misclassified in the same way. This analysis was not extended to Sarpy County or other structure types. But it indicates that GRR flood damage exposure data is likely inflated because incorrectly classifying a non-basement structure as having a basement greatly increases its flood damage exposure via HEC-FDA modeling. The GRR should correct this misclassification in the future to quantify the impact of this error on TSP feasibility measures.

E) Suspect first floor elevation data.

One of the most critical inputs to the accuracy of HEC-FDA flood modelling of potential flood damage is the first-floor elevation of structures that has a direct influence on USACE stage damage curves. This is almost always based on highly accurate USACE ground level elevation estimates based on LIDAR (satellite imagery) and terrain grid data that is typically also used for HEC-FDA hydraulic modelling. Ground elevation data is typically measured in the center of parcel boundaries but is also sometimes calculated within building footprints. First floor structure elevations may differ from ground elevation when structures have been located on a part of a parcel with higher elevation, or when a structures footprint has been purposely raised either through infill or building techniques that raise first floor heights.

First floor elevation data is almost always calculated by site visits to buildings during USACE structural inventories. Typically, all (close to 100%) of commercial structures have their first floor elevations measured this way during field visits used to collect information about the actual size, occupancy use and condition of the relatively unique and highly valued commercial structures. With single family residential (SFR) structures it is sometimes the case that elevation estimates are made using samples particularly when the SFR structures are highly similar and in the same sub-divisions with similar ground elevation measurements. Occasionally, it is mentioned in USACE structural inventory reports that the in-person site visits were actually based on 'windshield' (drive-by) surveys combined with getting out of your car and walking up to building elevation measurements.

The GRR did NOT adopt any of these typical/standard USACE approaches to estimate the first floor elevation of structures within the 500-year Papillion Creek Basin floodplain area. Instead this is how the GRR describes its approach to estimated first floor elevation values for structures:

"First floor elevations were determined using Google Earth Street View for a small sample of structures for (1) single-family residential one-and two-story homes; (2) single-family residential split-level homes; (3) mobile homes; and (4) multi-family and nonresidential structures in Douglas and Sarpy Counties. The averages of the samples were applied to all structures of those types that were not sampled. Those that were sampled retained their estimate." (Page 16, Section 3.3.3 of GRR Appendix F-Economics).

This is astonishing for a variety of reasons. First, I could not find any other USACE structural inventories (even recent ones conducted as late recent as 2021) that have used this 'Google Street View' approach to determine first floor elevation in lieu of in person measurements. Nor is the approach cited by the GRR as having being used before by the USACE or anybody else. Second, the GRR only applied Street View elevation estimates to a "small sample" of structures and neither their sampling approaches nor data results are reported. Third, it appears the GRR did not complete any verification or testing of the accuracy of this novel approach to determine first floor elevations. Instead, they just applied an assumed standard deviation of error or 0.5 feet that somehow mysteriously gets applied during the HEC-FDA modelling process.

One would have thought this was such an atypical, unique and unproven approach to estimated first floor elevations that the GRR would have compared their estimates to first floor estimates based on traditional measurement approaches (i.e. in person site visits). Another alternative would have been to compare their estimated first floor elevation values with those from FEMA LOMA files (floodplain exemption documents) where first floor elevations are carefully measured and specified. If the GRR had taken this approach they could have potentially justified the novel Street View approach (if it turned out accurate) and at the same time, created actual error distribution of estimates rather than relying on assumed error distribution.

Both ground and first floor elevation data for all GRR study area structures is contained in their structural inventory dataset (provided via the FOIA request). It turns out that both ground and first floor elevation data is missing from the GRR for 326 structures. It is unclear how HEC-FDA modelling could have been conducted on these 326 structures without this key missing elevation data. For the remaining 4,073 structures with elevation data, the mean difference between first and ground floor elevation is 1.07 feet with median difference of 0.94 feet and standard deviation of 1.05 (Table 14). These elevation differences vary substantially across different structure types.

Table 14: Summary Statistics for Differences Between First and Ground Floor Elevations (estimated by the GRR Using Street View)

Structure Type	Mean	Median	Std. Deviation
Hotel	0.17	0.25	0.12
Industrial	0.22	0.25	0.19
MFR	0.27	0.25	0.51
Mobile_Homes	2.47	2.50	0.31
Office	0.24	0.25	0.28
Recreation	0.13	0.25	0.13
Restaurants	0.26	0.25	0.45
Retail	0.20	0.25	0.17
SFR	1.60	1.30	0.97
Service_Stations	0.19	0.25	0.11
Special_Use_Misc	0.23	0.25	0.63
Warehouse	0.21	0.25	0.10
Total	1.07	0.94	1.05

An evaluation of the accuracy of the GRR first floor elevation estimates is beyond the scope of this current review but I did try and replicate the GRR elevation approaches using Google Street View. It turned out to be quite challenging. First, for commercial structures especially when there were multiple structures on multi-structure parcel (and/or street addresses) it was very difficult (almost impossible) to identify the exact structure for making the estimate. Second, for about 1/3 of my elevation estimation attempts I could not get a clear unobstructed view of structure entranceway which is the location where first floor elevation estimates are usually made. Finally, I could find no reliably accurate tool in Street View to measure the distance (in feet) from what I perceived to be ground floor and first floor elevations. In other words there was not a formal measuring tool for this purpose in Street View. Finally, in the handful of structures I tried to estimate first floor elevation for, I noticed several cases of where the GRR first floor elevation estimates clearly appear to be incorrect. This includes structures whose 'Street Views' appear not to show any visible difference between ground and first floor elevation either in the form of landscape height differentials and/or entrance steps indicating an elevation difference, having GRR data showing an elevation difference of a foot or more. Conversely, I observed other structures with visibly different ground to first floor elevations with GRR elevation data indicating no differences (i.e. ground and first floor elevation data being identical).

Considering the importance of having accurate first floor elevation data for structures for ensuring the accuracy of HEC-FDA flood damage modelling, the GRR should demonstrate the accuracy of their never seen before Google Street View elevation estimation approach and/or re-do the first floor elevation estimates using conventional USACE estimation approaches.

