Kimley-Horn

SUPPORTING DATA REPORT
FOR
APPEAL OF PROPOSED BASE FLOOD ELEVATIONS

HATCHETT CREEK
Sarasota County, Florida
(Unincorporated Areas)

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HATCHETT CREEK
Sarasota County, Florida
(Unincorporated Areas)

Prepared for:

Venice Service Corporation, a Florida Corporation
(a subsidiary of Banc Florida a Federal Savings Bank)

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Project No. 6744.00
September, 1991

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1.0 INTRODUCTION

On July 30, 1991, a written appeal to the proposed base flood elevations (BFEs) for the Hatchett Creek drainage basin was filed by the law firm of Icard, Merrill, Cullis, Timm, Furen and Ginsberg, P.A. This appeal was filed pursuant to Title 44, Chapter 1, Parts 59-77 of the Code of Federal Regulations (44 CFS 59-77) on behalf of Venice Service Corporation, a Florida corporation that owns and controls all of the interest of the affected Hatchett Creek DRI.

The engineering analyses contained in this report are provided to support the written appeal by demonstrating that based upon information not necessarily available at the time of the pending Flood Insurance Study, the proposed BFEs are scientifically and technically incorrect. Specifically, in order to justify revisions to the proposed BFEs, the supporting data demonstrates the following:

1. An inappropriate or incorrect hydraulic methodology has been used (scientifically incorrect)
2. The hydrologic methodology was not applied correctly (technically incorrect)
3. Insufficient or poor quality hydrologic data were used (technically incorrect)
4. Insufficient or poor quality hydraulic data were used (technically incorrect)

Each of the four (4) contentions identified above, are discussed in greater detail in the following sections. In support of the FIRM appeal, new hydrologic and hydraulic analyses have been performed resulting in more accurate Base Flood Elevations, BFEs. The establishment of accurate elevation requirements in this way will be a benefit to the community through a more accurate assessment of the potential flood hazard. Incorrect delineation of the flood hazard boundary not only causes difficulty in administration of the Flood Insurance programs, but may also cause an unjust application of Flood Insurance requirements.

It is recognized that the new analysis is of significantly greater detail than that originally contracted. The intent of this greater detail is to provide more accurate base flood elevations. It is not intended to discredit the validity of the methodology used by the original study contractor. Within the constraints of the original hydraulic methodology, the limited topography available at the time, and budgetary constraints, use of the original methodology with possibly some hydrologic flood routing iterations to account for the volume-dependent nature of the study area may have indeed been appropriate. It is also recognized that to its credit the original analysis yielded conservative results which may not be undesirable from a flood plain management standpoint.

2.0 AN INAPPROPRIATE OR INCORRECT HYDRAULIC METHODOLOGY HAS BEEN USED (SCIENTIFICALLY INCORRECT)

The proposed BFEs for Hatchett Creek were computed using the Corps of Engineers HEC-2 hydraulic model (Reference 20). Peak discharges were computed at six specific points of interest in the basin using the unit hydrograph method. These peak discharge rates were entered into the HEC-2 input file. HEC-2 then generated the water surface profile and base flood elevations which would occur if the specified flow rates were completely conveyed through the hydraulic system. The proposed BFEs are therefore based upon independent hydrologic and hydraulic analyses. While this hydraulic methodology is widely accepted and certainly appropriate in many if not most circumstances, certain considerations limit its use in flat, low-lying watersheds such as Hatchett Creek without excessive iterations between it and the hydrologic methodology.

Peak flow rates for flat coastal watersheds such as Hatchett Creek are often dependent on basin hydraulics. This dependency results from tailwater dynamics, the physical limitations of local topography to convey flows, and the effects of flood routing. Until fairly recently these hydraulic realities were difficult to simulate due to the limited availability of hydrodynamic computer models. A hydrodynamic model, capable of interfacing with the hydrologic process and taking into account both the conveyance and storage realities of the Hatchett Creek basin is required for the accurate computation of flood flows and BFEs.

Recent advances in computer software have made several hydrodynamic models readily available. These models recognize that the hydrologic (peak discharge component) and the hydraulic (storage and conveyance component) models are not independent of each other. This methodology more accurately computes discharge rates as a function of the system's hydraulics at each increment of the simulation. To facilitate the new hydraulic analyses, the ICPR computer program was utilized. This hydrodynamic program was developed in Florida by Peter S. Singhofen, P.E. (Reference 22) and has been used and accepted on numerous Flood Insurance Studies (FIS) in the State of Florida.

