

HYDROLOGIC/HYDRAULIC DESIGN ANALYSIS
BELL ROAD CROSSING
OF
MCMICKEN DAM AND RESERVOIR



A202.704

Collar, Williams & White Engineering, Inc.

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HYDROLOGIC/HYDRAULIC DESIGN ANALYSIS

BELL ROAD CROSSING

OF

MCMICKEN DAM AND RESERVOIR

Prepared By:

COLLAR, WILLIAMS & WHITE ENG.
2707 North 44th Street, Suite 205-5
Phoenix, Arizona 85008

October 1986

Job No. 850840-6

CONTENTS

I. INTRODUCTION 1
II. ANALYSIS 3
III. RESULTS 5

APPENDICIES

APPENDIX I - SUMMARY OF MODIFICATION TO SH & B'S HEC-1 MODEL

APPENDIX II - PREVIOUS CORRESPONDENCE ON PROJECT

APPENDIX III - PRINTOUTS OF HEC-1 COMPUTER RUNS (NOT INCLUDED)

- A. EXHIBIT 1 - HEC-1, MODEL #1 EXISTING CONDITION PMP
- B. EXHIBIT 2 - HEC-1, MODEL #2 EXISTING CONDITION 100 YR
- C. EXHIBIT 3 - HEC-1, MODEL #3A NORTH WITH BELL ROAD PMP
- D. EXHIBIT 4 - HEC-1, MODEL #3B SOUTH WITH BELL ROAD PMP
- E. EXHIBIT 5 - HEC-1, MODEL #4 COMBINED WITH BELL ROAD 100 YR
- E. EXHIBIT 6 - HEC-1, MODEL #5 COMBINED WITH BELL ROAD PMP

HYDROLOGIC/HYDRAULIC DESIGN ANALYSIS
BELL ROAD CROSSING
OF
MCMICKEN DAM AND RESERVOIR

I. INTRODUCTION

The proposed extension of Bell Road west across McMicken Dam will divide the existing reservoir area into two parts. The material for road fill is proposed to be obtained from the reservoir area which will result in a net increase in reservoir storage capacity.

The Corps of Engineers (COE) originally designed McMicken Dam under contract to the U.S. Air Force. The operation and maintenance of the dam is currently under the jurisdiction of the Flood Control District of Maricopa County.

The dam is strictly a flood control structure and was designed to provide flood protection to the downstream residential, agricultural, and military areas. As part of the restoration of the dam, in 1983, the firm Sergent, Hauskins, and Beckwith (SH & B) conducted a surface water hydrology study for the Flood Control District to determine if the dam's spillway could safely pass the probable maximum flood. Their study did indicate that the probable maximum flood (PMF) can be safely passed.

The Sergent, Hauskins, and Beckwith study estimated the 100 year flood peak to be 56,200 cfs which they used to calibrate the Basin HEC-1 model used to predict the probable maximum flood.

Our design of the roadway embankment hydraulically connects the two parts of the reservoir with culverts. The culverts are designed to maintain the following conditions.

1. To minimize interference with the cross drainage from South to North within the reservoir area, the positive gradient to the outlet will be maintained to allow the reservoir to drain as previously designed. With water at the spillway crest, the reservoir is supposed to drain within 3 to 4-1/2 days;

2. To allow passage of water from either side of the roadway embankment to maintain the existing 100 year flood level on both sides of the reservoir;
3. To allow passage of water through the roadway embankment at such a rate that there is no increase in the peak elevation of the water on either side of the road, in the reservoir for the PMF, or the 100 year event.

We modified the HEC-1 model created by Sergeant, Hauskins, & Beckwith, to analyze the PMP and to establish the 100 year flood elevation. The elevation storage capacity relationship presented in the original COE design and the spillway elevation discharge relationship also prepared by the COE were used. The recent restoration work on the dam supposedly restored the embankment elevation to 1361.0 feet, the original design height; however our field inspection and right-of-way topographic survey along the proposed alignment of Bell Road indicates the actual top of the dam is currently at 1362.0 feet.

Although old, the original elevation storage relationships should be safe to use since subsidence and excavation during the restoration work would have only increased the storage capacity over the original design. The low flow outlet characteristics were modified to reflect actual as built dimensions and the elevation discharge relationship developed by Tim Sutko of MCFCD was used. The modified HEC-1 model was used to route the inflow hydrograph from the drainage area above the portion of the reservoir South of Bell Road into that part of the reservoir with no outlet and then an appropriate size culvert was determined. Next the Trilby Wash inflow to the Northern portion of the reservoir was run with the South area cut off. The combined model of the entire reservoir area with the two parts connected by the culverts was then run to see that the water surface properly equalized on both sides of the embankment, and the reservoir drained within the design time.

II. ANALYSIS

The following HEC-1 models were created to analyze the effect of the road crossing on reservoir water levels and to size the culverts connecting the two reservoir areas.

1. The original SH & B HEC-1 model of existing conditions was revised to: reflect the total drainage area; correct the PMP precipitation total; improve the watershed routing configuration; and include the McMicken Dam outflow rating curve developed by the FCD staff. Results for the 72 hour PMP event show water overtopping the dam 0.50 feet at an elevation of 1361.50.
2. The same existing condition model (#1) was run with the 100 year 24 hour precipitation event to determine the 100 year water surface elevation. The results indicate the 100 year water surface elevation at 1354.44 feet.
3. As a worst case situation Bell Road was assumed to completely cut the reservoir into two independent sections. The 72 hour PMP event was centered separately over each reservoir section's tributary watershed to determine the maximum probable water surface elevation.
 - (a) Section North of Bell Road - The existing condition model (#1) was modified to reflect available reservoir storage on the north side of Bell Road only. Contributing tributary areas and the reservoir storage area south of Bell Road were eliminated. The resulting maximum water surface elevation is 1361.40 feet.
 - (b) Section South of Bell Road - The existing condition model (#1) was modified to reflect available reservoir storage on the south side of Bell Road only. Tributary areas north of Bell Road were eliminated. The PMP precipitation was centered over the White Tank Mountain tributary watersheds. Bell Road was modeled with a crown elevation equal to the top of the dam and with no low flow outlet. The resulting maximum probable water surface elevation is 1361.24 feet.

The results of these models (#1, #3a, #3b) show the crossing of Bell Road, even if it completely cut the reservoir into two separate parts, will not cause an increase in water surface elevations for the worst case situation, the Probable Maximum Flood.

Model (#2) of existing conditions for the 100 year 24 hour event was used to establish the actual design elevation for Bell Road through the reservoir area. The 100 year water surface elevation of 1354.44 obtained from Model #2, was rounded up to the nearest half foot and one foot of freeboard was added to obtain an elevation of 1355.5 feet.

Because the addition of Bell Road, even without culverts, will not adversely affect water levels in McMicken Dam, culverts are only needed to insure proper drainage of the southern reservoir area within the design drainage time. Various size culverts were analyzed and appropriate rating curves developed in the following models.

4. The existing condition 100 year 24 hour model (#2) was modified to reflect the addition of Bell Road with two 10 x 10 foot culverts. A discharge rating curve was developed for Bell Road with the culverts. Bell Road was modeled as a spillway at an elevation of 1355.5 feet. The McMicken Dam rating curve was adjusted to simulate the shut off of the inflow from the south side when the water surface elevations become equal. This model results in a maximum water surface elevation of 1354.89 feet on the north side.
5. The above model (#4) was also run using the 72 hour PMP event to again check the stability of McMicken dam. The result of this model is a maximum water surface elevation of 1361.39 feet which is below the elevation of existing conditions model (#1).