6) Suggestions to Correct the GRR.

This review has found the GRR structural inventory to be very inaccurate from many different perspectives. It is clearly the most poorly assembled structural inventory I have ever reviewed. There is so much error and inaccuracy within the inventory that is really almost impossible to measure the impacts of these errors on TSP feasibility measures. This is because some of the errors likely deflate flood damage exposure while other inflate it. <u>Making any decisions regarding the funding of current TSP components – without first correcting this data</u> <u>an unwise and improperly justified use of taxpayer monies</u>, which would likely result in ill-conceived and infeasible flood mitigation projects for the Papillion Creek Basin.

But on a more positive note, the structural inventory does contain some important and useful data that could be used for the construction of a new structural inventory at least with respect to correcting errors and omissions identified in this review and completely redoing the parts of the inventory dealing with estimating DSRVs. For this I would recommend the following:

a) Carefully evaluate the accuracy of Sarpy County Assessor DSRV estimates (308 SFR structures and 622 commercial structures). Evaluate their statistical properties (means, medians, standard deviations) across various structure sub-types. Compare the County Assessor data with USACE estimates of DSRVs using formal statistical comparative techniques. Try and understand when and where the two data estimates may diverge and why. In cases when they do diverge, attempt to get a third-party analysis/opinion on which of the two might be right/wrong. This could include using USACE NSI data for the same data, contacting the owners of the properties for their estimates of the DSRV, evaluating insurance coverage estimates of DSRV, and/or hiring commercial appraisers to value these structures.

Unless demonstrated otherwise, I strongly hypothesize that the Sarpy County Assessor data contains the most accurate available estimates of DSRVs for all structures in the County. This means that no GRR index-based valuations are needed.

b) Carefully evaluate the accuracy of Douglas County Assessor SFR structures. Using the same approaches described above for Sarpy County structures. It is very like that Douglas County Assessor reported DSRVs are the best data available and is preferable to the improved values collected by the GRR or their related index valuations

c) Attempt to estimate Douglas County DSRVs based on Sarpy County DSRV data for specific structure and segregated property types, values, and conditions. It is very likely that cost approach relationships and data from Sarpy County can be used to accurately predict the DSRVs of many Douglas County structures.

d) Do not use a single Index Ratio for Douglas County SFR Structures. If there is a need to use indexing to value some Douglas County SFR structures, do not use a single index ratio but rather several calculated for different classes of SFR structures.

e) No indexing for Douglas County Commercial Structures. Do not use indexing for any Douglas County commercial properties. Instead, these values should be estimated manually and compared to estimates based on Sarpy County DSRVs, NSI data, and/or data from other sources.

f) Manually measure first floor elevation data using standardized USACE approaches, for all structures that are visited in person during the inventory process. This is expected to near 100% of commercial structures in the study area.

The USACE should have been able to afford to manually value these 1,512 structures considering the GRR budget was $3 million. Again, other USACE inventories do not rely on sampled indexing to estimate the DSRVs of commercial structures. They value these structures manually.

When estimating the DSRVs of these 1,512 commercial structures, report key intermediary results in tables, so readers can evaluate important trends and/or verify the accuracy of the estimates. At a minimum this should include means, medians, and standard deviations of replacement cost new values (both total and on a SFT basis), rates of depreciation, DSRVs (again both total and on a square foot basis), and these should be displayed for different structure subtypes.

g) Investigate/correct/replace key missing data and verify why so many structures in the structural inventory are potentially missing key data (e.g., damage exposure estimates, stream reach location) and/or have incorrectly classified basement information. Create a complete structural inventory database that other people can use to evaluate and/or replicate the cost valuation work.

7) What to do with a Corrected Structural Database.

Once corrected/improved, the GRR structural inventory could be used to re-estimate feasibility measures of the TSP components. This does not necessarily involve redoing all of the GRR analyses. In particular the HEC-FDA modelling estimates for each structure could be converted from dollar measure to a percentage measure and then applied to the updated DSRVs. As well, TSP costs would not have to be changed.

Result #5: The Potential Double Counting of Project Benefits.

The double counting of flood mitigation benefits when calculating NED benefits is highly discouraged in USACE flood mitigation study guidance.

Because the Papio GRR pretty much ignores the issues of double counting, it was suspected of having occurred both with regards to non-structural components (floodproofing of 386 structures in the Basin) which would impact (inflate the BCRs) of both DS-10 Plus and DS-19 and with regards to a dam combined with downstream floodwall/levee construction which is only relevant to DS-10 Plus.

The double counting of flood damage benefits was suspected of having occurred with GRR analyses because of the nature of GRR text dealing with double counting below.

"*The plan formulation of the Papillion Creek basin alternatives assumes that actions on each of the major streams (i.e. Big Papillion Creek, Little Papillion Creek, etc.) have independent utility and benefits through most of the reaches due to streams confluence areas lying at the far southeast end of the basin. For example, a levee constructed on Big Papillion Creek does not provide a measurable positive or negative effect of the flood risk on Little Papillion Creek (except at the confluence itself). Therefore, alternatives were formulated and evaluated on each stream individually and not compared against alternatives on other channels. There are a few reaches that are affected by multiple alternatives downstream of the confluences and those* minor influences h*ave been accounted for in Table 27 and Table 29 to ensure benefits are not double counted in the tentatively selected plan (TSP)*." (page 40, GRR).

Contrary to what is implied to be contained above in Tables 27 and 29, they do not actually quantify the amount of double counting across different TSP components but rather just state that: "totals [i.e. NED benefits] do not equal the sum of alternatives due to impacts from multiple alternatives in the same reaches. But no data is presented for double counted benefits associated with different alternatives and the comparison area provided is across 5 creek sub-basins which do not correspond directly with TSP components.

To quantify and avoid (i.e. remove) the potential double counting of floodwall/levee and DS-10 damage reduction benefits (for DS-10 Plus) would require some very complex HEC-FDA modeling; and if this has been done, it would be expected that the GRR would explain and even highlight this and also have a table summarizing the double-benefits removed.

With regards to non-structural benefits, the correct approach to avoid the double counting of flood damage avoidance benefits would be to remove all predicted flood damage associated with proposed floodproofed structures from the flood damage benefits of upstream structural components (Dams, Floodwalls and Levees). This would not involve the complex HEC-FDA modelling scenarios required for identifying double counting of DS-10 Plus structural measures in the same stream reach. Still if the GRR had conducted these simple non-structural double counting avoidance approaches, it likely would have mentioned these findings and also report BCRs with and without double counting to demonstrate the relevance of the issue. This does not occur in the GRR. Instead in a footnote at the bottom of Table 20 (Little Papillion Creek Economic Comparison of Final Array of Alternatives, page 58, GRR) they state:

"The nonstructural alternative overlaps with the structural alternative in LP7 and would be impacted by the change in hydraulics from implementation of DS10, so there are likely fewer nonstructural measures implemented in the combined plan once the updated modeling is incorporated in optimization."

This does not indicate that the GRR removed double counting of non-structural flood damage benefits. And, this statement does not occur when DS-10 economic feasibility is discussed later in the GRR.

Quantifying the Double Counting of Non-Structural Benefits (DS-10 Plus & DS-19)

Non-structural flood mitigation components such as floodproofing and buyouts of structures have since the 1999 Water Resource Development Act (Section 219) have been required for consideration in flood mitigation studies with the caveat that they not be double counted as benefits for other mitigation activities that are in the same impact areas (i.e., sub-basins).

In the GRR TSP a non-structural plan (basement fills, dry proofing, and elevation increases) on 386 structures in 7 distinct stream reaches of the Papillion Creek Basin is included, combined with structural measures (DS-10 Plus levees/floodwalls, and DS 19)

The Non-structural measures actually have a higher reported BCR ratio of 1.83 than the structural measures (1.21 with DS-10 Plus and 1.40 for DS-19).

To avoid the double counting of non-structural and structural flood damage mitigation benefits it is necessary to subtract the damage exposure benefits of floodproofed structures that are downstream of the structural measures. In other words, if a structure is protected from flooding via floodproofing it should not also be considered to be protected by an upstream dam or levee. The GRR makes no mention of removing these floodproofed structure benefits from the BCR analyses of the upstream structural measure.

DS-10 Plus

For DS-10 Plus, the GRR does not specify the number of annual flood damage associated structures identified for floodproofing and within the sub-basins that are impacted by DS-10 Plus.

For example, Table 45 (page 104, GRR) has non-structural benefits reported for only 5 main stream reaches rather than by TSP component which is based on more specific sub-basins.

However, in Table 20 (page 58, GRR) titled: 'Papillion Creek Economic Comparison', the annual economic benefits associated with non-structural (Alt-4) are reported at $459,310 or 11% of total reported DS-10 Plus damage. This totals to $13 million over the full 50-year project.

Correcting for this (i.e., removing the double counting) would reduce the originally BCR for DS-10 Plus from 1.21 to 1.08, and further correction would place the BCR in the range of 0.74 to 0.97 (both infeasible) based on adjusted BCRs described in Table 2 of this Review.

DS-19

But for DS-19, non-structural specific flood damage was not reported (as it was by Table 20 for DS-10 Plus). So, to estimate the amount of non-structural damage double counting for this dam, I had to rely on Table 45 (page 104, GRR) which listed 31 structures in the South Papillion Creek sub-basin recommended for non-structural mitigation with average annual benefits (avoided flood damage of $353,290 or $10 million over the project life). This means the DS-19 project benefits are inflated by 14%, which is substantial and would reduce the reported 1.40 BCR of DS-19 to 1.22 (a 13% reduction). And if the lower BCRs for DS-19 are used, then actual BCR would range from 0.9 to 1.10 (i.e., from infeasibility to a break-even point).

Quantifying the Double Counting of Structural Benefits (DS-10 Plus only)

DS-19 does not have multiple structural components, so there are no double counting of structural benefits there.

But DS-10 Plus has both a dam and floodwall/levees, which could result in double counting of avoided damage benefits. This was suspected (described in the introduction part of this Section) in large part because of the complexity of applying HEC-FDA modelling to two simultaneous mitigation components and because the GRR never explicitly explained doing this and did not present any related summary results.

However, I have discovered evidence in GRR summary table which suggests that the USACE **did** remove double counted flood damage benefits from the DS-10 Plus NED analyses. Specifically, Table 20 (page 58, GRR), reports the unique average annual benefits of DS-10 by itself ($1,959,900) and unique Floodwall/Levee (Alt 3) benefits of $1,716.230. Combining these results in annual benefits for DS-10 Plus of being $4,476,730 (both by summing the two values manually and as reported in the Table). But the annual benefits for these same two components combined in Table 38 (page 91, GRR where BCRs are calculated), reports a DS-10 Plus annual benefit value of $3,699,860 which is $776,000 lower than the corresponding combined values in Table 20. This ***implies*** that the GRR somehow calculated the $776,000 of double counted benefits (which is 21% of total benefits) and removed them from the BCR analyses.

The word 'implies' is used above since the GRR never stated they actual did this double-benefit removal (I had to discover it from a review of several GRR data summary tables). This is strange, as usually when work is done to ensure compliance with USACE study guidelines it gets mentioned in the reports. Therefore, this Review's conclusion regarding no DS-10 structural double counting of benefits should be considered tentative or provisional with the GRR confirming if they did remove these overlapping benefits and how they accomplished the task.

Result #6: The Use of Inflated Content-To-Structure Value Ratios.

After estimating DSRVs for structures, the GRR assigned content values to each structure using content-to- structure ratios (CSVRs) taken from other USACE flood mitigation studies. They then used generic content depth-damage created by the USACE for modelling actual content damage with HEC-FDA modelling. In summary, content values are assumed to be a percentage of structure values and influenced by likely damage to different structure types via hydrologic modelling, historical data and assumptions. Overall structure and contents make up about 92% of flood damage exposure in the Papillion Creek Basin and 49% of this structure/content damage is associated with content damages. Alternatively, about 46% of flood damage exposure in the Papillion Creek Basin is associated with content damage.

A review of the USACE based depth damage functions used the by GRR is beyond the scope of this present review although it is worthy topic for future investigations since the USACE is relying on depth damage functions that are almost 20 years old.

Instead, this review focusses only on the content-to structure value ratios used by the GRR after obtaining them from previous USACE flood mitigation studies.

The GRR used CSVRs for residential structures from a study in the Louisiana Gulf Area (USACE, 2006): 100% for residential structures and 139% for Mobile Homes and relied on CSVRs of commercial structures from a 2015 American River Watershed study (USACE 2015).

The fact that that the GRR chose to use CSVRs from USACE studies in non-midwestern locations rather than more nearby studies (North Dakota and Kansas) raises the suspicion that their selection criteria may have been to 'shop around' for the highest possible CSVRs in order to inflate potential flood damage in the Papillion Creek Basin. This suspicion was raised further by the fact that the GRR did not use commercial CSRVs from the Louisiana study even though they relied on that same study for residential CSRVs and that commercial CRSVs were estimated in the Louisiana Study.

For these reasons, the CSRV's used in the GRR are summarized (both using reported values and values from their raw structural inventory), and these CSVR's are compared to those of other USACE studies: The California and Louisiana studies that were the sources of GRR CSRVs, as well as following UACE flood damage feasibility studies: the Fargo/Moorhead (2009), Manhattan, Kansas (2014), Lansing and Calumet City, Illinois (2021) and Desoto, Mississippi (2021). Comparisons also include CSVRs used by the private insurance industry, the FEMA HAZUS flood mitigation planning tool, and the USACE National Structure Inventory (NSI). The idea is to evaluate the appropriateness of the CSVRs used by the GRR and to evaluate how the use of alternative CSRV data would impact BCRs calculated for the TSP by the GRR.

The Source of CSRVs for the Papio GRR

Below is the verbatim text description from the GRR regarding their selection and use of CSRVs:

"For purposes of estimating investment only, residential contents (sans mobile homes) were valued at 50 percent of structure value. For mobile homes, which are not included in the IWR functions, a CSVR of 139 percent is used. This CSVR was taken from the 2006 Final Report, Depth-Damage Relationships for Structures, Contents, and Vehicles and Content-to-Structure Value Ratios (CSVR) in Support of the Donaldsonville to the Gulf, Louisiana, Feasibility Study.

CSVRs for nonresidential structures derived for the 2015 *American River Watershed General Reevaluation Report* by the Sacramento District were utilized for this study. As part of the report, the Sacramento District completed an expert elicitation to develop CSVRs. Upon review of these CSVRs, the Omaha District determined that they were an appropriate fit for this study as it was reasonably assumed that nonresidential contents would be similar nationwide.

CSRVS Used by the GRR and Other USACE Studies

The GRR states that they used a SFR CSRV of 50 (obtained from the Donalsonville Louisiana Study) but from their Table 8 in the GRR it is clear they ended up using 100. This was confirmed from a review of the raw GRR structural inventory data. This discrepancy may be because the IWR stage damage curves (used by the GRR and many other USACE studies) sometimes require a CSRV for 100 to be used for SFR structures. This was not mentioned in the GRR but it was mentioned in several other USACE Feasibility Studies.

Second the commercial CSRVs in the American River USACE Study are said to have been derived from an earlier (2008 EER) study where "an expert elicitation was performed to develop content values and content depth-percent damage curves for specific occupancy types" (Page 27, Appendix E-Economics, American River Watershed, GRR, 2015). The American River GRR does not provide a reference to cite the 2008 study and a detailed search of the USACE districts website pages could not turn up any evidence that it even exists. It probably does since the GRR uses specific CSVRs from the AR GRR but I personally have not determined a way to evaluate the accuracy or integrity of where this data actually came from.

The Fargo/Moorhead USACE feasibility study (2011) also used an 'expert elicitation' study combined with 33 field surveys of commercial structures to generate CSRVs (which are all 100 except for barns which are 200) and these values were also used by the Desoto MI USACE feasibility study. The Donaldson LA, USACE study (2006) also used expert elicitation to generate CSRVs and this particular study contains the most detailed descriptions of the approaches used and data outputs that have ever seen reported by a USACE study (it is 163 pages solely devoted to depth damage relationships, structure and content values and CSRVs). Finally, the Manhattan Kansas USACE Study (2014) reports content values and CSRVs for 4 structure types and repots getting the CSRVs from another study in Louisiana.

HAZUS (FEMA), NSI (USACE) and Insurance Industry CSRVs

The HAZUS flood mitigation planning tool by FEMA used CSRVs of 50 for all structure types except for industrial structures which use a CSRV of 150. FEMA has access to much of the actual flood damage data across the County so these CSRVs are likely reasonably accurate. Similarly, the National Structure Inventory of the USACE also recommends the use of CSRVs of

50 unless a feasibility study has access to more site specific and accurate data. Finally, the insurance industry uses a ballpark CSRV of 70 for single-family residential (SFR) structures.

Evaluating Whether GRR CSRVs are Inflated and Its Impact of TSP BCRs.

All CSRVs used in USACE studies appear to be flawed in that they seem to be based on a few poorly described and vetted 'expert opinion' exercises. These potentially subjective and poorly documented CSRV estimates combined with the USACE stage damage curves that are over 20-years old could be resulting to highly inaccurate data for flood damage to contents which can make up almost half of flood damage exposure in many areas. The USACE (nationally) should join forces with FEMA to create updated CSRVs by reviewing actual flood damage statement reports after flood events.

The CSRVs used by the GRR were obviously 'cherry picked'. That is different CSVRs appear to be selectively taken from other studies around the country in order to maximize content values.

Trying to gauge the relative CSRVs of the GRRs used with other studies is tricky because not all studies report values for particular structure types and some studies report average values across aggregate sub-structure types. However, comparing the actual GRR CSRVs to the mathematical averages of CSRVs used in all the USACE studies discussed above as well as with FEMA/HAZUS and NSI (USACE) recommended CSRVs, it appears the GRR has inflated CSRVs and hence content values by 10%. Since 45% of all GRR flood damage exposure is associated with contents BCRs are therefore inflated by 4.5%. Therefore, if the GRR were to use lower (typical or average) CSRVs then the BCRs for the TSP would be reduced as follows: Overall TSP 1.39 to 1.33; DS-10 Plus: 1.21 to 1.16; DS-19: 1.40 to 1.34.

Result #7: Ignoring flood proofing measures in recently built structures.

The GRR (and most other USACE flood mitigation feasibility studies) rely on stage damage curves that were developed by the Institute of Water Resources (IWR) of the USACE over 20 years ago. These two decades old stage damage curves used with HEC-FDA modelling to be assigning expected annual flood damage to structures (based on their building characteristics) are very likely now outdated due to major building standard improvements particularly after the year 2000. In fact, two independently released publications from the Multi-Hazard Mitigation Council with the National Institute of Building Sciences (2019) and FEMA (2020) have clearly documented extent of effectiveness of improved building codes and standards for mitigating flood damage.

The NIBS report found that adopting the latest building codes saves $11 in avoided damage per $1 invested. The FEMA study concluded that 51% of the 18.1 million post-2000 buildings that were modeled showed losses avoided resulting from the adoption of improved building codes and that about 80% of new construction (even in jurisdictions without more rigorous building code rules) are adopting improved construction standards focusing on natural hazard damage reduction.

It is therefore assumed that much of the new construction since 2004 in the 500-year floodplain study area of the GRR have been built with higher levels of flood protection measures than seen in structures built in earlier decades. And since 50% and 76% of expected annual flood damage associated with DS-10 Plus and DS-19 is associated with structures built since 2005, it is extremely likely that the GRR has vastly over-estimated flood damage exposure associated with the TSP by relying on stage damage curves that are 20-years old.

Examples of recently built floodproofed construction that I personally have noticed in the Papillion Creek Basin include multi-family residential structures with their entire first floors consisting of parking and/or common use recreation areas, commercial buildings with critical utilities not being located on second floors and building with advance drainage systems around foundations.

While this GRR flood damage exposure inflation is assumed to be large, there really were not any approaches the GRR could have used to avoid the problem without the creation of new/updated USACE stage damage curves.

Quantifying the extent of this damage exposure inflation by not accounting for newly built floodproofed structures is beyond the scope of this current review but future research is going to be proposed to quantify how much floodproofing improvements were incorporated in to recently built structures in the Papillion Creek 500-year floodplain and to put a dollar value on the incremental cost of these improvements over conventional construction approaches. It could then be assumed that the cost differential between flood-proofed and non-flood proofed construction is the likely economic benefit (avoided flood damages) that could be subtracted from NED mitigation benefit values. In the meantime, the GRR should at least mention this issue and take it into consideration when evaluating the already marginally low BCRs of the TSP.

Result #8: Overestimated recreation benefits for Dam Site 19.

Dam Site 19 in western Sarpy County was not found cost effective for flood control purposes even with potentially inflated flood damage exposure measures. However, with the inclusion of recreation benefits its feasibility increases to very marginal level (BCR ratio of 1.40).

This means that feasibility of the Dam Site 19 is entirely dependent on the accuracy of net recreation benefits which is problematic for two reasons:

1) Reservoir maintenance and repair cost based on historical expenditures incurred at other USACE managed reservoirs in the basin have been ignored. This deflates and obscures actual project costs.

2) Future recreation benefits are inflated under the assumption that Sarpy County population will grow over the next 25 years a 1.5% without an accompanying increase in outdoor recreational facilities. This inflates actual project benefits.

Each of these oversights (that are completely ignored in the GRR) are discussed in further detail below followed by estimates of the impact the 1.40 BCR for DS-19.

Deflated Reservoir Maintenance Costs

Man-made reservoirs in in the Omaha Metro Area have historically required substantial maintenance and costs associated with siltation and invasive species. More recently Walnut Creek Lake in Sarpy County now 20 years old (built and managed entirely by the PMNRD) need $220,000 of drainage projects to deal with in sedimentation issues. If it is assumed this is needed every 10 years, annual cost for this is $22,000.

These have been substantial and have included the complete drainage and long term shut down of the USACE owned and managed Zorinksy and Cunningham Reservoirs multiple times due to sedimentation and invasive species issues. There is no mention of these recreation costs that are clearly part of the historical record and well known to the Omaha branch of the USACE.

Inflated Recreational Benefits

Conversely, recreation benefits appear to be substantially inflated since the GRR analyses incorrectly assume that future population growth will not coincide with the increase provision of additional (non-USACE sponsored) park and recreational facilities. It may very well be the case that as predicted by the GRR that Sarpy County population will grow by 1.5 over the next 25 years and this alone will lead to an increase in annual recreation benefits of $95,644 (Table F-113 GRR Economic Appendix-Economics). This corresponds to 11.8% of all annual recreational benefits for DS-19.

But it is incorrect to assume that this will lead to an equal increase in visitation and corresponding recreation based economic benefits associated DS-19. That is because with increase population growth it is expected that local cities and governmental in Sarpy County will continue building new recreational facilities (parks, trails, and maybe even more man-made Lakes). The GRR assumption that no new recreational facility supply will take place during 25 years of population growth in the County is simplistic and wrong. And even the GRR local partner is planning on building additional lakes in Sarpy County (including an already funded 113 acre lake at nearby Offutt Air Force Base). Omitting this key information is likely intended to disguise the unrealistic assumption regarding future increases in recreational demand for DS-19.

Revised DS-19 BCR with Corrected Benefit and Cost Data.

If DS-19 annual recreation benefits are reduced by $95,644 after dropping the incorrect assumption that no additional outdoor recreation assets are created with forecasted population growth, and annual average drainage maintenance cost of $22,000 per year observed at another recently constructed dam/reservoir (Walnut Creek), are added to DS-19 annual recreation costs, then the BCR for ratio falls from 1.40 to 1.30 which is 7% reduction.

Result #9: Violations of the Federal Data Quality Act.

The Federal Quality Data Act intended to ensure that Federal Agencies to disseminate accurate information (to ensure the quality utility, objectivity, and integrity of utilized data).

