CONFINED DISPOSAL FACILITY APPLICATION FOR DREDGING OPERATIONS DECISION SUPPORT SYSTEM

Derek Wilson[1]

ABSTRACT

The U.S. Army Corps of Engineers Dredging Operations Decision Support System(DODSS) has developed a Confined Disposal Facility(CDF) utilization optimization tool. DODSS developed the tool for the Kings Island Turning Basin(KITB) in Savannah Harbor, Georgia. This paper describes how the tool optimizes CDF sequencing through Use/Rest requirements, dredging requirements, and CDF capacity. CDF utilization is a primary factor in dredging operation decision making in Savannah Harbor and is the primary focus for the KITB project scenario. The CDF utilization optimization tool develops solutions based on these factors for this scenario and as a general CDF application for dredging projects corps wide.

Keywords: Dredge scheduling, decision support system, DSS, analytical tool, confined disposal facility optimization

INTRODUCTION

Kings Island Turning Basin(KITB) in Savannah Harbor, Georgia (Figure 1) presents an important and complex dredging issue for operations managers of the Savannah Corps of Engineers District. The confined disposal facility(CDF) adjacent to KITB, DA2A, is rapidly reaching capacity. Overhead power lines above DA2A restrict vertical clearance limiting expansion by raising the dikes surrounding the CDF. Without full use of DA2A, CDFs 5 miles away (DA12A, DA12B and DA13A) are the closest alternative. This drastic increase in pipeline length to these CDFs complicates dredging operations in KITB.

Several factors further complicate dredge planning and the dredge process to maintain KITB to 15.24m (50ft.) project depth. This includes scheduling pipeline dredges, dredge material volume expected, and CDF scheduling. The overall cost is affected by all of these factors.

DODSS developed the CDF Optimization Tool to assist the decision making process for dredging operations in KITB. This optimization tool incorporates applied knowledge associated with dredging operations in KITB, data analysis, and a rules based scheduling program. The CDF Optimization Tool schedules CDFs, compares the schedule to dredge requirement in KITB, and determines the resulting CDF capacity.

CDF OPTIMIZATION

DODSS identified 3 key issues that affect the relationship between dredging in the turning basin and disposal area use:

1. Blackout period on pipeline dredging between March 15 and May 31 due to environmental restrictions
2. Floods immediately following droughts correspond to heavy sedimentation
3. Two year drying period in CDFs required before dike raising can begin.

Satisfying these three issues requires coordination between when the turning basin is dredged,which CDF is used for disposal, and how much material is disposed into the CDF.

WORK FLOW MODEL

The Work Flow Model(Figure 2) outlines the Decision Support System for the CDF Optimization Tool. This model illustrates the procedure to develop decision making output from stored data, user input, and external data sources. The CDF Optimization Tool acquires input data pertinent to dredging operations in KITB and Savannah Harbor. Analytical

[1]Research Hydraulic Engineer, U.S. Army Corps of Engineers, Coastal and Hydraulics Laboratory, 3909 Halls Ferry Road, Vicksburg, Mississippi 39180, T: 601-634-4174, Fax: 601-634-3080, Email: derek.a.wilson@erdc.usace.army.mil