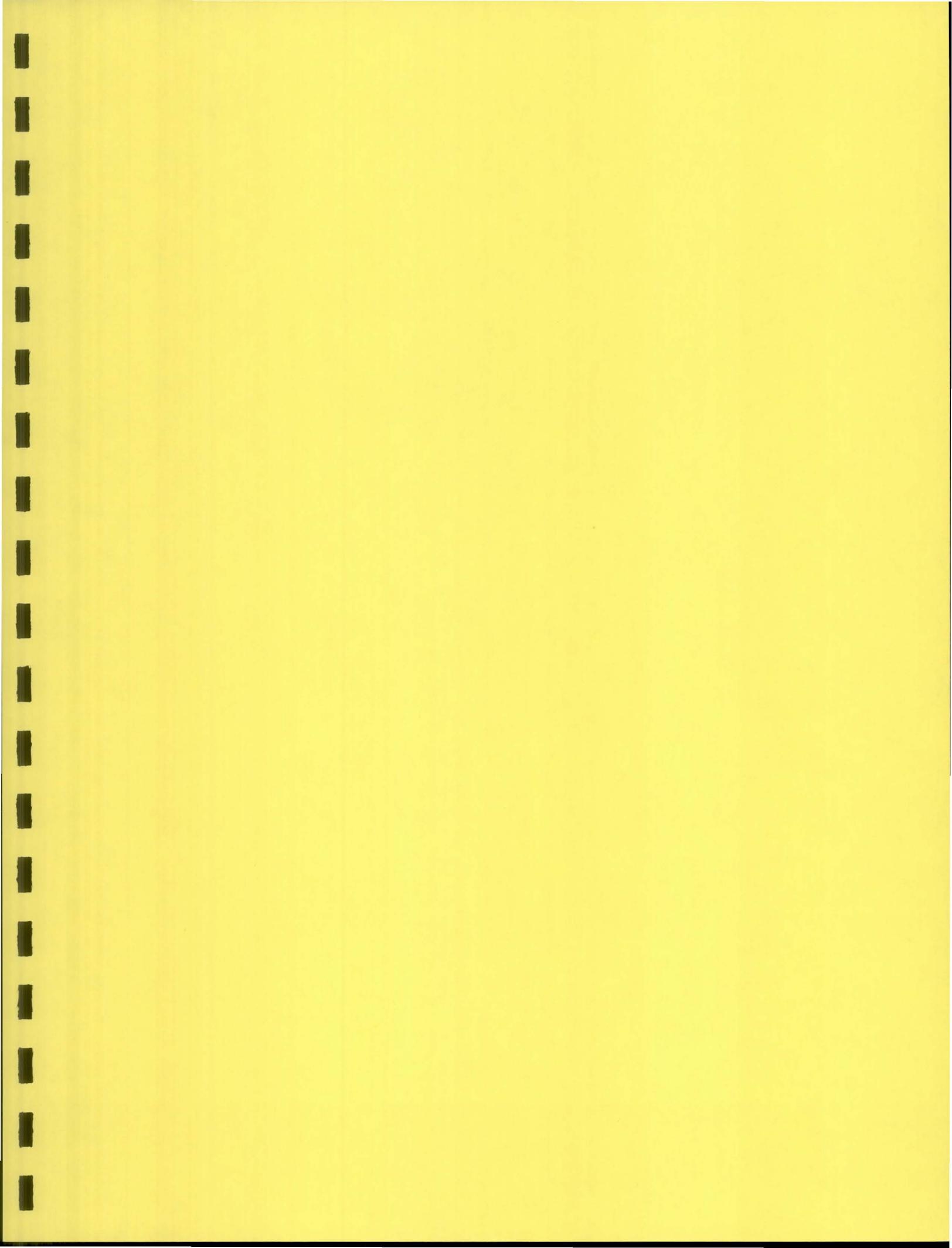
III. RESULTS

Field investigation and a recent topographic survey indicate the top of McMicken Dam is at elevation 1362.0 not 1361.0 as previously assumed.

The original SH & B HEC-1 Model was modified to incorporate all the changes and corrections recommended by ADWR and the FCD staff. The revised HEC-1 Model for the PMP event produced a maximum water surface elevation of 1361.50 feet compared to SH & B's original model which generated a maximum elevation of 1360.8.

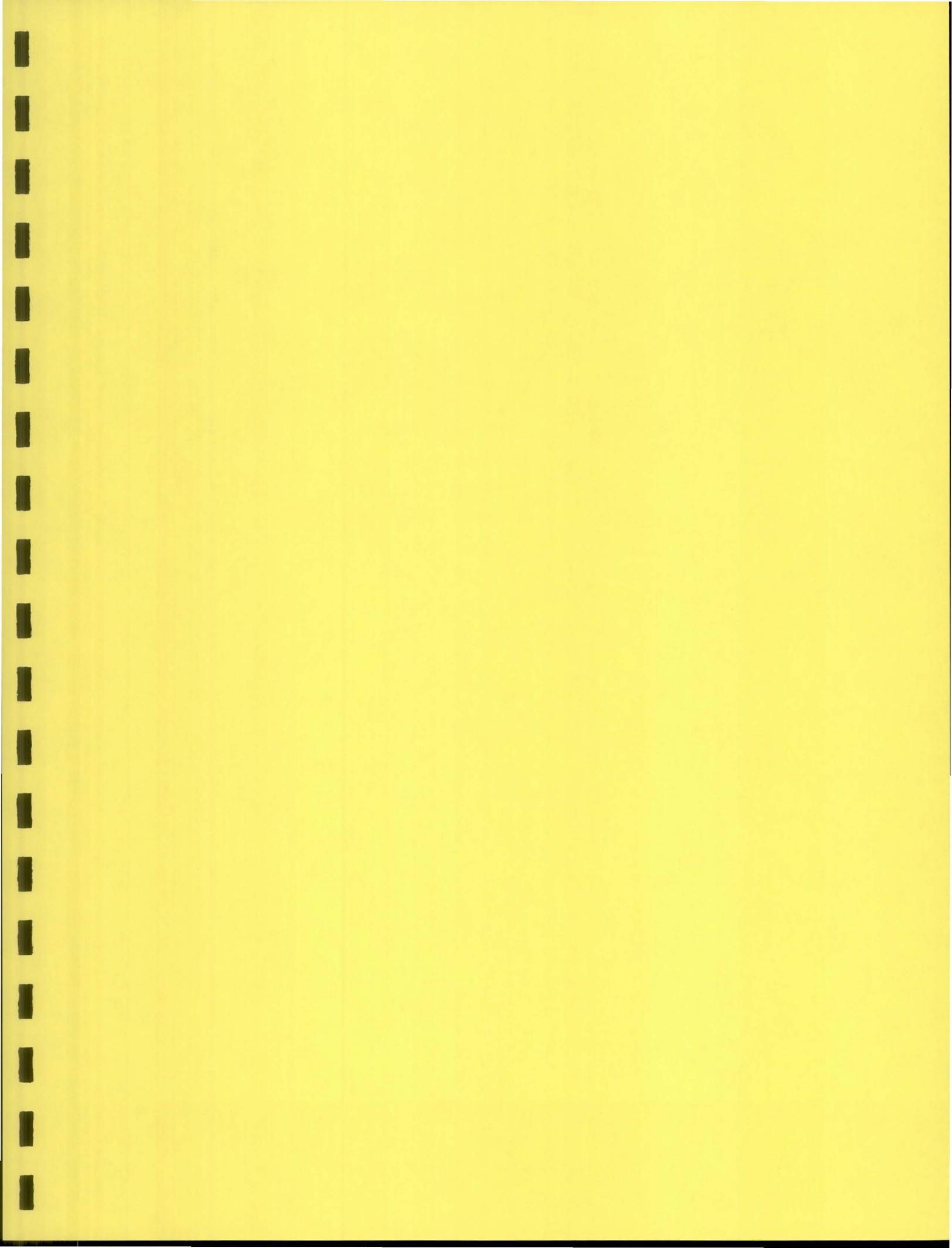
The model, run under several worst case situations, indicated that the addition of the Bell Road crossing will not cause an increase in the maximum water surface elevation during the PMP or the 100 year flood events, even without culverts under the road. The model run for the 100 year event predicted a water surface elevation of 1354.44 feet.

The proposed road design criteria are to construct a minimum road surface elevation through the reservoir at 1355.5 feet, one foot above the 100 year event; and to install two 10 x 10 foot concrete box culverts or the equivalent to permit drainage of the South reservoir area.



APPENDIX I
SUMMARY OF MODIFICATION TO SH & B'S HEC-1 MODEL

1. Total watershed area increased to 247 square miles.
2. The low level outlet works and spillway outflow combined and replaced with the elevation/discharge rating curve provided by FCD staff. This corrects the outlet orifice size and elevation problems in the original model.
3. The PMP precipitation total was increased from 15.0 to 15.7 inches to correct a math error in the original PMP precipitation analysis.
4. HMR-49's isohyetal computation procedure was used to determine precipitation amounts for each subarea. Results indicated that the uniform (general) precipitation over the entire area used in SH & B's original model produces the larger PMF. Therefore, the general storm was used in our analysis of the PMP.
5. The routing error associated with data card 61 RK was corrected.
6. The watershed configuration of subareas and the routing network was changed to better represent the White Tank Mountain tributary areas.



MEMORANDUM

TO: Chief: Engineering Division
Supervisor: Dam Safety Branch
Supervisor: Flood Control Planning Branch
Supervisor: Non-Structural Measures Branch

FROM: David E. Creighton, Jr., P.E.

SUBJECT: Review of Maricopa County Flood Control District hydrologic supporting data for application to repair McMicken Dam (07.21), 1983.

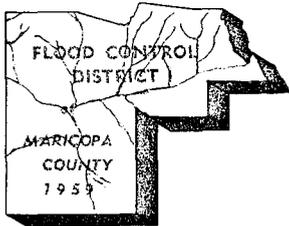
Summary

1. The input data elements which are in error, unsupported, misleading, or of questionable logic are:
 1. The reduction of the watershed from 247 sm. to 236 sm. is unsupported and will reduce the runoff rate and volume, thereby reducing the maximum water surface elevation.
 2. The watershed area delineation is not supported for the changes from the USCE boundary and that are traceable on 7 1/2' quadrangle topography. The drainage area is not defined by drainage course hydrologic units, but by two highways and the CAP Granite Reef Aqueduct which are structures designed on the basis of 50 to 100 year flood flows rather than the PMF which is the criteria for dam safety.
 3. The spillway, outlet works, and dam data input on the SS, SL, and ST cards (lines 113, 114, and 115 respectively) are not in agreement with the AS-BUILT data and drawings submitted by the USCE upon original completion. No justification is given to support the changes.
 - a. Spillway is over-rated by SHB by a variable amount ranging from 78% to 28% of the USCE Design rating, primarily due to SHB using a uniform crest coefficient of 3.087 instead of the variable crest coefficient used by USCE. See attached figure for comparison of the two.
 - b. Outlet works has a different orifice area, orifice center elevation, and 'C' value than the As-Built and design data. SHB also did not treat the OW as a free flow channel at critical depth before the 11'x20' orifice became submerged. The 1335.0 initial elevation on the SL card is supposed to be the free flow grade sill and not the center of the orifice elevation at 1339.61.
 - c. The dam crest length as a weir is different from the As-Built data.

4. If the SHB spillway crest elevation is based on the same bench system used for the dam embankment, the embankment and reservoir storage may have subsided equally. These elevations should be definitively resolved by a level circuit from bed-rock benches. The text statement does not appear to be conclusive.
5. The HEC-1 kinematic wave routing may be inappropriate for the watershed subareas which are greater than the recommended 2 sm. considering the initial methodology was particularly created for small urban watersheds, or to a maximum of 4 to 5 sm.
6. The computer model watershed configuration of subareas and channel network is questionable as appropriately descriptive of the lengths, widths, and areas, particularly in the White Tank Mountains.
7. The precipitation amount and distribution needs to be reviewed under HMR-49 and HMR-36 criteria. The following statement from Paragraph 4.5 Precipitation is of concern for the implication that a pre-established goal of keeping the Max.W.S. elevation below the design dam crest elevation of 1361.0 was the over-riding goal. "Time distribution of the 72-hour rainfall amounts was arranged to minimize the PMF." (emphasis supplied).
8. The use of the HMR-49 isohyetal computation and the derivation of mean subarea precipitation amounts needs to be re-examined.
9. The default instruction error at input data card 61 RK results in a erroneous schematic flow diagram and a computational error. This error drops a channel length of 37,600 ft from the routing of 64,651 cfs from a drainage area of 97.1 sm and translates this Q directly to the spillway structure a flow path distance of over 54,000 ft away from the drop point. The error also routes the 41,406 cfs from the 61.2 sm Subarea 4 through the default main channel length of 8,000 ft, in a 30 ft bottom width channel with 2:1 sideslopes, and a channel slope of 0.2.
10. The Design Storm emphasis on "100 year rainfall" and the "calibration" based on the USGS equation diverts attention from the fact that there are no gaged runoff records upon which to base a calibration. THIS IS NOT A CALIBRATION! to use a regionalized frequency discharge equation which is subject to a significant range of limits of confidence. The Roske equations (ADOT-RS-15(121) Final Report) by the USGS, 1978, in Region 3 (87 Stations) have a standard error of estimate of 66% for the Q100.
11. The Manning's 'n' used in the draft report was 0.05, and in the final report the 'n' used was 0.075. No supporting information is provided to support such a significant increase, neither is there any discussion in deriving the draft 'n'. An

impression is gained that there have been several adjustments in the computations prior to the copy of the single run that is included in the bound report. Adjustments which kept the maximum water surface elevation at 1360.8, just below the dam crest design elevation of 1361.0.

12. The starting of the PMF routing with an empty reservoir is not within the generally accepted policy and criteria of DWR. From Section 5. RESULTS & SUMMARY "At the outset of this study, the concern was that with recent revisions of PMP determinations presented in HMR 49, the spillway would not have the capacity to pass the PMF flood."



FLOOD CONTROL DISTRICT

of

Maricopa County

3335 West Durango Street • Phoenix, Arizona 85009
Telephone (602) 262-1501

BOARD of DIRECTORS

George L. Campbell, Chairman
Carole Carpenter
Tom Freestone
Fred Koory, Jr.
Ed Pastor

D. E. Sagramoso, P.E., Chief Engineer and General Manager

APR 24 1986

Collis Lovely, Senior Hydrologist
Collar, Williams & White Engineering, Inc.
2702 North 44th Street, Suite 205-B
Phoenix, Arizona 85008

Re: Bell Road Crossing of McMicken Dam

Dear Mr. Lovely:

We have reviewed your hydrologic/hydraulic design analysis approach for the proposed Bell Road crossing of McMicken Dam and reservoir. In the third paragraph of your approach, you state that the dam was designed to provide flood protection from the 100 year runoff event for downstream residential and military areas. According to Design Memorandum Number 1, Hydrology and Hydraulic Design for Trilby Wash Detention Basin and Outlet Channel, November 1953, page 20, the design flood for the dam was the standard project flood with a peak inflow of 35,000 cfs. The Flood Control District has negotiations underway with the WLB Group to study the McMicken Dam watershed and determine the level of protection that is provided by the dam using current hydrologic methods. We anticipate that this study will take approximately a year to complete. Until the results of the study are reviewed and accepted by the District, we will be unable to determine the precise level of protection afforded by the dam. We will also be unable to assess the adequacy of low flow structures beneath the proposed road until further information is received on lesser frequency (10, 50, 100 year) flood events. You will have to generate this information if your schedule is such that you can not wait for the results of the WLB study.

Your proposal to use a modified version of the 1983 Sargent, Hauskins & Beckwith (SHB) hydrology may not be adequate to supply the needed information for the lesser frequency flood events. The SHB report assumed worst case routing conditions in which major structures were overtopped. This may not be the case for lesser frequency events. Also, the 100 year flood peak of 56,200 cfs that is discussed in the SHB report is based on a gross approximation given the general characteristics of the watershed. The intent of including this approximation in the report was to help calibrate the HEC-1 model for the PMP event. It was not intended for use as an accurate assessment of low flow conditions behind the dam for the purpose of balancing flows in the reservoir as your project entails.

Since the effect of the proposed roadway construction is to divide the reservoir into two parts and to perhaps divide the watershed, the assumptions made in the SHB study for storm positioning over the watershed and for runoff routing may not be valid for your case. The effect that the proposed roadway embankment will have on dividing the reservoir will depend on its height and length as it passes through the reservoir. In order to adequately address the effect on the safety of the dam, we feel the hydrologic modeling should consider positioning the storm over the divided dam in three ways: to produce the greatest volume of runoff south of the new road embankment and evaluate routing, to produce the greatest volume of runoff north of the new road embankment and evaluate routing, and in a position that would produce the highest volume of runoff overall. In this fashion, the true effect of the new embankment on the safety of the dam can be evaluated.

Your assumption that the original elevation storage relationships should be safe to use, since subsidence and excavation during the restoration have probably increased storage capacity, appears to be a conservative approach. However, the WLB study will include an assessment of actual storage capacity behind the dam using new topography with four foot contour intervals.

Given the state of our current knowledge of the routing and storage upstream of McMicken Dam, it would be desirable to have the results of the WLB study in order to assess the impact of constructing Bell Road through the reservoir. If you are unable to await the results of the WLB study, we request that you conduct your own detailed study of the watershed contributing to the dam in order to assess the impact of the proposed road for low-flow (10, 50, 100 year) conditions as well as for the probable maximum flood. The results of your study will be reviewed by the State Dam Safety Division as well as the Flood Control District. You should also begin studying the effects that your proposed development will have on the watershed and possibly the dam.

Sincerely,



D. E. Sagramoso P.E.

Collar, Williams & White Engineering, Inc.

DONALD H. COLLAR, P.E.
President
ROBERT R. WAGONER, P.E., R.L.S.
Vice President

Consulting Engineers

2702 N. 44th Street, Suite 205-B
Phoenix, Arizona 85008
(602) 957-3350

GEORGE J. TEPLY, P.E.
ROBERT E. MOHNING, P.E.
LES F. OLSON, P.E., R.L.S.
DON L. FERRIS JR., PE., R.L.S.
JAMES B. BAKKEDAHL, P.E.
ROBERT S. MITCHELL, P.E., R.L.S.
KEN DYER, P.E.
WM. ROSS NELSON, R.L.S.
GERALD RASMUSSEN, R.L.S.
RANDY DELBRIDGE, R.L.S.

April 3, 1986

Maricopa County Flood Control District
3325 West Durango Street
Phoenix, AZ 85009

Attention: Mr. Dan Sagramoso
Chief Engineer

Re: White Tank Mountains
Phase I Road Design - McMicken Dam Crossing
CWW NO. 850840-06

Dear Mr. Sagramoso:

We have been retained by The Adams Group to design the extension of Bell Road west across McMicken Dam. In conversation with various members of your staff, it appears the proposed extension of Bell Road over McMicken Dam will require several different reviews and permits before construction can begin.

This letter is in specific regard to hydrologic/hydraulic analysis required and the reviews and permits associated with the portion of the road crossing the dam and passing through the reservoir area West of the dam.

We have talked with Edward Raleigh, about dam safety concerns; Dave Johnson about floodplain encroachments; and Teresa Dominguez concerning the upcoming Area Master Drainage Study. It was suggested by your staff that we provide you with a written analysis approach which we have attached for your review and approval.

Could you please provide us with a written response as to your recommendations in regard to our proposed analysis approach. In addition could you provide us with a complete list of: different reviews and permits that will be required by your various departments; any other related permits that you will require from other agencies; the estimated review time required before actual construction can begin; and appropriate staff contacts if different than those mentioned above.



Scottsdale Office:
2922 N. 70th Street
Scottsdale, Arizona 85251
(602) 947-5433

Maricopa County Flood Control District

Attention: Mr. Dan Sagramoso

Chief Engineer

Re: White Tank Mountains

Phase I Road Design - McMicken Dam Crossing

CWW NO. 850840-06

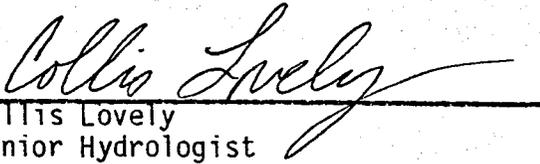
April 3, 1986

Page Two

Thank you for your cooperation, the above information will help us plan the most efficient approach to the design and approval of this project.

Respectfully submitted,

COLLAR, WILLIAMS, & WHITE ENG., INC.


Collis Lovely
Senior Hydrologist

LF0/CL/s1

cc: Don Ferris
Adams Group
Ed Ralieggh, MCFCD
Dave Johnson, MCFCD
Teresa Domingez, MCFCD

Attachment

PROPOSED HYDROLOGIC/HYDRAULIC DESIGN ANALYSIS APPROACH
BELL ROAD CROSSING OF McMICKEN
DAM AND RESERVOIR

The proposed extension of Bell Road west across McMicken Dam will divide the existing reservoir area into two parts. The material for fill on both sides of the dam is proposed to be obtained from the reservoir area which will result in a net increase in reservoir storage capacity.

The Corps of Engineers originally designed McMicken Dam under contract to the U.S. Air Force. The operations and maintenance of the dam is currently under the jurisdiction of the Flood Control District of Maricopa County.

It is our understanding that the dam was designed to provide flood protection from the 100 year runoff event for downstream residential and military areas. As part of the restoration of the dam, in 1983, the firm of Sergent, Hauskins, and Beckwith conducted a surface water hydrology study for the Flood Control District to determine if the dam's spillway could safely pass the probable maximum flood. Results indicate that the probable maximum flood (PMF) can be safely passed.

The Sergent, Hauskins, and Beckwith study also determined the 100 year flood peak to be 56,200 cfs which they used to calibrate the Basin HEC-1 model for predicting the probable maximum flood.

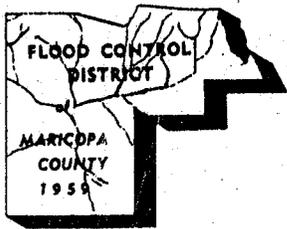
In our design analysis for the roadway embankment, we proposed to hydraulically connect the two parts of the reservoir with culverts which could act as control structures if necessary. The culverts will be designed:

- 1) So as not to interfere with the cross drainage from South to North within the reservoir area. The positive gradient to the outlet will be maintained to allow the reservoir to drain as previously designed. At the spillway crest the reservoir is supposed to drain within 3 to 4-1/2 days;
- 2) To allow passage of water from either side of the roadway embankment to maintain the existing 100 year flood level on both sides of the reservoir;
- 3) To allow passage of water through the roadway embankment at such a rate so that the reservoir doesn't spill sooner than it currently would, nor, at the same time causing an increase in the elevation of the outflow for the PMF.

We propose to use the HEC-1 model created by Sergent, Hauskins, & Beckwith, and the 100 year peak inflow of 56,200 cfs to establish the 100 year flood elevation; the elevation storage capacity relationship presented in the original COE design; and the spillway elevation discharge relationship also prepared by the COE. The spillway dimensions were confirmed by Sergent, Hauskins, & Beckwith in 1983, and the recent restoration work on the dam restored the embankment elevation to 1361 feet, the original design height.

Although old, the original elevation storage relationships should be safe to use since subsidence and excavation during the restoration work have probably increased the storage capacity over the original design.

Modifying the HEC-1 model as needed, the inflow hydrograph from the drainage area above the portion of the reservoir South of the proposed Bell Road alignment will be routed into that part of the reservoir, and then the appropriate size culvert will be determined. Next the Trilby Wash inflow to the Northern portion of the reservoir will be routed in and the appropriate size culvert determined. The combined model of the entire reservoir area with the two parts connected via the resulting culverts will be run to check the interaction between the two parts of the reservoir, to see that water surface properly equalizes on both sides of the embankment.



FLOOD CONTROL DISTRICT of Maricopa County

Interoffice Memorandum

CMT. NO.	SUBJECT: REVIEW OF ROADWAY PLANS SUN VALLEY PARKWAY, PHASE I, II & III	<input type="checkbox"/> FILE _____
		<input type="checkbox"/> DESTROY _____
TO:	FROM:	DATE:
NICK ICARAN DAVE JOHNSON	DICK PERREAU	17 DEC 86
<p>① ATTACHED IS A COPY OF THE BELL RD. EXTENSION PLANS (SHEETS ¹/₂ 10 THRU 15) ¹/₂ FOR 291ST AVE, (1 THRU 5 OF 93).</p> <p>② Please review & comment on the impact that this roadway would have on our structures and list any recommended changes.</p> <p>③ Please return comments to me by <u>12 JAN 87</u>.</p> <p>Thanks, D.L.C.</p> <p>14 JAN 87 - Check w/ NPK/TAD; plans sent to DRJ, no impact.</p>		

COLLAR, WILLIAMS & WHITE ENGINEERING, INC.



Civil Engineers, Land Surveyors and
Aerial Mapping

2702 N. 44th STREET
SUITE 205-B
PHOENIX, ARIZONA 85008
PHONE 957-3350

LETTER OF TRANSMITTAL

DATE <i>12-8-86</i>	JOB NO. <i>850840</i>
ATTENTION <i>Richard G. Perreault</i>	
RE:	

TO *Flood Control Dist. of Maricopa Co.*
3335 W. Durango
Phoenix, Az. 85009

GENTLEMEN:

WE ARE SENDING YOU HEREWITH UNDER SEPARATE COVER VIA

COPIES OF THE FOLLOWING ITEMS:

- PLANS ORIGINALS COPY OF LETTER SPECIFICATIONS REPORTS
 PRINTS OF THE FOLLOWING: _____

**FLOOD CONTROL DISTRICT
RECEIVED**

DEC 9 1986

CH ENGR	P & PM
DEP	HYDR
ADMIN	LMGT
FINANCE	FILE
C & O	
ENGR	<i>86/</i>
REMARKS	

<p>PLATS:</p> <p>_____ PRELIMINARY PLAN</p> <p>_____ PRE-FINAL</p> <p>_____ FINAL</p> <p>_____</p> <p>_____</p> <p>PLANS:</p> <p>_____ MASTER PLAN</p> <p>_____ SITE STUDIES</p> <p>_____ SKETCH</p> <p>_____ WATER</p> <p>_____ SEWER</p> <p><input checked="" type="checkbox"/> _____ PAVING</p> <p><input checked="" type="checkbox"/> _____ GRADING & DRAINAGE</p> <p>_____ BOUNDARY & TOPOGRAPHY</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>	<p>REPORTS & DESCRIPTIONS:</p> <p>_____ SOILS TEST REPORT</p> <p>_____ LEGAL DESCRIPTION</p> <p>_____ COST ESTIMATES</p> <p>_____ SURVEY</p> <p>_____ DRAINAGE STUDY</p> <p>_____ CALCULATIONS</p> <p>HEALTH DEPARTMENT FORMS</p> <p>_____ SUBDIVISION APPLICATION</p> <p>_____ APPLICATION FOR APPROVAL TO CONSTRUCT</p> <p>_____ WATER SERVICE AGREEMENT</p> <p>_____ SEWER SERVICE AGREEMENT</p> <p>_____ GARBAGE SERVICE AGREEMENT</p>
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FEE IN THE AMOUNT OF \$ _____
FOR _____

- THESE ARE TRANSMITTED as checked below:
- FOR REVIEW FOR APPROVAL ESTIMATING ONLY SIGNATURE
 PER YOUR REQUEST FOR YOUR USE FOR BID RESUBMIT FOR APPROVAL
- _____

REMARKS: _____

COPY TO: _____

VERY TRULY YOURS
COLLAR, WILLIAMS & WHITE ENGINEERING, INC.
CONSULTING CIVIL ENGINEERS

Signed *Tom R. Adams*

If enclosures are not as noted, kindly notify us at once.

There have been some questions raised by ADWR concerning the adequacy and correctness of the hydrology generated by Sargent Hauskins and Beckwith (S.H&B) for the design of McMicken Dam and its spillway. S.H & B has been informed of ADWR's concerns. The Hydrology division has addressed these questions and adjusted the HEC-1 hydrology model created by S.H&B to more correctly model the watershed. A copy of the memo submitted by ADWR listing their concerns and hydrology's response is attached. The major result of these questions is that due to a math error in the computation of the Probable Maximum Precipitation hyetograph, the dam appears to be inadequately sized. Use of the PMP event as the design storm results in McMicken Dam being overtopped by approximately 0.58'.

The WLB Group is in the process of re-modeling the watershed above McMicken Dam in conjunction with the FCD sponsored Wittman Area Drainage Master Study, and it is expected that their modeling of the area will more definitively determine the adequacy of this structure. At the same time, the engineering firm of Collar, Williams and White is in the process of designing the Bell Road crossing of McMicken Dam and need to know the maximum height of the dam which they need to consider. In an effort to provide an interim estimate of the elevation of the top of the dam which would prevent the structure from being overtopped, the HEC-1 model was run using the same outlet rating curve and area-volume-elevation curve, but allowing the model to extrapolate values for these curves above the elevation of 1361.0'. While the model may still be lacking in some respects, the results should be reasonable. These results indicate that, given the existing outlet works, the top of the dam should be raised to 1363.0'. However, while this elevation will prevent the dam from being overtopped, it will result in a peak discharge through the outlet works of 143,000 cfs. The spillway channel downstream has a design capacity of only 22,000 cfs, the discharge from the outlet works for the Spillway design flood.

FLOOD CONTROL DISTRICT

of

Maricopa County

1115 West Dunsmuir Street • Phoenix, Arizona 85001
Telephone (602) 262-1301

BOARD OF DIRECTORS

George J. Campbell, Chairman
Carole Carpenter
Tom Freestone
Fred Kooy, Jr.
Ed Pastor

D. L. Sagamoso, P.E., Chief Engineer and General Manager

APR 24 1986

Collis Lovely, Senior Hydrologist
Collar, Williams & White Engineering, Inc.
2702 North 44th Street, Suite 205-B
Phoenix, Arizona 85008

Re: Bell Road Crossing of McMicken Dam

Dear Mr. Lovely:

We have reviewed your hydrologic/hydraulic design analysis approach for the proposed Bell Road crossing of McMicken Dam and reservoir. In the third paragraph of your approach, you state that the dam was designed to provide flood protection from the 100 year runoff event for downstream residential and military areas. According to Design Memorandum Number 1, Hydrology and Hydraulic Design for Trilby Wash Detention Basin and Outlet Channel, November 1953, page 20, the design flood for the dam was the standard project flood with a peak inflow of 35,000 cfs. The Flood Control District has negotiations underway with the WLB Group to study the McMicken Dam watershed and determine the level of protection that is provided by the dam using current hydrologic methods. We anticipate that this study will take approximately a year to complete. Until the results of the study are reviewed and accepted by the District, we will be unable to determine the precise level of protection afforded by the dam. We will also be unable to assess the adequacy of low flow structures beneath the proposed road until further information is received on lesser frequency (10, 50, 100 year) flood events. You will have to generate this information if your schedule is such that you can not wait for the results of the WLB study.

Your proposal to use a modified version of the 1983 Sergent, Hauskins & Beckwith (SHB) hydrology may not be adequate to supply the needed information for the lesser frequency flood events. The SHB report assumed worst case routing conditions in which major structures were overtopped. This may not be the case for lesser frequency events. Also, the 100 year flood peak of 56,200 cfs that is discussed in the SHB report is based on a gross approximation given the general characteristics of the watershed. The intent of including this approximation in the report was to help calibrate the HEC-1 model for the PMP event. It was not intended for use as an accurate assessment of low flow conditions behind the dam for the purpose of balancing flows in the reservoir as your project entails.

Since the effect of the proposed roadway construction is to divide the reservoir into two parts and to perhaps divide the watershed, the assumptions made in the SHB study for storm positioning over the watershed and for runoff routing may not be valid for your case. The effect that the proposed roadway embankment will have on dividing the reservoir will depend on its height and length as it passes through the reservoir. In order to adequately address the effect on the safety of the dam, we feel the hydrologic modeling should consider positioning the storm over the divided dam in three ways: to produce the greatest volume of runoff south of the new road embankment and evaluate routing, to produce the greatest volume of runoff north of the new road embankment and evaluate routing, and in a position that would produce the highest volume of runoff overall. In this fashion, the true effect of the new embankment on the safety of the dam can be evaluated.

Your assumption that the original elevation storage relationships should be safe to use, since subsidence and excavation during the restoration have probably increased storage capacity, appears to be a conservative approach. However, the WLB study will include an assessment of actual storage capacity behind the dam using new topography with four foot contour intervals.

Given the state of our current knowledge of the routing and storage upstream of McMicken Dam, it would be desirable to have the results of the WLB study in order to assess the impact of constructing Bell Road through the reservoir. If you are unable to await the results of the WLB study, we request that you conduct your own detailed study of the watershed contributing to the dam in order to assess the impact of the proposed road for low-flow (10, 50, 100 year) conditions as well as for the probable maximum flood. The results of your study will be reviewed by the State Dam Safety Division as well as the Flood Control District. You should also begin studying the effects that your proposed development will have on the watershed and possibly the dam.

Sincerely,

D. E. Sagramoso P.E.

DES/EAR/sy

4/23/86

COORD:

~~TAD~~

~~DRJ~~

~~NPK~~

SLS

FILE:

Collar, Williams & White Engineering

DONALD H. COLLAR, P.E., R.L.S.
President
ROBERT R. WAGONER, P.E., R.L.S.
Vice President

Consulting Engineers
2702 N. 44th Street, Suite 205-B
Phoenix, Arizona 85008
(602) 957-3350

October 15, 1986

Mr. D.E. Sagramoso, P.E.
Chief Engineer
Flood Control District Maricopa County
3335 West Durango Street
Phoenix, Arizona 85009

Re: Bell Road Crossing of McMicken Dam

Dear Mr. Sagramoso:

Per your letter dated April 24, 1986 we have completed and are enclosing a copy of our analysis of the proposed Bell Road crossing of McMicken Dam, for your review and approval.

In response to Arizona Department of Water Resources Memorandum dated June 21, 1986, our analysis includes review and revision of the HEC-1 computer model completed by Sergent Hauskins and Beckwith after several consultations with Tom LaMarsh and Tim Sutko of your staff.

Our proposed design criteria to construct Bell Road through the reservoir area are summarized as follows:

1. Construct the road surface elevation at 1355.5 one foot above the 100 year water surface elevation.
2. Install two 10 x 10 foot concrete box culverts (or equivalent) for both drainage of the reservoir area south of Bell Road and to allow balancing of flows or water surface elevations on both sides of the road.

Various configurations with and without the Bell Road extension were analyzed for both the 72 hour Probable Maximum Precipitation (PMP) and the 100 year event. The worst case situation was analyzed when Bell Road was assumed to cut the reservoir into two independent sections. The north section was modeled with McMicken Dam's outflow characteristics but without the reservoir storage capacity south of Bell Road. The south section was modeled with no outflow.

Each case produced a maximum water surface elevation slightly below that of the existing conditions model. Our analysis concludes the presence of Bell Road will not adversely affect the integrity of McMicken Dam nor adversely effect the water surface elevations within the reservoir during the PMP or the 100 year event.



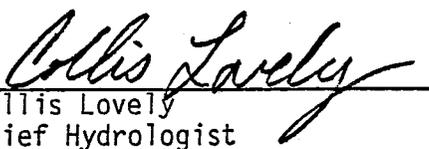
Scottsdale Office:
2922 N. 70th Street
Scottsdale, Arizona 85251
(602) 947-5433

Mr. D.E. Sagramoso
Bell Road Crossing of McMicken Dam
October 10, 1986
Page Two

We trust you will find the enclosed information complete. If you have any questions, or would like to meet to discuss our findings please let us know as soon as possible so we can assist in expediting your review. Thank you for your cooperation.

Respectfully Submitted,

COLLAR, WILLIAMS & WHITE ENG.


Collis Lovely
Chief Hydrologist

CL/tp

Enclosures: 1 - Copy of Analysis Report with HEC-1 Runs
2 - Copies of Analysis Report w/o HEC-1 Runs

cc: Don Ferris
Adams Group

Collar, Williams & White Engineering, Inc.

DONALD H. COLLAR, P.E.
President
ROBERT R. WAGONER, P.E., R.L.S.
Vice President

Consulting Engineers
2702 N. 44th Street, Suite 205-B
Phoenix, Arizona 85008
(602) 957-3350

GEORGE J. TEPLY, P.E.
ROBERT E. MOHNING, P.E.
LES F. OLSON, P.E., R.L.S.
DON L. FERRIS JR., P.E., R.L.S.
JAMES B. BAKKEDAHL, P.E.
ROBERT S. MITCHELL, P.E., R.L.S.
KEN DYER, P.E.
WM. ROSS NELSON, R.L.S.
GERALD RASMUSSEN, R.L.S.
RANDY DELBRIDGE, R.L.S.

April 3, 1986

Maricopa County Flood Control District
3325 West Durango Street
Phoenix, AZ 85009

Attention: Mr. Dan Sagramoso
Chief Engineer

Re: White Tank Mountains
Phase I Road Design - McMicken Dam Crossing
CWW NO. 850840-06

Dear Mr. Sagramoso:

We have been retained by The Adams Group to design the extension of Bell Road across McMicken Dam. In conversation with various members of your staff, it appears the proposed extension of Bell Road over McMicken Dam will require several different reviews and permits before construction can begin.

This letter is in specific regard to hydrologic/hydraulic analysis required and the reviews and permits associated with the portion of the road crossing the dam and passing through the reservoir area West of the dam.

We have talked with Edward Raleigh, about dam safety concerns; Dave Johnson about floodplain encroachments; and Teresa Dominguez concerning the upcoming Area Master Drainage Study. It was suggested by your staff that we provide you with a written analysis approach which we have attached for your review and approval.

Could you please provide us with a written response as to your recommendations in regard to our proposed analysis approach. In addition could you provide us with a complete list of: different reviews and permits that will be required by your various departments; any other related permits that you will require from other agencies; the estimated review time required before actual construction can begin; and appropriate staff contacts if different than those mentioned above.

FLOOD CONTROL DISTRICT
RECEIVED

APR 07 '86

1	CE/ENG	2	HYDRO
	ADMIN		IMPL
	C & O		SUSP
3	FINANCE		FILE
			DESIGN
REMARKS			
HEARD			
STAD			



Scottsdale Office:
2922 N. 70th Street
Scottsdale, Arizona 85251
(602) 947-5433

Maricopa County Flood Control District

Attention: Mr. Dan Sagramoso
Chief Engineer

Re: White Tank Mountains
Phase I Road Design - McMicken Dam Crossing
CWW NO. 850840-06

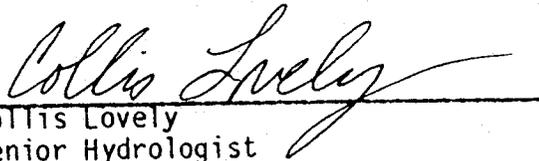
April 3, 1986

Page Two

Thank you for your cooperation, the above information will help us plan the most efficient approach to the design and approval of this project.

Respectfully submitted,

COLLAR, WILLIAMS, & WHITE ENG., INC.



Collis Lovely
Senior Hydrologist

LFO/CL/sl

cc: Don Ferris
Adams Group
Ed Ralieggh, MCFCD
Dave Johnson, MCFCD
Teresa Domingez, MCFCD

Attachment

PROPOSED HYDROLOGIC/HYDRAULIC DESIGN ANALYSIS APPROACH
BELL ROAD CROSSING OF McMICKEN
DAM AND RESERVOIR

The proposed extension of Bell Road west across McMicken Dam will divide the existing reservoir area into two parts. The material for fill on both sides of the dam is proposed to be obtained from the reservoir area which will result in a net increase in reservoir storage capacity.

The Corps of Engineers originally designed McMicken Dam under contract to the U.S. Air Force. The operations and maintenance of the dam is currently under the jurisdiction of the Flood Control District of Maricopa County.

It is our understanding that the dam was designed to provide flood protection from the 100 year runoff event for downstream residential and military areas. As part of the restoration of the dam, in 1983, the firm of Sergent, Hauskins, and Beckwith conducted a surface water hydrology study for the Flood Control District to determine if the dam's spillway could safely pass the probable maximum flood. Results indicate that the probable maximum flood (PMF) can be safely passed.

The Sergent, Hauskins, and Beckwith study also determined the 100 year flood peak to be 56,200 cfs which they used to calibrate the Basin HEC-1 model for predicting the probable maximum flood.

In our design analysis for the roadway embankment, we proposed to hydraulically connect the two parts of the reservoir with culverts which could act as control structures if necessary. The culverts will be designed:

- 1) So as not to interfere with the cross drainage from South to North within the reservoir area. The positive gradient to the outlet will be maintained to allow the reservoir to drain as previously designed. At the spillway crest the reservoir is supposed to drain within 3 to 4-1/2 days;
- 2) To allow passage of water from either side of the roadway embankment to maintain the existing 100 year flood level on both sides of the reservoir;
- 3) To allow passage of water through the roadway embankment at such a rate so that the reservoir doesn't spill sooner than it currently would, nor, at the same time causing an increase in the elevation of the outflow for the PMF.

We propose to use the HEC-1 model created by Sergeant, Hauskins, & Beckwith, and the 100 year peak inflow of 56,200 cfs to establish the 100 year flood elevation; the elevation storage capacity relationship presented in the original COE design; and the spillway elevation discharge relationship also prepared by the COE. The spillway dimensions were confirmed by Sergeant, Hauskins, & Beckwith in 1983, and the recent restoration work on the dam restored the embankment elevation to 1361 feet, the original design height.

Although old, the original elevation storage relationships should be safe to use since subsidence and excavation during the restoration work have probably increased the storage capacity over the original design.

Modifying the HEC-1 model as needed, the inflow hydrograph from the drainage area above the portion of the reservoir South of the proposed Bell Road alignment will be routed into that part of the reservoir, and then the appropriate size culvert will be determined. Next the Trilby Wash inflow to the Northern portion of the reservoir will be routed in and the appropriate size culvert determined. The combined model of the entire reservoir area with the two parts connected via the resulting culverts will be run to check the interaction between the two parts of the reservoir, to see that water surface properly equalizes on both sides of the embankment.

The Adams Group, ETC.



A Subsidiary of Burns International Inc.

DEVELOPMENT/CONSTRUCTION MANAGEMENT/CONSULTATION

May 23, 1986

Mr. George L. Campbell, Chairman
County Board of Supervisors
111 South Third Avenue
Phoenix, AZ 85003

RE: Proposed Parkway - Bell Road to I-10

Dear Mr. Campbell:

At the policy committee meeting on May 21st, there were several questions raised concerning the above Parkway and its method of financing. Please accept this letter with attachments as a clarification of those points brought up at the meeting.

1. Land use plan vs. roadway; which comes first?

As is often the case in a rural area, a roadway is constructed connecting two or more points of use. This is the case with Interstate 17 from Phoenix to Flagstaff and many others. The development occurs after the roadway along the corridor and is very seldom planned in advance of the construction of the road. A better example is Interstate 10, from Phoenix westward. The Estrella Planning Committee, a public/private multijurisdictional planning partnership is charged with developing a comprehensive general plan for the area bordered by Interstate 10, Black Canyon Freeway/19th Avenue, Salt River, and the Agua Fria River.

Of itself, the general plan has little meaning and is totally dependent on the freeway for any viability. So it is with the proposed Parkway. Its east/west connection to Bell Road is a given, its shift slightly to the north of the White Tank Mountain County Park is ordered by the slope of the foothills of the park. On the south end, the existing Interstate 10 at Palo Verde Road is a logical terminus, and its north/south alignment paralleling a major 500 KV transmission line is reasonable. The alignment of the remaining ten plus miles through the 28,000 acres comprising Sun Valley is dictated by the physical features

of the site, such as the Wagner Wash, the topography of dozens of minor washes, power lines, etc. The land plan will also reflect the constraints of contours, power line easements, the C.A.P. and other givens.

Many areas of our state are experiencing the problems that develop when large regional areas such as this are planned first to include a roadway. The road locations as selected more often than not, do not take into consideration the physical features and restraints dictated by the field conditions of the site. The result then, when the actual engineering begins are road locations which are economically unfeasible and not in the best interest of the general public.

The point to remember is that the County Board of Supervisors, via public hearings, will control the land plan as far as uses, densities, etc. The road need not be relocated by the plan, but the master plan will follow all constraints, including the Parkway. While locations of some intersections will obviously depend on an approved plan, the actual alignment itself will not.

2. Maricopa County Highway Maintenance Costs:

Early in our discussion with the County Highway Officials, it was determined that proper design would minimize, if not eliminate any maintenance cost for the first seven or so years. By the use of such items as thermo-plastic paint striping (expensive first cost, but long lasting and requiring no maintenance), desert landscaping (eliminating any mowing or irrigation costs), and other design features, the outlay funds by the County would be extremely low. These high first-cost items are a part of the proposed Parkway construction.

3. Other state(s) use of 63-20 Authority:

A packet of information was supplied to Supervisor Carpenter the afternoon of the 21st and is attached for reference.

4. Effect on the Town of Surprise:

A meeting has been set with Mr. Yingling, Town Manager, for May 28th, at which time we shall review all aspects of the proposed Parkway with him and, although our property lies over ten miles from the current city limits of the Town of Surprise, we will gladly work out any problems that may come up in connection with our plans and how they may impact the Town of Surprise.

5. List of interested agencies/authorities:

A list of contact persons for various interested governmental and other agencies was given to Joan Brown, Assistant to Carole Carpenter, on May 22nd. With her kind efforts, a meeting with all parties is to be set up during the last week in May.

6. Development Master Plan Status:

As mentioned by Mr. Joe Adams in his presentation, a Master Plan, meeting the guidelines of the County Planning Department, is to be submitted the first week in June with such attachments as a preliminary traffic study, water and wastewater plan, hydrology study, drainage study, traffic study, and other support data. Upon staff review and comments, the plan should proceed at a timely pace to the Planning and Zoning Commission and your Board.

7. Question to County Attorney and Bond Counsel:

Mr. Terrance Thompson of Brown & Bain has been in contact with Mr. Fred Rosenfelt on this issue. A letter is forthcoming from Mr. Rosenfelt which is self explanatory.

8. Would land value support the bonds?

Attached is a letter from Mr. Steve Butterfield of Boettcher & Company Inc. which states the affirmative.

We hope this answers the questions and concerns that you may have. If you require further clarification on other points, please feel free to contact our office.

Respectfully,

THE ADAMS GROUP, INC.

Joseph A. Adams
President


Robert M. Williams
General Manager

JAA/RMW:cls

Enclosures



Boettcher & Company
Investment Bankers Since 1910

Suite 100
2621 East Camelback Road
Phoenix, Arizona 85016-4285
(602) 954-0000

2621 East Camelback Road
Phoenix, Arizona 85016-4285

Camelback Road
Phoenix, Arizona 85016-4285

May 22, 1986

Supervisor Carole Carpenter
The County of Maricopa
Board of Supervisors
111 South Third Avenue
Phoenix, AZ 85003

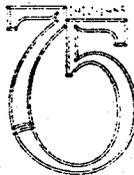
Re: The Adams Group
Sun Valley Arizona Project

Dear Supervisor Carpenter:

As financial advisor to the Adams Group and Bond Underwriter to this project, I am writing to answer your financial question presented in yesterday's meeting regarding the above-referenced project.

More specifically your question was "Is the value of the land sufficient to cover the bonding?" My direct answer after discussions with our bond traders and the individuals who commit our firm's capital is, yes! We are requesting from the developers on behalf of the potential bondholders a ratio of between 2.5 and 3 times coverage as a land value to improvements ratio. Therefore to finance \$60,000,000 in bonds the 44,000 acre development would have to have an appraised value of between \$150,000,000 to \$180,000,000 for the financing to proceed.

Therefore, the estimated current value of \$350,000,000 to \$400,000,000 will provide an excellent security for the proposed financing. The bondholders will have a first lien on the property which will be voluntarily placed on the property by the landowner. This is the same security associated with a County Improvement District under our current Arizona laws and a format which investors have seen before.



Supervisor Carole Carpenter

May 22, 1986

Page 2

We believe these bonds to be of great interest to institutional investors who are seeking long-term fixed interest rates for a non-rated bond. In fact our firm will commit our capital to purchase the securities on behalf of the project. Having recently been acquired by The Kemper Insurance Company and its \$7.5 billion in assets we believe that the financing will be successful and a tool for Municipalities and developers across our state to use in meeting its future capital needs.

I appreciate your willingness to review the financing questions and I remain available to you if I can provide any assistance relating to this project.

Thank you for your cooperation.

Very truly yours,

BOETTCHER & COMPANY, INC.

Stephen F. Butterfield

Stephen F. Butterfield
Senior Vice President

SFB/kg



Arizona Department of Water Resources

Engineering Division
2702 N. 3rd Street, Suite 2010
Phoenix, Arizona 85004
(602) 255-1541

Evan Mecham, Governor
Alan P. Kleinman, Director

July 2, 1987

Mr. Dan Sagramoso
Chief Engineer & General Manager
Flood Control District of Maricopa County
3335 West Durango
Phoenix, Arizona 85009

Subject: Alteration to McMicken Dam (07.21)
Sun Valley Parkway Crossing

Dear Mr. Sagramoso:

We have completed our review of the Application for Alteration to McMicken Dam including the construction drawings and specifications and hereby approve that Application. An approved set of drawings and the approved Application are transmitted with this letter.

We wish to reiterate the condition of approval mentioned in the application that "no foundations or abutments shall be covered by the materials of the dam until the Department has been given an opportunity to inspect and approve the same". Further, you will be required to submit the as-built drawings after completion of the project. We will expect that they will reflect the true and existing elevations at the location of the Parkway crossing of McMicken Dam.

Sincerely,

Doug Toy, P.E.
Deputy Director
Engineering

zq

c: Collar, Williams & White Engineers

Enclosures

FLOOD CONTROL DISTRICT RECEIVED	
AUG 06 87	
CH ENG	P & PM
DEP	HYDRO
ADMIN	LMGT
FINANCE	FILE
C & O	RGP
ENGR	
REMARKS	

State of Arizona
Department of Water Resources
Division of Safety of Dams

RECEIVED
MAR 6 1987
WATER RESOURCES

Application No. 07.21 Filed March 6, 1987
(Applicant shall not fill in above blanks)

**APPLICATION FOR THE APPROVAL OF THE PLANS AND SPECIFICATIONS
FOR THE CONSTRUCTION, ENLARGEMENT, REPAIR, ALTERATION OR REMOVAL
OF A DAM AND RESERVOIR**

(This application involves in no way the right to appropriate water. To secure the right to appropriate water, application has to be made to the Department of Water Resources, Division of Water Rights on forms which will be furnished upon request.)

This application is for the Alteration of the McMicken Dam.
(Construction, Repair, Alteration, Etc.)

LOCATION OF DAM

This dam is in Maricopa County, in the _____ ¼, Sec. _____, Tp. 3 & 4N
R. 2W, G&SR, B&M, and is located on Trilby Wash
(Creek, River or Watershed)
tributary to Aqua Fria River
(Creek or River)

OWNER

Name Flood control District of Maricopa County
Address 3335 West Durango Street
(Street and Number, or P.O. Box)
Phoenix Arizona 85009 262-1501
(City) (State) (Zip) (Telephone)

If this application is for construction of a new dam complete all items (1 thru 21) except Item 15. For alteration, repair, enlargement or removal of a dam complete Items 15 thru 21 and those other items where a change is being made.

DESCRIPTION OF DAM AND RESERVOIR

1. Type of dam _____
(Earth, Rock, Concrete Gravity, Concrete Arch)
2. Crest length _____ ft. Crest width _____ ft.
3. Slope, upstream _____ Slope, downstream _____
4. Dam crest elevation _____ ft. Spillway crest elevation _____ ft.
5. Dam height is _____ feet (Measured from original ground level at the downstream toe to the spillway crest).
6. Volume of material in dam _____ cubic yards.
7. Water surface elevation is _____ feet at the time of maximum spillway discharge.
8. Spillway (type, size and capacity) _____
9. Outlet (type, size and capacity) _____
10. Reservoir capacity at spillway crest elevation is _____ acre feet.
11. Reservoir surface area at spillway crest elevation is _____ acres.

(See Reverse Side)

HYDROLOGIC DATA

- 12. Maximum Recorded Rainfall _____ inches in _____ hours.
Date _____ Location _____
- 13. Maximum Recorded Streamflow _____ cubic feet per second.
Date _____ Location _____
- 14. Drainage Area _____ square miles.

GENERAL INFORMATION

- 15. Description of Work (repair, alteration, etc.) The construction of a six lane parkway crossing over the top of the dam. Fill on the downstream and upstream side of the dam will be installed for the road approach sections. Box culverts will be installed to permit drainage between two portions of the reservoir on each side of the parkway. No structural changes in the dam itself will be made
- 16. Use of Stored Water None, purpose is to only temporarily detain floodwaters.
- 17. What provisions to divert flood flows during construction? Construction of the box culverts for drainage will be installed first so as to allow free flow of flood water
- 18. Construction will begin July 1, 1987 Estimated Completion January 1, 1989
(Date) (Date)
- 19. Estimated cost of dam, reservoir, and appurtenances: \$ 836,966.80
- 20. Fees accompanying this application: \$ 5485.00
- 21. Investigations, plans and specifications prepared by Collar, Williams & White Engineering

Signed: *Stanley G. Spivey*
 Address: FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
 3335 W. Durango St., Phoenix, AZ 85009
 Legal capacity if other than owner: DEPUTY CHIEF ENGINEER

Date: 3-6-87

APPROVAL OF APPLICATION No. 07.21, INCLUDING THE PLANS AND SPECIFICATIONS

This is to certify that Application No. 07.21, including the plans and specifications for Alteration to McMicken Dam and Reservoir has been examined and the same is hereby approved, subject to the following terms and limitations:

- 1. Construction work shall be started within one (1) year from date.
- 2. No foundations or abutments shall be covered by the material of the dam until the Department has been given an opportunity to inspect and approve the same.
- 3. The contractor's plans for dewatering and removal of surface water must be submitted to Department in writing for review and approval at least (3) working days prior to the start of such operations at the site.

Dated this 2nd day of July, 1987.

Doug Toy
 DOUG TOY, P.E.
 DEPUTY DIRECTOR, ENGINEERING