The GRR appears to violate the Act by filling up valuable space in the report document with highly generalized and in some cases irrelevant information while proving very limited or no explanation of leaving out critically important details of the study (methodologies, assumptions, data sources and summary statistics of intermediate and results).

Instead of describing methodological approaches utilized, general references are made to prior USACE studies or reports. The problem is that many of these prior reference studies are out of date and/or almost impossible to locate, and since the references to them in this feasibility study in most cases did not include specific page numbers, it is time consuming and sometimes impossible process to try and track down the methodologies referenced to. The result appears to be more 'smoke and mirrors' and 'hand waving' than 'transparent scientific method'.

In summary key methodologies and approaches used in this feasibility study need to be explicitly described rather than just vaguely referenced. Sufficient information should be supplied in the Report to allow a reader or interested third person to replicate the approaches and analyses undertaken. Some specific examples of the intractability and insufficiency of described methods and approaches is contained in my comments below regarding the assignment of first floor elevations of structures and structural inventory.

As well Omaha USACE staff appear to have been issued blanket refusals to release any data used in the study which then had to be obtained through a lengthy FOIA request. Once the requested data focused on the GRR structural inventory it was discovered to be incomplete, contain many error and omissions, and without proper meta-data documentation.

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Appendices

A) Glossary of Terms Used

B) Resume of Study Report Author

C) Memorandum of Support for the Study from the Douglas County Board of Commissioners

D) Secretary of the Army Letter Summarizing Potential Approval of the Project

Appendix A. Glossary of Terms

USACE – United States Corps of Engineers
GRR – General Reevaluation Report
TSP – tentatively selected plan
DS-10 – dry dam, northern Douglas County, southern Washington County
DS-10 Plus – Dam Site 10 combined with levees/floodwalls in Douglas County
DS-19 – wet dam near Gretna, NE
BCR – benefit cost ratio
EAD – expected annual flood damage
NED – national economic development
LOMA – letters of map amendments
FEMA – Federal Emergency Management Agency
PMNRD – Papio-Missouri River Natural Resource District
ASCE – American Society of Civil Engineers
FOIA – Freedom of Information Act
WRDA – (Federal) Water Resource Development Act
NFIP – National Flood Insurance Program
GIS – geographic information system
AEP – annual exceedance probability

Appendix B. Resume of Study Report Author

Resume: Steven D. Shultz

Professor of Real Estate and Land Use Economics
Finance, Banking, & Real Estate Dept.
College of Business Administration, University of Nebraska-Omaha
Tel. 402-554-2810   Email: sshultz@unomaha.edu

Education:

Ph.D. University of Arizona. 1993.
Renewable Natural Resources/Agricultural Economics

MS University of New Hampshire. 1989.
Resource Economics

BA (Honors), McGill University (Montreal, Canada) 1987.
Geography/Environmental Studies

Current Position

Professor of Real Estate and Land Use Economics
University of Nebraska at Omaha (2005 to present)

Other Recent Employment

- Associate Professor of Natural Resource Economics. Dept. of Agribusiness & Applied Economics, North Dakota State University (1997-2005)

- Natural Resource Economist, CATIE/RENARM/USAID Watershed Management Project, Costa Rica, Nicaragua, Honduras, El Salvador, Guatemala, Panama (1993-97)

Current Research Interests:

Natural Hazards and real estate; Property Taxation; Hedonic valuation, Urban Planning, Agricultural Amenity Valuation/Appraisal, Conservation Easements, GIS spatial analyses.

Research Activities:

Refereed Journal Publications: 43
Book Chapters: 5   Other Publications: 15
External Funding: (1997 to present): 21 Projects ($870,000)
Awards (Best Journal Articles): 3

A Sample of Recent Peer-Reviewed Journal Publications

Shultz, 2021. "The Accuracy of FEMA-HAZUS Single-Family Residential Damage Exposure Data in Houston: Implications for Using or Correcting the HAZUS General Building Stock". ***Natural Hazards Review of the American Society of Civil Engineers.***

Shultz, 2018. Housing Depreciation Revisited: Hedonic Price Modeling Versus Assessor Estimates. ***Journal of Housing Research***, 27(1).

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Shultz, 2017. Using Assessed Housing Values to Estimate Depreciated Structural Replacement Costs: Opportunities for Natural Disaster Management Planning. ***Journal of Property Tax Administration and Assessment*** Issue 2, Fall, 2017.

Journals titles where prior research articles have been published:
Journal of Real Estate and Finance, The Appraisal Journal, Land Economics

Recent Research Grants (external funding)

* 2012-2014. **U.S. Army Corp of Engineers (Institute of Water Resources)**
'Development of a National Database of Depreciated Structure Replacement Values for Inclusion with SimSuite/HAZUS and Flood Mitigation Reconnaissance Studies'.

* 2011-2012. **University Council of Water Resources (UCOWR)-Institute of Natural Resources (IWR-USACE) Sabbatical Fellowship**. Title of proposed work: Improving the Efficiency and Accuracy of Flood Damage Estimates Using Geographic Information System (GIS) Based Property Tax Assessment Databases

Funding Agencies from Prior Years: Federal: UDSA, USGS, USFW. State: NE Invest, Finance Authority, NE Game and Parks, ND Water Commission, Douglas County (NE).

Appendix C. Memorandum of Support and Supply of In-kind service by Douglas County

BOARD OF COUNTY COMMISSIONERS
DOUGLAS COUNTY, NEBRASKA

WHEREAS, The U.S. Army Corps of Engineers (USACE) produced a Final Draft Feasibility Report in January of 2021, that evaluated the flood control projects in the Papillion Watershed; and,

WHEREAS, that report recommends a single dry dam flood control project named Dam Site 10 ("DS-10"); and,

WHEREAS, DS-10 focusses on the Thompson and Little Papillion Creeks and directly impacts both Washington and Douglas Counties, with a projected cost of $128 million and a 65%-35% federal-local cost share; and,

WHEREAS, Steven Schultz, a professional consultant who is also the Baright Professor of Real Estate and Land Use Economics at the University of Nebraska at Omaha, conducted a preliminary analysis of the USACE data sources and methodological approaches and has discovered several potential flaws and errors that may reduce the economic feasibility of the project; and,

WHEREAS, considering the extensive future financial burdens that may be placed on Douglas and Washington County taxpayers to fund DS-10, and because the extensive property acquisitions and potential benefits associated with the project will occur in these two counties, Steven Schultz intends to conduct an in-depth economic benefit analysis of the proposed DS-10 project.

NOW, THEREFORE, BE IT RESOLVED BY THIS BOARD OF COUNTY COMMISSIONERS, DOUGLAS COUNTY, NEBRASKA, that this Board hereby supports the production of an economic benefits analysis of the proposed DS-10 project, and is supportive of an in-depth and serious consideration of flood-control alternatives to the construction of DS-10.

DATED this 30th day of March, 2021.

Appendix D. Secretary of the Army Summary (Draft support/approval) of the Papio GRR

SUBJECT: Papillion Creek and Tributaries Lakes, Nebraska
THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress my report on flood risk management and recreation for the South Papillion Creek, Little Papillion Creek, Thomas Creek, Big Papillion Creek, Cole Creek, Papillion Creek, Saddle Creek, and West Papillion Creek. It is accompanied by the report of the Omaha District Commander. The Papillion Creek and Tributaries Lakes, Nebraska project was originally authorized by Section 203 of the Flood Control Act of 1968 (Public Law 90-483), in accordance with the recommendations of the Chief of Engineers in House Document No. 349. This report was completed in response to direction in the Energy and Water Development Appropriation Act, 1982 (Public Law 97-88), House Report No. 97-177, for reevaluation of the findings of the original report. The authorized project consisted of a system of 21 dams and reservoirs, located on tributaries upstream from Metropolitan Omaha. In addition to flood control, the other purposes of the authorized project are recreation, fish and wildlife enhancement, and water quality. Preconstruction engineering and design, if funded, will be conducted under the study authority cited above.

2. The reporting officers recommend a project that will make significant contributions to National Economic Development (NED). The NED plan includes:

a. a dam with a 74-acre conservation pool and sediment detention at South Papillion Creek Dam Site 19 near Gretna, Nebraska.

b. a dry dam at Thomas Creek Dam Site 10 in rural Douglas County, Nebraska.

c. new levee/floodwall along Little Papillion Creek in Omaha, Nebraska consisting of 3.67 miles of structure on the right bank, 2.98 miles of structure on the left bank, and eight road and bridge closure structures.

d. nonstructural features including 71 basement fills, 59 elevations of residential structures and 256 dry floodproofings of commercial/industrial/municipal structures along Big Papillion Creek, Cole Creek, Papillion Creek, Saddle Creek, South Papillion Creek, and West Papillion Creek.

e. recreational features consisting of a 2.5-mile trail, parking lots, restrooms, picnic shelter, boat access, and related features at the Dam Site 19 reservoir; and

3. The recommend plan necessitates the removal of 23.5 acres of riparian forest habitat for dam construction, reservoir inundation and levee/floodwall construction and would require replacement. The recommended plan includes 31.8 acres of tree plantings within the boundaries of the normal operating pool and maximum operating pool of South Papillion Creek Dam Site 19 and three acres at Thomas Creek Dam Site 10. Approximately 0.35 acres of palustrine emergent wetlands would be directly filled from embankment construction of South Papillion Creek Dam Site 19. Approximately 1.4 acres of palustrine emergent wetlands will be restored through the excavation of shallow areas connected to

the edge of the normal pool area of South Papillion Creek Dam Site 19. Impacts from converting a stream to a lacustrine system would also require mitigation; this would be accomplished by planting a 100-foot-wide buffer of native prairie and wetland plants along each side of the Little Papillion Creek for 1,000 feet and planting a 100-foot-wide buffer along both sides of South Papillion Creek for 1,200 feet. This would result in 10.1 mitigation acres for stream impacts. Mitigation requirements were determined through analysis utilizing the Nebraska Stream Condition Assessment Procedure and the Brown Thrasher Habitat Evaluation Procedure and costs are included in the total project cost.

4. The Papio-Missouri River Natural Resources District is the non-federal cost sharing sponsor for all features of the project. Project costs are based on October 2020 price levels. The estimated project first cost of construction is $134,127,000. This includes $25,965,000 for Dam Site 19 ($22,032,000 for flood risk management features and $3,933,000 for recreation features); $20,472,000 for Dam Site 10; $45,799,000 for levee/floodwall construction on Little Papillion Creek; and the $41,890,000 for the nonstructural plan for Big Papillion Creek, Cole Creek, Papillion Creek, Saddle Creek, South Papillion Creek, and West Papillion Creek. These costs include the value of lands, easements, rights-of-way, relocations, and disposal areas (LERRDs). Total LERRD is estimated to be $29,338,000. Cost sharing is applied in accordance with the provision of Section 103(c)(5) of the Water Resources Development Act (WRDA) of 1986, as amended (33 U.S.C. §2213(c)(5)), as follows:

a. The cost of construction of structural and nonstructural flood risk measures is shared 65 percent federal and 35 percent non-federal. The cost of construction of recreation features is shared 50 percent federal and 50 percent non-federal. The estimated federal and non-federal shares of the project first cost are $86,592,000 and $47,534,000 respectively. The non-federal sponsor will receive credit for the costs of LERRD toward the non-federal share.

b. The additional annual cost of operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) for the recommended plan is estimated to be $496,000. The levee and floodwall OMRR&R includes periodic culvert inspections, culvert repair, rock placement for levee tops and toe stabilization, cleaning pipes for inspection, weed spraying, and mowing. The dam OMRR&R includes periodic inspections, monthly inspection and data collection on piezometers, maintenance, and mowing. The non-federal sponsor will be responsible for 100 percent of the cost of project OMRR&R.

5. Based on a 2.50 percent discount rate and a 50-year period of analysis, the equivalent average annual benefits and costs are estimated at $8,214,000 and $5,423,000, respectively. The project is estimated to provide annual net benefits of $2,791,000 and a benefit-to-cost ratio of 1.5 to 1. All project costs are allocated to the authorized purposes of flood risk management and recreation.

6. The study report fully describes flood risk to structures and life safety. The recommended plan is designed to reduce the risk of flood damages to key infrastructure and residential/commercial structures resulting from a flood event with an annual exceedance probability of one percent. The recommended plan would greatly reduce, but not eliminate future damages and residual risk would remain. The recommend plan will reduce expected annual flood damages in the study area by 51 percent overall, and by 69-78 percent across the South Papillion, Little Papillion, Thomas, and Saddle Creek portions of the watershed.

The residual risk, along with the potential consequences, has been communicated to the non-federal sponsor and will become a requirement of any communication and evacuation plan. The recommended plan is not intended to, nor will it, reduce the risk to loss of life during major flood events. The only certain method to prevent loss of life is by residents and visitors following existing local evacuation plans and leaving the study area prior to significant events.

7. The recommended plan was developed in coordination and consultation with federal, state, and local agencies and numerous tribes. Risk and uncertainty were addressed during the study by completing a cost and schedule risk analysis that integrates the uncertainty from the engineering, costs, economics, and other aspects of the project. Risk includes project scope, schedule, and cost changes associated with acquisition strategy; levee and floodwall quantities; the timing of the real estate acquisitions and unforeseen risks with tenant relocations; and funding limitations impacting the construction schedule.

8. In accordance with U.S. Army Corps of Engineers policy on the review of decision documents, all technical, engineering, and scientific work underwent an open, dynamic, and rigorous review process. The comprehensive review process included District Quality Control Review, Agency Technical Review, Type I Independent External Peer Review, and headquarters policy and legal compliance review to confirm the planning analyses, alternative design and safety, and the quality of decisions. Washington-level review indicates that the plan recommended by the reporting officers complies with all essential elements of the U.S. Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Land Related Resources Implementation Studies, as well as other administrative and legislative policies and guidelines. The views of interested parties, including federal, state, and local agencies, and tribes were considered and all comments from public reviews have been addressed and incorporated into the final report documents where appropriate.

9. I concur in the findings, conclusions, and recommendations of the reporting officers. Accordingly, I recommend that the plan for flood risk management and recreation for Papillion Creek and Tributaries Lakes, Nebraska, be authorized in accordance with the reporting officers' recommended plan at an estimated cost of $134,127,000 with such modifications as in the discretion of the Chief of Engineers may be advisable. My recommendation is subject to cost sharing and other applicable requirements of federal laws and policies, including Section 103 of P.L. 99-662, WRDA 1986, as amended (33 U.S.C. §2213). These requirements include, but are not limited to, the following items of local cooperation from the non-federal sponsor:

a. Provide 35 percent of construction costs allocated to nonstructural flood risk management; a minimum of 35 percent, up to a maximum of 50 percent, of construction costs allocated to structural flood risk management; and 50 percent of construction costs allocated to recreation, as further specified below:

i. Provide, during design, 35 percent of design costs, in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

ii. Pay, during construction, a contribution of funds equal to 5 percent of construction costs allocated to structural flood risk management;

iii. Provide all real property interests, including placement area improvements, and perform all relocations determined by the Federal Government to be required for the project;

iv. Provide, during construction, any additional contribution necessary to make its total contribution equal to at least 35 percent of construction costs for structural flood risk management, 35 percent of construction costs for nonstructural flood risk management and 50 percent of construction costs for recreation;

b. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) that might reduce the level of flood risk reduction the project affords, hinder operation and maintenance of the project, or interfere with the project's proper function;

c. Keep the recreation features, access roads, parking areas, and other associated public use facilities, open and available to all on equal terms;

d. Inform affected interests, at least yearly, of the extent of risk reduction afforded by the flood risk management features; participate in and comply with applicable federal floodplain management and flood insurance programs; prepare a floodplain management plan for the project to be implemented not later than one year after completion of construction of the project; and publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in adopting regulations, or taking other actions, to prevent unwise future development and to ensure compatibility with the project;

e. Operate, maintain, repair, rehabilitate, and replace the project or functional portion thereof at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable federal laws and regulations and any specific directions prescribed by the Federal Government;

f. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-federal sponsor owns or controls for access to the project to inspect the project, and, if necessary, to undertake work necessary to the proper functioning of the project for its authorized purpose;

g. Hold and save the Federal Government free from all damages arising from design, construction, operation, maintenance, repair, rehabilitation, and replacement of the project, except for damages due to the fault or negligence of the Federal Government or its contractors;

h. Perform, or ensure performance of, any investigations for hazardous, toxic, and radioactive wastes (HTRW) that are determined necessary to identify the existence and extent of any HTRW regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. 9601-9675, and any other applicable law, that may exist in, on, or under real property interests that the Federal Government determines to be necessary for construction, operation, and maintenance of the project;

i. Agree, as between the Federal Government and the non-federal sponsor, to be solely responsible for the performance and costs of cleanup and response of any HTRW regulated under applicable law that are located in, on, or under real property interests required for construction, operation, and maintenance of the project, including the costs of any studies and investigations necessary to determine an appropriate response to the contamination, without reimbursement or credit by the Federal Government;

j. Agree, as between the Federal Government and the non-federal sponsor, that the non-federal sponsor shall be considered the owner and operator of the project for the purpose of CERCLA liability or other applicable law, and to the maximum extent practicable shall carry out its responsibilities in a manner that will not cause HTRW liability to arise under applicable law; and

k. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended, (42 U.S.C. 4630 and 4655) and the Uniform Regulations contained in 49 C.F.R Part 24, in acquiring real property interests necessary for construction, operation, and maintenance of the project including those necessary for relocations, and placement area improvements; and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

10. The recommendation contained herein reflects the information available at this time and current departmental policies governing the formulation of individual projects. It does not reflect program and budgeting priorities inherent in the formulation of the national civil works construction program or the perspective of higher levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to Congress for authorization and implementation funding. However, prior to transmittal to Congress, non-federal sponsor, the State of Nebraska, interested federal agencies, and other parties will be advised of any significant modifications in the recommendations and will be afforded and opportunity to comment further.

SCOTT A. SPELLMON
Lieutenant General, USA
Chief of Engineers