BFEs at each simulated point of interest were taken from the hydrodynamic routing at their maximum (i.e. irrespective of time) to develop the water surface profile. Likewise, peak discharges at the six basin points of interest specified in the pending FIS were taken irrespective of time and entered into the original HEC-2 input files for purposes of reconciliation and floodway determination.

A complete listing of the model input and summaries of the results are provided in APPENDIX A.

3.0 THE HYDROLOGIC METHODOLOGY WAS NOT APPLIED CORRECTLY (TECHNICALLY INCORRECT)

The hydrologic methodology used in the pending Flood Insurance Study (FIS), was the unit hydrograph method. This method is widely accepted and is capable of adapting to site specific conditions through adjustments to the peak rate factor, the time to concentrate, and the runoff curve number. The use of the unit hydrograph method for the hydrologic analysis is considered both appropriate and correct for the Hatchett Creek watershed. However, a more accurate methodology for computing the time of concentration for undeveloped areas was considered appropriate. In addition, based on the recent availability of more accurate topographic information for the Hatchett Creek study area, it is now possible to compute the time of concentration for the developed portions of the basin more accurately using procedures outlined in TR-55 (Reference 17). Brief discussions on the methodology used to determine basin/sub-basin times of concentration as well as peak rates factors and runoff curve numbers are discussed in the following sections.

3.1 TIME OF CONCENTRATION

The supporting hydrological data for the pending FIS indicates that for the Hatchett Creek sub-basins, time of concentration was computed as the sum of overland and channelized travel times. In general, overland flow times were based upon a velocity of 0.2 feet per second, while channelized velocities ranged from 1 to 3 feet per second. The methodologies used in the new hydrologic analysis for computing times of concentration from undeveloped and developed areas are discussed below. These methodologies are believed to be more appropriate and site-specific and should therefore afford more accuracy to the analysis.

3.1.1 UNDEVELOPED AREAS

Lag times for undeveloped, unimproved areas are based upon the equation presented in the report entitled 'Estimation of Runoff Peak Rates and Volumes from Flatwoods Watershed' (Reference 21). This modified lag equation is given as follows:

$$L = 3.0 + 0.34\,(A^{0.11})\,(W+1)^{0.71}$$

Where L = watershed lag in hours,

A = drainage area in acres, and

W = percent wetlands

This equation was developed by University of Florida from observed data from five (5) drainage basins located in south Florida which ranged between 160 and 3600 acres in size. A sixth basin of only 20 acres (with no on-site wetlands) exhibited significantly longer times of concentration than those given by the modified lag estimations equation.

It should be noted that the modified lag estimation equation is based upon observed runoff hydrographs. However, the evaluation of the SCS unit hydrograph method by the University of Florida indicated that the modified lag estimation equation produced the most consistent optimized peak rate factor for all of the sites studied. Best results using the SCS unit hydrograph method were in fact achieved with the modified lag equation and a peak rate factor of 75.

The modified lag equation was therefore considered appropriate for undeveloped, unimproved areas. However, as a conservative measure, the percent isolated wetlands for each undeveloped area was set equal to zero. Time of Concentration was computed by dividing the watershed lag value by 0.60.

3.1.2 DEVELOPED AREAS

Time of concentration for developed areas was taken as the sum of sheet flow and shallow concentrated flow times in accordance with Technical Release No. 55, 2nd Edition (Reference 17). Channelized flows travel times, based upon 2.5 feet per second were also considered, as applicable. As previously stated, this more accurate methodology is possible due to the recent availability of more detailed topographic data for the Hatchett Creek basin.

3.2 PEAK RATE FACTOR

The supporting hydrological data for the pending FIS (References 11 and 25) provides a general guideline for computing basin/sub-basin peak rate factors as a function of the percent developed. The general equation presented in the pending FIS discharge calculations document is given below:

$$K = 350\ (\%\ \text{developed}) + 150\ (1 - \%\ \text{developed})$$

where K = basin peak rate factor

It should be noted that a peak rate factor of 350 would apply to both a commercial shopping center and a residential development, based upon a percent developed of 100%. Also, based upon the previously cited study by the University of Florida, 150 may be a somewhat high value for the undeveloped portions of the Hatchett Creek basin. However, if these assumptions are in error, the error will be on the conservative side. The methodology concept of a weighted peak rate factor which varies between 150 and 350 as a function of development is believed to be appropriate.

3.3 RUNOFF CURVE NUMBER

Runoff curve numbers were taken as the weighted average between 78 for pervious and 98 for impervious surfaces. The methodology used for the FIS used a runoff curve number of 71 for pervious surfaces in the undeveloped portions of the Hatchett Creek watershed. The use of a runoff curve number of 78 for pervious areas corresponds to a watershed storage value of 2.8 inches. Studies performed by the Agricultural Research Service (Reference 26) suggests an apparent relationship between watershed storage and water table depth. Research by the University of Florida (Reference 21) indicated that this methodology consistently performed better than all other methods in predicting runoff losses. A depth to water table of ± 30 inches is considered appropriate for initial antecedent moisture conditions. Based on the ARS absorption curve equation given below, this would correspond to a watershed storage value of 2.9 inches and a runoff curve number of ± 78.

$$AS = 1.44 + 1.50\,(DWT - 1.5)$$

Where AS = available moisture storage of soil, in inches

DWT = depth to water table, in feet

4.0 INSUFFICIENT OR POOR QUALITY HYDROLOGIC DATA

A new hydrologic analysis has been performed based on more accurate hydrologic data. Specifically, more accurate precipitation, topographic, and other mapping data were utilized to re-define drainage sub-basins and to generate discharge rates. Brief discussions of this more accurate data are presented below:

4.1 PRECIPITATION

Rainfall volumes used to generate peak discharge rates in the FIS for Hatchett Creek, were reportedly taken from the isopleth maps in Technical Paper No. 40 (Reference 12). These rainfall volumes are regionally specific to the southeastern portion of the United States and were developed using the Gumbel Distribution. Although TP-40 does not reflect the last ± 30 years of record, the lack of more site specific information would certainly justify the use of TP-40 in determining rainfall volumes for the Hatchett Creek FIS.

However, a literature search reveals two additional authoritative sources of rainfall information exist which are both more accurate and site specific. These two sources are identified below:

- Rainfall Analysis Southwest Florida Area prepared for the Southwest Florida Water Management District by the University of Central Florida - Engineering and Industrial Experiment Station; October, 1987.

- Hydrologic and Hydraulic Analysis for Hatchett Creek Basin - Sarasota County, Florida prepared for Gulfstream Land and Development Corporation - Venice, Florida, by C.K. Sarkar, Ph.D., P.E. - Tri-County Engineering, Inc.; April, 1974.

Copies of these two (2) reports are provided in APPENDIX B and C respectively. Brief descriptions of the findings contained in each of these two reports with respect to rainfall follow:

4.1.1 SOURCE 1 - SWFWMD RAINFALL ANALYSIS FOR SOUTHWEST FLORIDA

Seventeen recording rainfall stations for the Southwest Florida area were used to develop probability frequency distributions for 24-hour storm events (Reference 13). Daily data were used. Eight probability frequency distributions, including the Gumbel Distribution, were fit to each empirical frequency distribution. Using graphical presentations, standard error, residuals, and statistical tests, the Log-Pearson Type III distribution was determined to be the best fit. Isopleth maps were developed for the two-year through the 100-year, 24-hour storm volumes. These final rainfall volumes include an adjustment factor of 1.13 to convert 24-hour "clock" day time to actual continuous 24-hour period time.

Two of the seventeen recording rainfall stations were located within 24 miles of the Hatchett Creek coastal drainage basin, namely the Bradenton and Punta Gorda coastal stations. Unfortunately, the study did not include any recording stations within Sarasota County. Averaging the actual 24-hour rainfall totals for the Bradenton and Punta Gorda stations yielded the following rainfall totals:

Frequency -	10-yr	25-yr	50-yr	100-yr
Rainfall Depth -	7.07"	8.02"	9.08"	10.18"

4.1.2 SOURCE 2 - SARKAR RAINFALL ANALYSIS FOR HATCHETT CREEK

This 1974 flood study included probably the most site-specific rainfall analysis for the Hatchett Creek drainage basin (Reference 24). Specifically, published data from the Venice Airport was analyzed using the Log-Pearson Type III distribution. The Venice rainfall recording station is located about 4 miles from the center of the Hatchett Creek watershed. Resulting 24-hour "clock" rainfall depths are provided in the Sarkar report. It is interesting to note that even though the SWFWMD analysis did not consider the Venice station in the determination of rainfall depths, it was considered in determining "clock" to actual 24-hour conversion factors. From the SWFWMD analysis, the conversion factor for the Venice rainfall station was determined to be 1.15. Using this conversion factor yields the following design rainfall depths for the Venice rainfall station:

Frequency -	10-yr	25-yr	50-yr	100-yr
Rainfall Depth -	6.90"	8.05"	8.62"	9.77"

With respect to the Hatchett Creek drainage basin, the analyses contained in the SWFWMD and SARKAR reports provide more accurate and site specific rainfall depths than those provided in TP-40. The former rainfall totals should therefore be considered the best available information. The SWFWMD/SARKAR rainfall values are compared with those contained in TP-40 below:

	10-yr	25-yr	50-yr	100-yr
TP-40 -	8.0"	9.5"	11.0"	12.0"
SWFWMD/SARKAR -	± 7"	± 8"	± 9"	± 10"

4.2 TOPOGRAPHIC AND OTHER MAPPING DATA

In addition to rainfall, another important parameter when determining peak discharge rates, is contributing drainage area. In 1987, approximately 90% of the Hatchett Creek drainage basin was flown and mapped under a contract with Southwest Florida Water Management District. The end product of this effort are a series of 1" = 200' and 1" = 1000' aerials with one-foot contours (Reference 1). In addition, 1" = 100' topographic maps for the 1,000 acre Hatchett Creek DRI site were prepared by Southern Resource Mapping Corporation in 1982 (Reference 10), and are available.

Since previous basin/sub-basin delineations, including those used in the Preliminary Flood Insurance Study relied upon significantly less accurate topographic information (i.e. U.S.G.S. 5-foot contour maps), the Hatchett Creek basin/sub-basin delineations were updated based upon this more accurate topographic information. To assist in this delineation effort, numerous field reconnaissance trips were conducted and information was pulled from the list of sources identified in the bibliography and references section of this report (References 1-10, 15, 16, 18, 19, 23, and 24). Therefore, the updated drainage basin/sub-basin delineations are based upon the best available information and afford greater accuracy to the new hydrologic analysis.

5.0 INSUFFICIENT OR POOR-QUALITY HYDRAULIC DATA

The new hydraulic analysis considers insufficiencies due primarily to limited topographic data as inventoried below:

5.1 HATCHETT CREEK HYDRAULIC CONNECTION TO BLACKBURN CANAL

At or about elevation 11.9 NGVD, the Hatchett Creek basin is hydraulically connected to the Blackburn Canal sub-basin located to the north. This connection is located at the northeasterly end of the Hatchett Creek site and results in the overtopping of Venice Avenue, just west of its intersection with Jacaranda Boulevard. This hydraulic connection would place a significant amount of acreage under water and provide a source of relief to the system at or about elevation 12.0 NGVD. From a flood routing standpoint (i.e. volumetric, storage, outflow potential), this hydraulic connection acts to control flood water levels. This was addressed by modelling the twin culverts beneath Jacaranda Boulevard that discharge to Blackburn Canal as a one-way riser structure. This riser structure requires water levels to rise to elevation 11.9 NGVD and discharge against a constant tailwater elevation of 10.66 NGVD (which corresponds to the highest 100-year base flood elevation computed for Curry Creek and contained in the pending FIS for Sarasota County). In addition, the top of road geometry for Venice Avenue was modelled as a overflow weir which would allow flows to be conveyed from the Hatchett Creek basin when flood stages reach 11.9 NGVD.

5.2 MAJOR ROADWAY AND LAKE CONTROL STRUCTURES INVENTORY

An extensive inventory of major roadway lake control structures was performed. These structures were considered in the new hydraulic analysis to more accurately determine the results of flow constriction, road over-topping, and storage routing. The one-foot contour aerials also provide stage/area information at out-of-bank storage areas for the input into hydrodynamic model.

6.0 CONCLUSIONS

In conclusion, the new analyses are based on more accurate methodologies and site-specific data and therefore reflect more accurate base flood elevations for the Hatchett Creek basin. The following specific assertions are also provided:

1. The design rainfall volumes utilized for the Hatchett Creek watershed in the new analysis are consistent with the statistical analyses of actual records of the Bradenton and Punta Gorda coastal stations by the Southwest Florida Water Management District (Reference 13) and the Venice station by Tri-County Engineering, Inc. (Reference 24). This data provides the most accurate precipitation information for the Hatchett Creek basins.

2. The design flood hydrographs used in the new analysis have been developed using more accurate rainfall information and topography. The hydrologic characteristics of some 90 drainage sub-basins were inventoried in order to accurately determine and model the allocation of flows throughout the basin.

3. The hydrodynamic methodology used for the new analysis is the most appropriate and accurate method for modelling the hydrologic/hydraulic conditions of the Hatchett Creek watershed. It is capable of addressing such basin realities as time-dependent tailwater conditions, flood routing, and limitations of the natural and man-made topography to physically convey flows. This methodology is also capable of taking into account volumetric considerations and cross-basin flow transfers.

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