NAU CENE 486C

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30% Design Report for San Simon Barrier Dam Evaluation

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Table of Abbreviations

- BLM: Bureau of Land Management
- C - City Importance Coefficient
- DFA: Dam Failure Analysis
- f - Social and Environmental Impact Index,
- HEC-RAS: Hydrologic Engineering Center's River Analysis System
- h - Cultural relics and other factors
- I - Facility importance factor
- L - Human Cultural Landscape Coefficient
- l - Biological Environmental Coefficient
- NAU - Northern Arizona University
- N - Risk Population Coefficient
- P - Pollution Industrial Coefficient
- R - Channel form factor
- SSBD: San Simon Barrier Dam

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Acknowledgments:

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1.0 Project Introduction:

The Bureau of Land Management (BLM) has requested that student engineers from Northern Arizona University (NAU) conduct a Dam Failure Analysis (DFA) on the San Simon Barrier Dam (SSBD). The SSBD is located roughly 4 miles to the Southeast of Safford and 2.5 miles

Southeast of Solomon. The location of Safford Arizona can be seen below in Figure 1 in perspective to the rest of the state of Arizona, Figure 2 [2] shows the dam location in reference to Safford and Solomon.

Figure 1. Location of Safford, AZ on map of Arizona [1]

The SSBD analysis project has been requested because of a change in regional growth. When the dam system first began in the 1950s with the most recent dam, the San Simone Barrier Dam, being finished in the 1980s, the towns of Solomon and Safford were relatively small with a minimal population[2,3]. Has time has progressed these towns have grown, the City of Safford has tripled since the 1950s and the town of Solomon has grown by over 2000% since 1990 [4,5]. The significant growth in a relatively short amount of time, has caused concern about the Barrier Dams Hazard rating and if it is still appropriate with the increase in population, and the resulting increase in economic activity. The engineering team has been tasked with analyzing the flood effects if the dam were to fail during a 100 and 500-year flood as outlined in Federal Standards [6]. This analysis will first be performed by creating a basic HEC-RAS simulation of the channel to gauge expected results of a large storm event. Then a more complex HEC-RAS model will be constructed and run for both a 100 and 500-year storm event. The results of this event can then be analyzed to determine the water level over the downstream agricultural fields and if necessary the water level as it enters the town of Solomon or Safford. These levels then can be used to estimate possible damage costs.

This project primarily is concerned with flow data, topographic data of the area, and various files often collected by state and federal government agencies. This information will be cited and referenced throughout the report when appropriate and will often be used for the analysis of the dam breach and to estimate expected flows and dimensions.

The greatest limitations for this project will include data collection, because this area is relatively remote and fairly rural there is minimal data and much of it has little explanation and must be interpreted. Much of the data available is also sporadic and located among multiple government entities and other organizations. Coordinating our existing data will be the primary challenge for the first stage of the project.

This project is constrained to focus on economic impacts of a dam failure. This is because the teams results will be used to justify further investigation of the dams hazard rating if necessary. Loss of life analysis will not be included in the report for these reasons.

2.0 Technical Considerations:

2.1 Field Work:

2.1.1 Methods

2.1.2 Results

2.1.3 Relevance

2.2 Testing/Analysis:

Predominate Testing/Analysis Performed: Analyses (laboratory, software, hand, etc…) that were performed. Complete detail of experimental designs/methods/procedures/raw data can be put in an Appendix, but results should be summarized in the main narrative.

2.2.1 Methods

HEC-RAS (Hydrologic Engineering Center - River Analysis System) is a one-dimensional hydraulic simulation program based on four kinds of analysis of rivers: 1. Stable flow model 2. Unstable flow model 3. Sediment transport model 4. Water quality analysis. It can simulate the flow of natural riverbed or human-made channels to determine the water level as its primary goal, carry out flood studies and identify flooded areas. HEC-RAS consists of a series of programs, tools and uses for processing georeferenced data, and teams can import geometric data into HEC-RAS. The HEC-geoRAS file collects data on the geometry of the study area, including river beds, cross-sections, waterways and more. Hydraulic calculations can obtain velocity and depth results. Finally, you can export these results to ArcGIS for processing to get flood and risk maps.