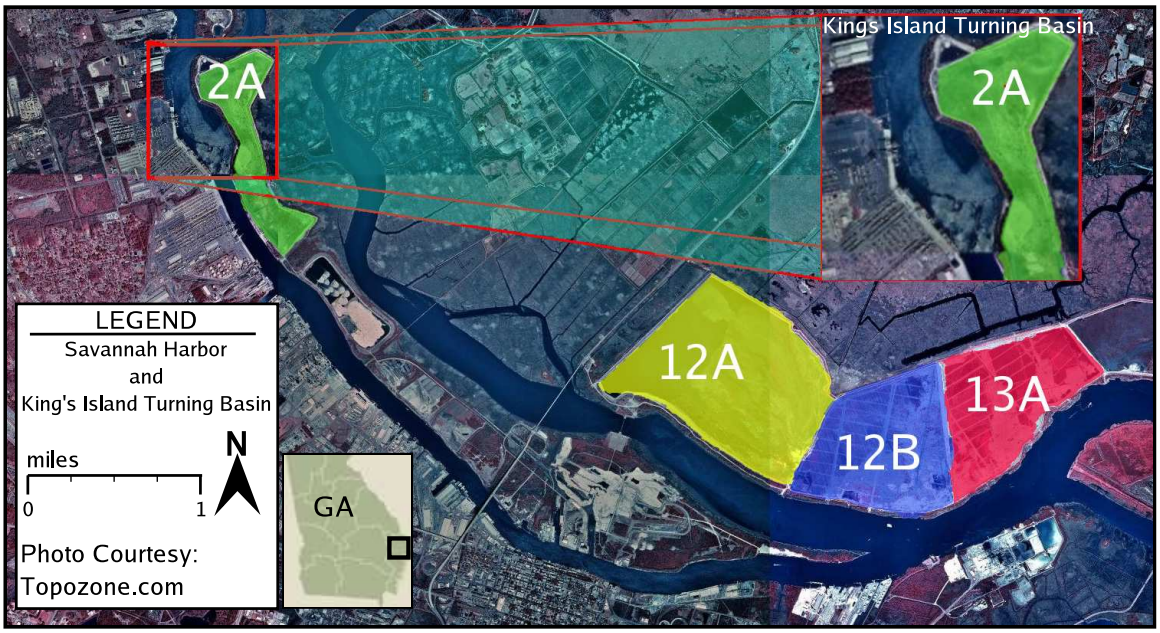

Figure 1:
Savannah Harbor with Kings Island Turning Basin and Confined Disposal Facilities

tools process these data and stored information about KITB and its CDFs. Solution tools develop hypothetical CDF use sequences and dredge schedules from stored information and analytical tool results. Merit evaluation tools determine the rank of each sequence from their properties along with the results from the analytical tools. Sequences with minimum acceptable merit requirements are then listed as operation candidates that provide the decision support for operations managers.

Stored Data

Stored data contain information concerning the present states of the Confined Disposal Facilities available for dredging operations in KITB. Stored data includes information concerning:

a. CDF capacity

a. CDF volume

a. Use/Drying Status each CDF

These data define the state of the CDFs available when dredging KITB.

Input Data

The CDF Optimization Tool uses input data sources that are pertinent and relevant towards dredging applications. These data sources are not only consistently available, but also easily obtainable primarily from on-line sources.

Hydrologic data

The U.S. Geological Survey(USGS) provides online historic and real-time streamflow data for the Savannah River. The Advanced Hydrologic Prediction Service(AHPS) provides 5-day river forecast of the Savannah River streamflow. These data provide a qualitative description of the sediment load transported to KITB. Dredge operations managers have gained the heuristic knowledge that droughts followed by floods signal heavy sediment loads. Therefore, streamflow data provide a distinct indicator of present and future dredge requirements based on recent and forecast streamflow.

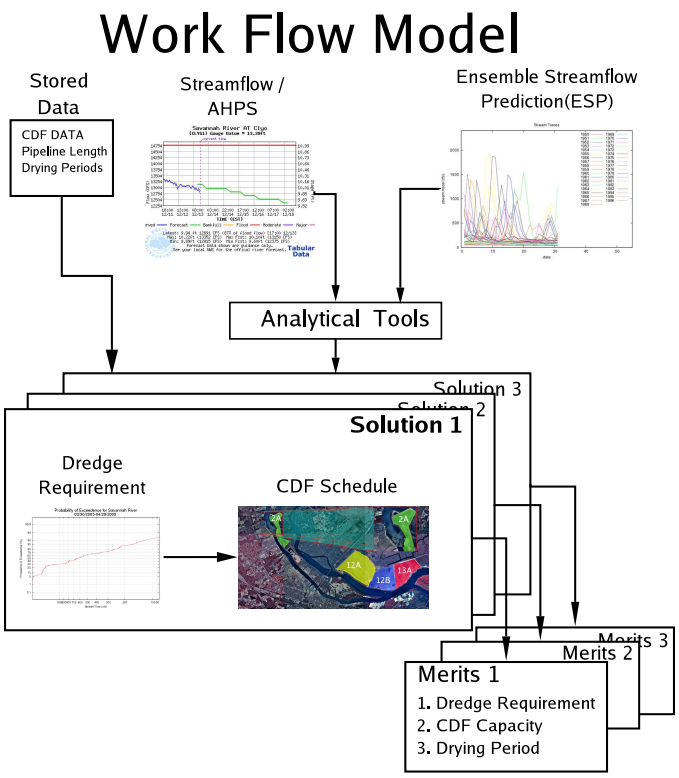

Figure 2:
Workflow Model of the DODSS components

Streamflow prediction

The Southeast River Forecast Center(SERFC) provides Ensemble Streamflow Prediction(ESP) for the Savannah River. ESP provides streamflow probability for up to one year. While these data do not necessarily provide an exact solution to sedimentation estimates, they do provide qualitative estimates to predict dredging requirements in KITB.

Analytical Tools

DODSS developed analytical tools to process input data into discernible results in order to base dredge decisions. Current analytical tools identify the dredging requirement from the ESP and hydrologic input data. These data provide insight as to whether heavy sedimentation will result from flooding immediately following drought conditions.

Long-term probability

The long-term probability tool determines the probability of exceedance(POE) of streamflow in the Savannah River over a 30, 60, 90, 120 or 300 day period as illustrated in Figure 3. This analysis provides operations managers with estimates concerning possible future dredge requirements in KITB.

Near-Term hydrologic conditions

Near-term hydrologic conditions signal whether or not recent streamflow in the Savannah river corresponds to high sedimentation. Analysis determines if, when, and how much flood stage was exceeded since the last dredging operation in KITB as illustrated in Figure 4. Flooding information in the Savannah River serves as a good indicator of whether or not heavy sedimentation occurred in KITB.

Solution Tool

The Solution Tool develops hypothetical operation plans based on the initial conditions of CDF properties and the dredge requirements suggested by the analysis tools. Using rules based programming software, the solution tool

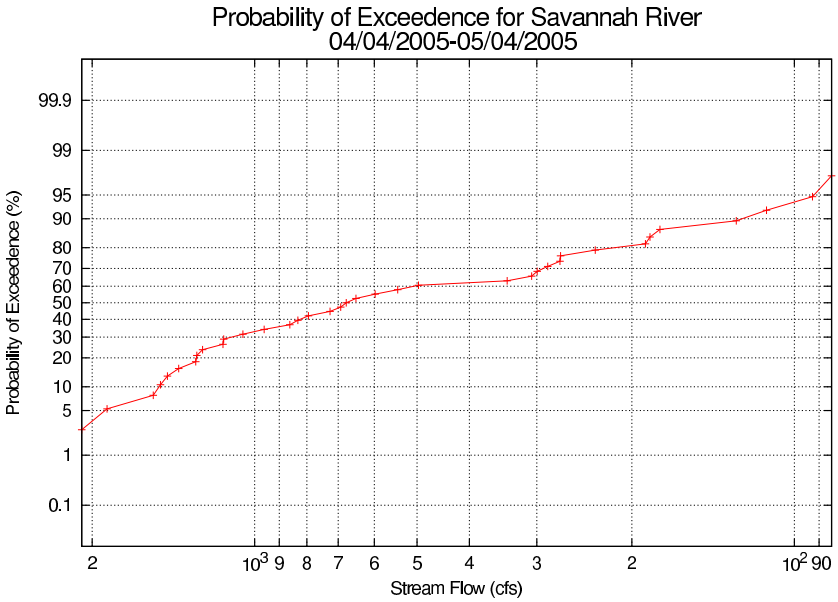

Figure 3:
Probability of exceedance for Savannah River

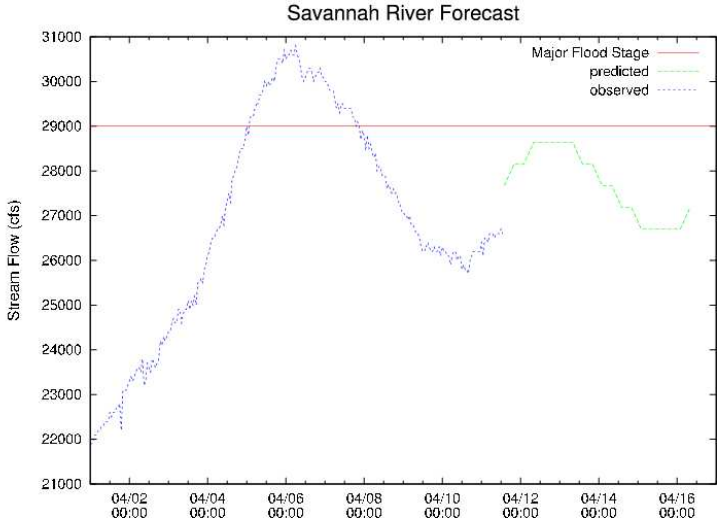

Figure 4:
Savannah River observed and predicted streamflow

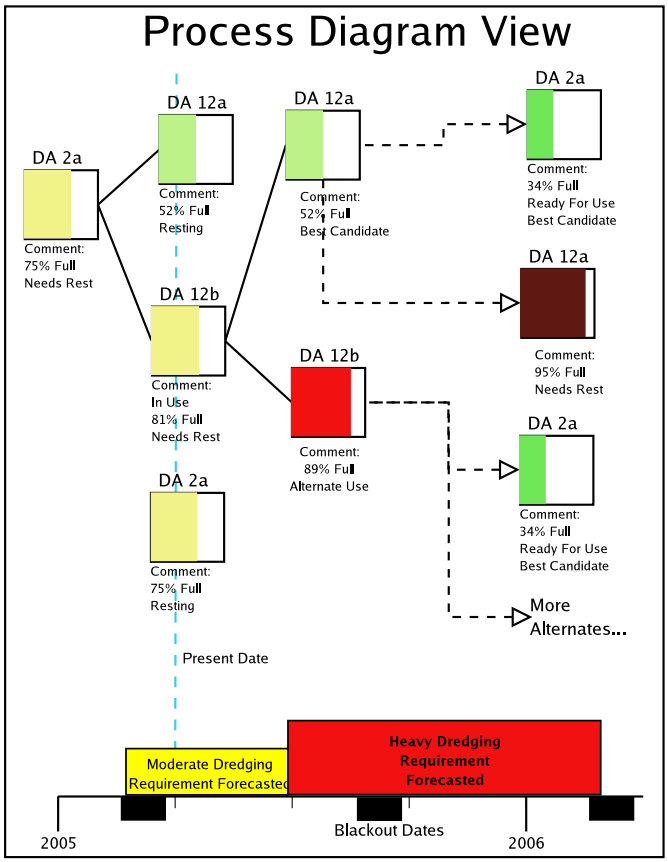

Figure 5:
Disposal area use sequences time-line and dredging requirement.

develops multiple operation solutions based on possible combinations of CDF use sequences. These CDF sequences are illustrated in Figure 5. The CDF sequences provide dredging operations managers with an illustrated time-line of dredging requirements with the future states of the CDFs depending on their use or rest periods. This scheduling tool allows operations managers to view "what if" scenarios to reduce overall uncertainty. Current work with the solution tool involves incorporating factors that further influence the dredge planning process in KITB. These factors include:

1. Current and projected budget over the fiscal year
2. Contract bids on dredging and dike construction projects
3. Analysis to quantify estimated sediment volume based on historical and forecast streamflow.

Integrating these factors into the solution tool will provide operations managers with further flexibility in their decision making process.

CONCLUSIONS

The CDF Optimization Tool develops operation solutions given the knowledge dredge operations managers rely on to make decisions, available pertinent data to base decisions, and engineering principles to analyze and process data. Operation solutions then clarify the future availability of a CDF system with limited capacity and long pipeline distances. With enhancements underway for the solution tool, dredge operations managers will have improved knowledge of the future state of the system and can make more accurate and confident decisions to maintain navigability of Kings Island Turning Basin.

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