2.2.2 Results

2.2.3 Relevance

2.3 Economic Analysis:

2.3.1 Methods

The teams approach is based on the local economic structure of the risk cost assessment methods. The costs of agricultural, residential, commercial, industrial and public property were studied in detail. Calculate the cost-benefit ratio after a dam failure to assess the impact of the economic performance. By analyzing the 100-year flow rate, the team can calculate the flow rate and the danger of the dam failure. Sam simon dam Belongs to the use of Dandy Dam The loss of risk is mainly due to the damage caused by dam floods to the downstream inundation and erosion. From the perspective of the consequence loss assessment, losses can be divided into loss of life, economic loss and social and environmental Three aspects of the impact of the loss.

Equation 1: Social and Environmental Impact Index [8]

$$(f)=f = N\times C\times I\times h\times R\times l\times L\times p$$

2.3.1.1 Economic losses:

Economic losses include direct economic losses and indirect economic losses.

2.3.1.2 Social and environmental Impact:

The impact of dam failure on society and the environment involves a wide range and complexity. Reference should be made to social and environmental risk criteria, taking into account factors such as the number of risky people, the importance of the city, the shape of the riverway, and the cultural landscape.

2.3.2 Results

2.3.3 Relevance

In the economic risk analysis, the risk is not the smaller and better, because the reduction of the risk needs to pay the price, whether it is reducing the probability of failure through reinforcing measures or reducing the risk loss through precautionary measures, all must invest human resources, financial resources and material resources.

The determination of an acceptable risk criterion is a matter of resolving the issue of "what is safe before it is perceived as safe." Therefore, the following criteria should be met for accepting acceptable risk criteria (1) The principle of consistency, that is, the risk accepted by the original project and the risk of the new plan should be the same on the measured values, which can not be far different. (2) As Low As Reasonably Practicable. In different dams, unnecessary risks cannot be accepted, but reasonable risks must be recognized, and the dangers of significant hazards should be minimized. As the project has a low risk, it is more difficult to reduce the risk. (3) Affect the controllable principle, that is, the new plan can not increase the risk of the original project and its risk impact should be controlled within a minimal range.[9]

3.0 Final Design Recommendations:

3.1 Hazard Rating Recommendation:

3.2 Economic Impact of Recommendation:

3.2.1 BLM Funding Change:

3.2.2 Economic Risk to Community:

3.3 Statistical Analysis:

4.0 Summary of Engineering Work:

4.1 Expected Results Change:

(Flood conditions are not significant to cause concern)

4.1.1 Changes Cause:

4.1.2 Scope Changes:

4.1.3 Schedule Changes:

4.1.3.1 Gantt Chart Changes:

Gantt chart changes because of changes in the plan and different work reports. At various times, the teams will report and summarize existing work. However, the final project end time will not be changed.

4.1.4 Effects of Changes:

Changes to the plan will not affect the overall project. The team will make different arrangements to achieve the most efficient operation. That will improve the utilization of time so that the project can be completed on time or ahead of schedule.

5.0 Summary of Engineering Costs:

The cost of the San Simon Dam Failure Analysis project includes variable costs as well as fixed costs, and the team uses industry-specific rates for specific jobs. This will be provided in the table below as well as a combination of the total costs. Fixed costs are constant and do not depend on output or activity levels. Variable costs are the costs that vary with the volume of production in total costs. The project only needs to provide dam failure analysis and support data collection, not including dam reconstruction and restoration work.

5.1 Changes to Staffing:

5.1.1 Original Staffing Estimate:

5.1.2 Actual Costs Estimate:

5.2 Changes to Costs:

5.2.1 Original Costs Estimate:

5.2.2 Actual Costs:

5.3 Causes for changes to Staffing and Costs:

6.0 Conclusion:

6.1 Expected Floodway Flows:

6.2 Expected Economic Damage:

6.3 Changes in Hazard Rating:

7.0 References:

Intentionally left this way to allow for easier changes has report Progresses

1. https://www.google.com/maps/dir//Safford,+AZ/@32.7880835,-109.6688232,15351m/data=!3m1!1e3!4m9!4m8!1m0!1m5!1m1!1s0x86d7f6fc89bf058f:0xeb719602820d6e8b!2m2!1d-109.70758!2d32.8339546!3e2?hl=en&authuser=0
    a. Map of dam from Google Maps
2. %
    a. Documentations of when dam system improvement started
3. ?
    a. Construction document for Barrier Dam
4. https://en.wikipedia.org/wiki/Safford,_Arizona#History
    a. Safford Wiki
5. https://en.wikipedia.org/wiki/Solomon,_Arizona#History
    a. Solomon Wiki
6. Probably can just use Graham County Flood Insurance Doc
    a. Standards that state we need the 100, and 500 year storm event

8.0 Appendices: