Spook Hill ADMP Update

Flood Control District of Maricopa County

Appendix A
Volume 6

No-Action/Non-Structural Alternative Analysis

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Registered Professional Engineer (Civil)
28615
RICHARD L
HINER
Date Signed 9-20-0
ARIZONA U.S.A.

Spook Hill Area Drainage Master Plan Update

Flood Control District of Maricopa County

List of Appendices

Appendix A

Volume 1	HEC-1 Modeling Input Data & Output Files – Level III
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Volume 5	Design Alternative Analysis – Level II
Volume 6	No-Action/Non-Structural Alternative Analysis
Volume 7	Conveyance Material Analysis
Volume 8	Hydraulics
Volume 9	Red Mountain Freeway Crude Cost Estimates

Property of
Flood Control District of MC Library
Please Return to
2801 W. Durango
Phoenix, AZ 85009

Appendix B

Volume 1	Level I – Hydrology (1999 – 03/10/2000)
Volume 2	Level I – Hydrology (03/10/2000 – 05/11/2000)
Volume 3	Level I – Hydrology (05/11/2000 – 06/19/2000)
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Volume 7B	HEC-1 Modeling Output Files (Level II)
Volume 7C	HEC-1 Modeling Output Files (Level II)

Registered Professional Engineer
CERTIFICATE NO.
28615
RICHARD
HINEH
Date Signed 9-20-01
ARIZONA U.S.A.

WOOD/PATEL

MEMO

TO: File

FROM: Jeffrey D. Sims, P.E.

DATE: October 1, 2001

RE: Spook Hill ADMP

SUBJECT: Design memo describing the assumptions used in determination of the Potential Flood Impact Zone for the No Action Alternative

The Potential Flood Impact Zone shown on the No Action Alternative exhibit was determined according to the methodology described here. Since a majority of the factors required to perform a hydraulic analysis on an alluvial fan were unknown, we decided to estimate the area that might be in the path of a potential flood originating from three locations. The factors required to perform a hydraulic analysis of the alluvial fan include available sediment load in the upstream reach, the location of active and inactive alluvial fan flooding, and the location of the transition from piedmont to alluvial fan. Also, flooding on an alluvial fan is highly unpredictable in terms of path location, flow mechanics or distribution. Flooding may be in the form of concentrated channel flow, overland sheet flow, or a combination of both.

The flood locations are the northeast corner of Hawes Road and Oak Street, the corner of Hawes Road and McDowell Road, and south of Mallory Street at approximately 8600 East. The Potential Flood Impact Zone was delineated by estimating the possibility of floodwater entering into a downstream wash, channel or depressed area at each point along the flow path. In other words, it was assumed that flooding would proceed generally perpendicular to the contour lines unless there appeared to be a possibility of the flood water breaking through or overtopping an adjacent bank, berm or rise. However, actual flood dynamics could result in a situation where overtopping or bank breakout might occur at locations different than those estimated in our delineation.

Once the boundary of the Potential Flood Impact Zone was determined, the flood damage costs were estimated. The costs depend on flooding depth, homes impacted, and structure and content value. We estimated flood damage with flood depths of six inches and one foot to all of the homes in the Potential Flood Impact Zone. The cost estimates do not necessarily represent the damage from a single event. We assumed that there is equal risk for every home within the Potential Flood Impact Zone. We counted the number of homes using aerial photographs. The average value of the structures and their contents was determined by following procedures outlined by the US Army Corps of Engineers (USACE) in Appendix A of *Flood Proofing, How to Evaluate Your Options*, 1993.

The procedure used to estimate flood damage in the USACE method follows: determine the assessed value of the structure, apply a factor to the assessed value to estimate the market value, apply a factor to the market value to estimate the value of the structure contents, estimate percent damage based upon flood depth, and calculate total flood damage.

Based on lot size, three areas of representative residences were identified. The assessed value of several properties including improvements was obtained from the Maricopa County Assessor's Office. The

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average assessed structure value for each area was calculated. Only one-story homes were used to determine the average assessed structure value. This is because percent flood damage is different for multi-level homes and single-story homes and there are few multi-story homes in the area. The average assessed structure value was multiplied by 1.5 to determine the average market value. This was determined by dividing the listed market price by the assessed value for homes sold in the year 2000 as shown in Table I: Representative Areas Average Structure Values. A content value to structure value of 0.35 was used from Appendix A of *Physical and Economic Feasibility of Nonstructural Flood Plain Management Measures*, 1978. This value represents $49,800 worth of contents in a $142,300 home. We analyzed the validity of this assumption in Table II: Estimate of Household Item Costs.

Percent damage values for the structure and contents were taken from Figures A-10 and A-14 in Appendix A of *Flood Proofing, How to Evaluate Your Options*, 1993. The percent damage from a six-inch flood is 12.9% for a structure and 15.5% for the contents. For a one-foot flood, the percent damage is 15.3% for the structure and 18.8% for the contents. Table III: Preliminary Cost Estimate of Potential Flood Damage shows the calculation for total flood damage for both the six-inch and one-foot floods. The total cost assumes that a flood will damage every residence in the Potential Flood Impact Zone. It is unlikely that a single 100-year even would do this. The estimated damages do not include costs for food, lodging or transportation during or after the flood event. These costs could be substantial.

Table I: Representative Areas Average Structure Values

Map 23

Use	APN	Assessed Value	% improve	Assessed Structure Value	Structure Area	Stories
SFR	031A	$134,500	0.8	$107,600	1844	1
SFR	029B	$158,500	0.8	$126,800	1941	1
SFR	028J	$179,000	0.8	$143,200	2370	1
SFR	028E	$179,000	0.8	$143,200	2363	1
SFR	028L	$180,500	0.8	$144,400	2516	1
SFR	027B	$187,500	0.8	$150,000	1930	1
SFR	025G	$138,000	0.8	$110,400	2496	1
SFR	005B	$180,000	0.8	$144,000	2484	1
SFR	006C	$142,500	0.8	$114,000	1960	1
SFR	006D	$164,500	0.8	$131,600	2287	1
SFR	006F	$159,500	0.8	$127,600	2000	1
SFR	011D	$222,500	0.8	$178,000	2506	1
SFR	013D	$169,000	0.8	$135,200	2982	1
SFR	016C	$300,000	0.8	$240,000	4511	1
SFR	017A	$298,500	0.8	$238,800	3000	1
SFR	030A	$172,500	0.8	$138,000	3012	2
SFR	027D	$154,000	0.8	$123,200	2092	2
SFR	027G	$180,500	0.8	$144,400	3610	2
SFR	014D	$201,000	0.8	$160,800	2963	2
SFR	028N	$208,690	0.88	$183,647		

Average assessed value (Total):	**$149,242**	2572	1.21
Average Market Value (Total):	**$223,864**		
Average assessed value (1 story):	**$148,987**	2479	1
Average Market Value (1 story):	**$223,480**		
Market/Assessed value:	1.5		

Map 28

Use	APN	Assessed Value	% improve	Assessed Structure Value	Structure Area	Stories
SFR	36	$103,000	0.8	$82,400	1710	1
SFR	32	$94,500	0.8	$75,600	1232	1
SFR	28	$145,500	0.8	$116,400	2375	1
SFR	26	$100,000	0.8	$80,000	1260	1
SFR	24	$153,000	0.8	$122,400	2577	1
SFR	22	$108,000	0.8	$86,400	1684	1
SFR	30	$152,000	0.8	$121,600	2185	2
Map 29						
SFR	36	$100,500	0.8	$80,400	1741	1
SFR	32	$140,000	0.8	$112,000	2130	1
SFR	30	$70,000	0.8	$56,000	1144	1
SFR	24	$138,500	0.8	$110,800	2081	1
SFR	22	$114,000	0.8	$91,200	1965	1
SFR	28	$100,500	0.8	$80,400	1940	2

Average assessed value (Total):	**$93,508**	1848	1.15
Average Market Value (Total):	**$140,262**		
Average assessed value (1 story):	**$92,145**	1809	1
Average Market Value (1 story):	**$138,218**		
Market/Assessed value:	1.5		

Map 26: Properties 24-94

Use	APN	Assessed Value	% improve	Assessed Structure Value	Structure Area	Stories	Market Price	Year	Assessed %
SFR	25	$94,000	0.8	$75,200	1260	1			
SFR	26	$93,500	0.8	$74,800	1144	1			
SFR	27	$121,000	0.8	$96,800	1722	1			
SFR	28	$110,000	0.8	$88,000	1640	1			
SFR	29	$99,500	0.8	$79,600	1440	1	$90,000	98	1.13
SFR	30	$106,500	0.8	$85,200	1539	1	$136,000	2000	1.60
SFR	33	$123,000	0.8	$98,400	2026	1			
SFR	34	$98,000	0.8	$78,400	1460	1			
SFR	35	$127,500	0.8	$102,000	1782	1	$183,000	2000	1.79
SFR	36	$96,000	0.8	$76,800	1352	1			
SFR	37	$113,500	0.8	$90,800	1760	1			
SFR	38	$116,500	0.8	$93,200	1860	1			
SFR	39	$120,000	0.8	$96,000	1948	1			
SFR	40	$118,000	0.8	$94,400	1948	1			
SFR	41	$102,500	0.8	$82,000	1560	1			
SFR	42	$120,000	0.8	$96,000	1771	1			
SFR	43	$133,500	0.8	$106,800	1918	1	$112,999	96	1.06
SFR	44	$149,500	0.8	$119,600	1961	1			
SFR	45	$115,000	0.8	$92,000	1648	1	$110,000	95	1.20
SFR	49	$110,000	0.8	$88,000	1574	1	$115,000	97	1.31
SFR	53	$123,500	0.8	$98,800	1825	1	$126,500	97	1.28
SFR	54	$98,000	0.8	$78,400	1352	1	$118,500	96	1.51
SFR	55	$103,000	0.8	$82,400	1591	1	$117,000	97	1.42
SFR	66	$110,500	0.8	$88,400	1758	1	$129,000	99	1.46
SFR	67	$103,500	0.8	$82,800	2106	1	$102,000	96	1.23
SFR	76	$106,000	0.8	$84,800	1593	1	$115,000	99	1.36
SFR	79	$107,500	0.8	$86,000	1500	1	$127,000	2000	1.48
SFR	81	$104,000	0.8	$83,200	1080	1	$83,500	97	1.00
SFR	82	$108,500	0.8	$86,800	1779	1	$135,900	98	1.57
SFR	83	$85,500	0.8	$68,400	1092	1	$85,500	2000	1.25
SFR	86	$92,000	0.8	$73,600	1333	1	$123,000	98	1.67
SFR	92	$96,500	0.8	$77,200	1438	1	$115,000	98	1.49
SFR	24	$119,500	0.8	$95,600	2072	2			
SFR	31	$278,552	0.8	$222,842	3283	2			
SFR	32	$187,000	0.8	$149,600	3250	2			

Average assessed value (Total):	**$93,510**	1725	1.09	average:	1.38
Average Market Value (Total):	**$140,265**			2000 average:	1.53
Average assessed value (1 story):	**$87,650**	1618	1		
Average Market Value (1 story):	**$131,475**				
Market/Assessed value:	1.5				

Table II: Estimate of Household Item Costs
(Family of 4)

Item	Cost
Couches & chairs - living room	$2,000
Kitchen table & chairs	$1,500
coffee table	$150
end tables	$200
book shelves	$200
books	$6,000
Entertainment center	$250
Lazy boy	$800
Wood bed frames	$2,100
dressers	$600
night stands	$100
piano	$3,000
computer & software	$3,000
Desk	$200
TV	$700
Family room couch set	$1,500
Nintendo	$250
Stereo components	$1,500
Electronic media	$2,000
Vacuum cleaner	$300
Lawn mower	$300
Power tools	$1,000
Food Storage	$500
Bar Stools	$200
Kitchen appliances	$800
VCR/DVD player	$200
video camera	$600
sewing machine	$900
plants	$100
exercise equipment	$1,000
Bar-B-Que	$500
Trimmer	$100
Clothing/Shoes	$3,000
Household cleaning supplies	$250
Toiletries	$400
Kitchen items	$500
Decorations	$500
Bedding	$200
Washer/Dryer	$1,000
Refrigerator	$1,000
Games	$200
Camping gear	$400
Jewelry/Guns	$3,000
Lamps	$250
Dining room table & chairs	$2,000
China cabinet	$900
Garage hardware	$400
Tools	$500
Toys	$500
Garden tools/hoses	$250
Beds	$2,000
Total:	**$49,800**
Content value/structure value ratio:	**0.35**
Cost of Home:	**$142,286**

Table III: Preliminary Cost Estimate of Potential Flood Damage
(During the assumed 100-year lifespan of the project)

Location	Representative Assessor Map Location	Number of Homes at Risk of Flooding	Average Structure Market Value	Content Value (35% of structure)	Six inch flood: Structure Damage %	Structure Damage Cost per Home	Structure Damage Total	Content Damage %	Content Damage Cost per Home	Content Damage Total	Total Damage Cost
North of McDowell	Map 23	84	$222,368	$77,829	12.9%	$28,685	$2,409,580	15.5%	$12,063	$1,013,334	$3,422,913
Between McDowell & Culver	Map 28 & 29	43	$137,531	$48,136	12.9%	$17,741	$762,884	15.5%	$7,461	$320,826	$1,083,711
Between McDowell & Culver	Map 28 & 29	46	$137,531	$48,136	12.9%	$17,741	$816,109	15.5%	$7,461	$343,210	$1,159,319
Between Culver & Hermosa Vista											
East of 78th Street	Map 28 & 29	46	$137,531	$48,136	12.9%	$17,741	$816,109	15.5%	$7,461	$343,210	$1,159,319
West of 78th Street	Map 26	70	$130,821	$45,787	12.9%	$16,876	$1,181,314	15.5%	$7,097	$496,789	$1,678,103
Between Hermosa Vista & McKellips											
Existing	Map 28 & 29	39	$137,531	$48,136	12.9%	$17,741	$691,918	15.5%	$7,461	$290,982	$982,901
Future	Map 26	59	$130,821	$45,787	12.9%	$16,876	$995,679	15.5%	$7,097	$418,722	$1,414,401
Existing	Map 28 & 29	4	$137,531	$48,136	12.9%	$17,741	$70,966	15.5%	$7,461	$29,844	$100,810
Future	Map 26	92	$130,821	$45,787	12.9%	$16,876	$1,552,584	15.5%	$7,097	$652,923	$2,205,506

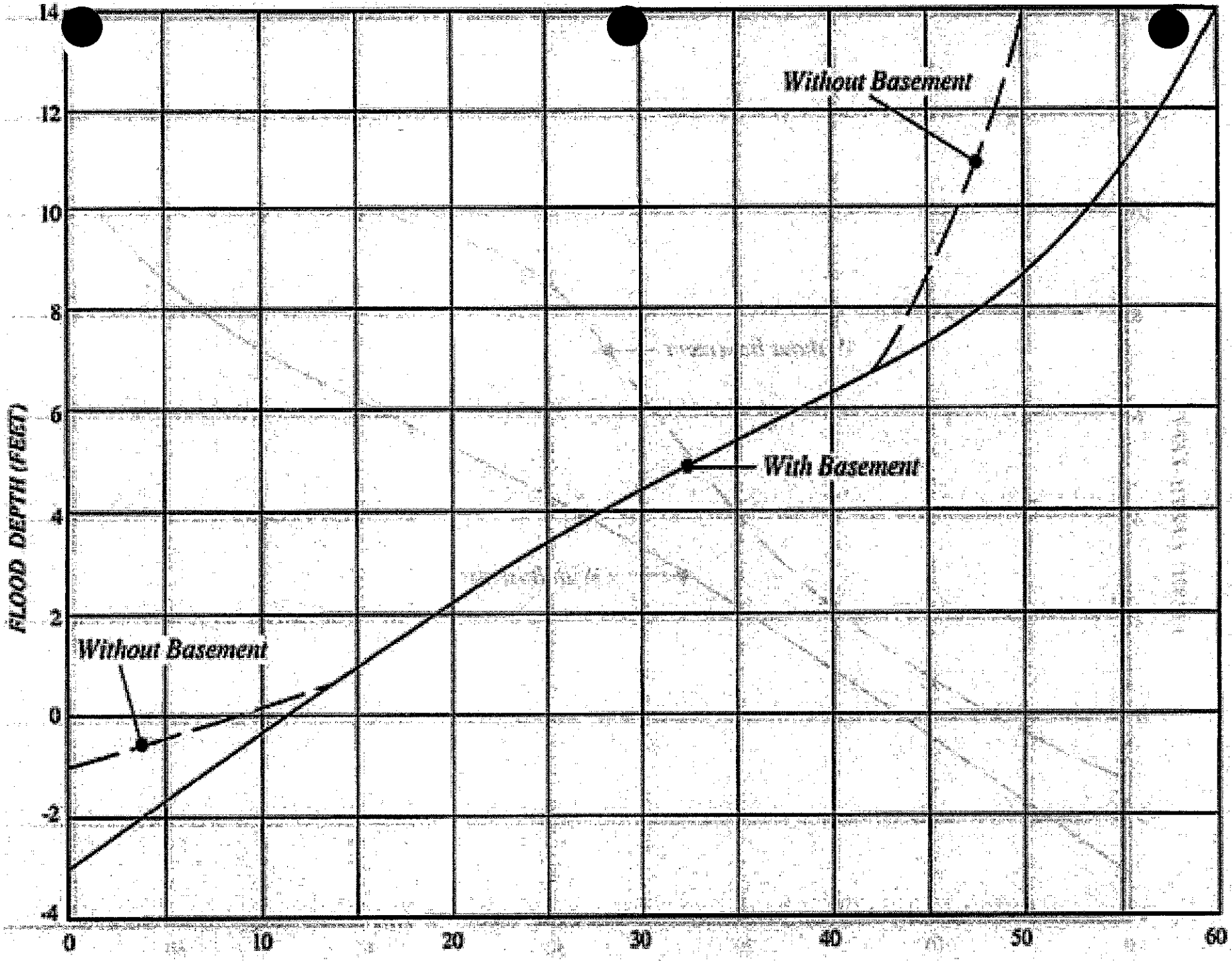
Total affected homes: 483 **Grand Total: $13,207,000**

Location	Representative Assessor Map Location	Number of Homes at Risk of Flooding	Average Structure Market Value	Content Value (35% of structure)	One foot flood: Structure Damage %	Structure Damage Cost per Home	Structure Damage Total	Content Damage %	Content Damage Cost per Home	Content Damage Total	Total Damage Cost
North of McDowell	Map 23	84	$222,368	$77,829	15.3%	$34,022	$2,857,874	18.8%	$14,632	$1,229,076	$4,086,949
Between McDowell & Culver	Map 28 & 29	43	$137,531	$48,136	15.3%	$21,042	$904,816	18.8%	$9,050	$389,131	$1,293,948
Between McDowell & Culver	Map 28 & 29	46	$137,531	$48,136	15.3%	$21,042	$967,943	18.8%	$9,050	$416,280	$1,384,223
Between Culver & Hermosa Vista											
East of 78th Street	Map 28 & 29	46	$137,531	$48,136	15.3%	$21,042	$967,943	18.8%	$9,050	$416,280	$1,384,223
West of 78th Street	Map 26	70	$130,821	$45,787	15.3%	$20,016	$1,401,093	18.8%	$8,608	$602,557	$2,003,650
Between Hermosa Vista & McKellips											
Existing	Map 28 & 29	39	$137,531	$48,136	15.3%	$21,042	$820,647	18.8%	$9,050	$352,933	$1,173,581
Future	Map 26	59	$130,821	$45,787	15.3%	$20,016	$1,180,921	18.8%	$8,608	$507,869	$1,688,791
Existing	Map 28 & 29	4	$137,531	$48,136	15.3%	$21,042	$84,169	18.8%	$9,050	$36,198	$120,367
Future	Map 26	92	$130,821	$45,787	15.3%	$20,016	$1,841,436	18.8%	$8,608	$791,932	$2,633,368

Total affected homes: 483 **Grand Total: $15,769,000**

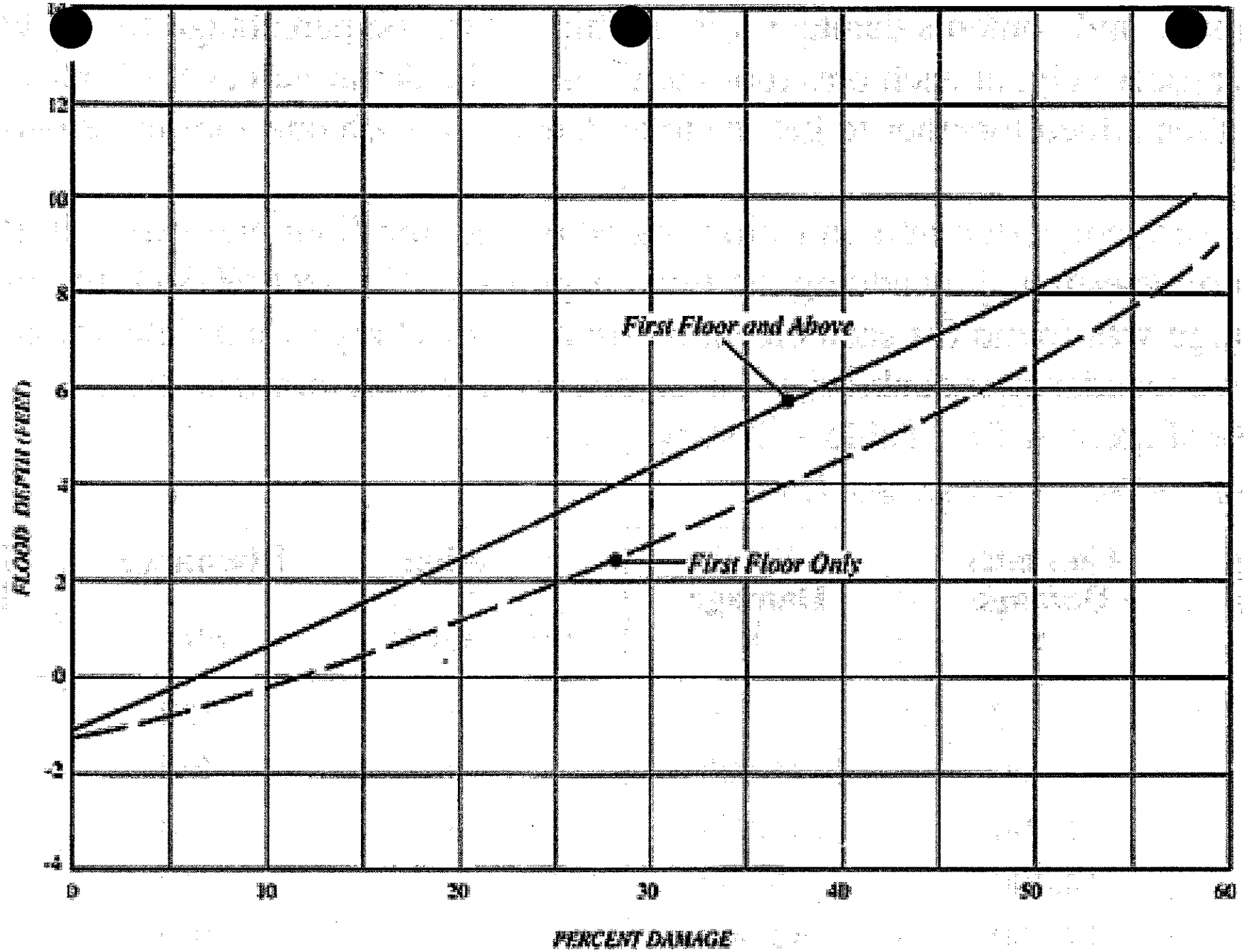
Note: Structure damage percent was obtained from Figure A-10 in Appendix A of *Flood Proofing - How to Evaluate Your Options*, USACE, 1993.
Content damage percent was obtained from Figure A-14 in the same source.

Note: The above values assume that during the next 100 years it is likely that all of the homes within the Potential Flood Impact Zone shown on the No Action Alternative exhibit will experience flooding.



A-10: Damage for One-Story Home

Based on FEMA Actuarial Information System



A-14 : Damage to Home Contents

Based on FEMA Actuarial Information System

WOOD/PATEL

CIVIL ENGINEERS • HYDROLOGISTS • LAND SURVEYORS • CONSTRUCTION MANAGERS

PROJECT Spook Hill NO. 99989

CALC'D BY JDS CHK'D BY

SHEET OF DATE 5/16/01

- Determine the area of potential flood impact downstream of three discharge points.

• Flow from area above the intersection of Oak St. and Hawes Road.

Q = 973 cfs (from Rick)
S ≈ 4% at intersection gradually decreasing to 2% at the Spook Hill FRS.

It is unknown what the available sediment load is, the location of active or inactive alluvial fan flooding, or the location of the transition from piedmont to alluvial fan.

Since flooding on an alluvial fan is highly unpredictable in ~~there~~ terms of location, flow mechanics or distribution, identify the possible locations where a flood may occur.

Assume that no flow from the point in question is conveyed down the ditch on the east side of Hawes Road.

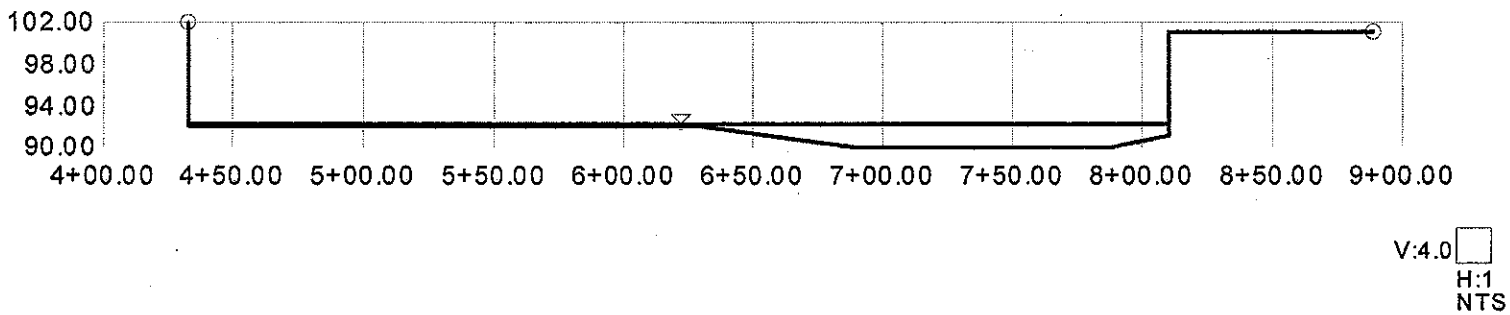
Delineate the potential flood impact zone by making an assessment of the possibility of the flood stream entering into a downstream wash, channel or depressed area.

• other areas – use above procedure.

Section 1
Cross Section for Irregular Channel

Project Description	
Worksheet	Section 1 - Channelized
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

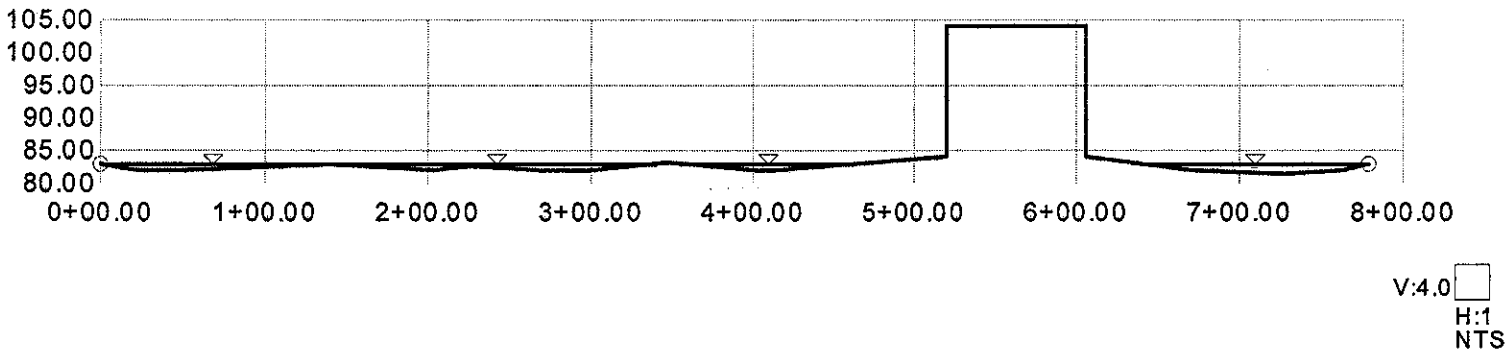
Section Data		
Mannings Coefficient	0.060	
Slope	0.015000	ft/ft
Water Surface Elevation	92.13	ft
Elevation Range	90.00 to 102.00	
Discharge	973.00	cfs



Section 2
Cross Section for Irregular Channel

Project Description	
Worksheet	Section 2
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

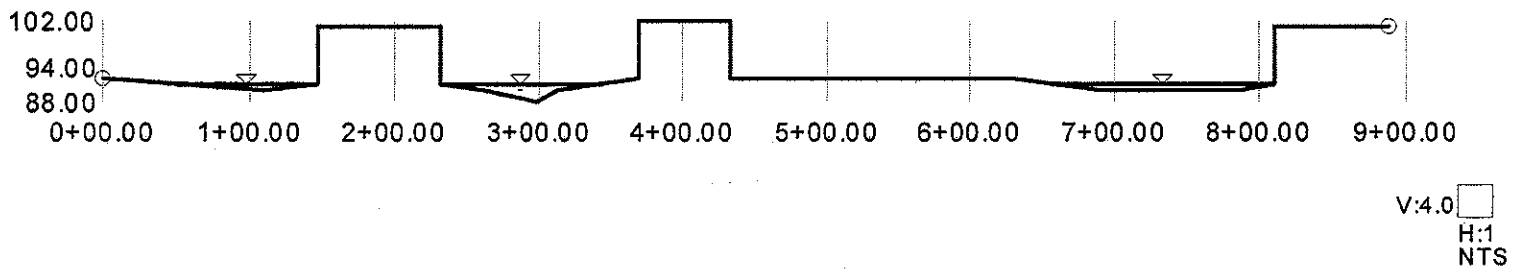
Section Data		
Mannings Coefficient	0.060	
Slope	0.016670	ft/ft
Water Surface Elevation	82.93	ft
Elevation Range	81.30 to 104.00	
Discharge	973.00	cfs



Section 1
Cross Section for Irregular Channel

Project Description	
Worksheet	Section 1 - No Action
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.060	
Slope	0.015000	ft/ft
Water Surface Elevation	91.08	ft
Elevation Range	88.00 to 102.00	
Discharge	973.00	cfs



Drainage	Location	Number of Homes	Total
1	North of McDowell	84	
	Between McDowell & Culver	43	127
2	Between McDowell & Culver	46	
	Between Culver & Hermosa Vista	116 (70)	
	Between Hermosa Vista & McKellips		
	Existing Home	39	
	Future Development	59	260
3	Existing Home	4	
	Future Development	92	96

WOOD/PATEL

CIVIL ENGINEERS • HYDROLOGISTS • LAND SURVEYORS • CONSTRUCTION MANAGERS

PROJECT Spook Hill ADMP NO. 99989
CALC'D BY JDS CHK'D BY
SHEET OF DATE 6/6/01

Need – ① Average tax assessment value
② Relationship between market + assessed value
③ Relationship between structure value and contents value
④ Determination of the zero-foot flood depth relative to the actual flood depth

① – see spreadsheet with county assessor data

② – Assume Assessed value / market value = 0.67 based upon the 2000 sale of properties in Map 26. The average ratio of the assessed value to the sale price is 0.67.

③ – Use 0.35 as recommended in "Physical and Economic Feasibility of Nonstructural Flood Plain Management Measures," USACE, 1978. (See Appendix A)

④ – Assume slab on grade construction with the zero-foot flood depth corresponding to the actual flood zero-depth.

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Map 23

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SFR	031A	$134,500	0.8	$107,600	1844	1
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SFR	028L	$180,500	0.8	$144,400	2516	1
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Average assessed value (Total):	**$149,242**	2572	1.21
Average Market Value (Total):	**$222,750**		
Average assessed value (1 story):	**$148,987**	2479	1
Average Market Value (1 story):	**$222,368**		
Assessed/Market value:	0.67		

Map 28

Use	APN	Assessed Value	% improve	Assessed Structure Value	Structure Area	Stories
SFR	36	$103,000	0.8	$82,400	1710	1
SFR	32	$94,500	0.8	$75,600	1232	1
SFR	28	$145,500	0.8	$116,400	2375	1
SFR	26	$100,000	0.8	$80,000	1260	1
SFR	24	$153,000	0.8	$122,400	2577	1
SFR	22	$108,000	0.8	$86,400	1684	1
SFR	30	$152,000	0.8	$121,600	2185	2
Map 29						
SFR	36	$100,500	0.8	$80,400	1741	1
SFR	32	$140,000	0.8	$112,000	2130	1
SFR	30	$70,000	0.8	$56,000	1144	1
SFR	24	$138,500	0.8	$110,800	2081	1
SFR	22	$114,000	0.8	$91,200	1965	1
SFR	28	$100,500	0.8	$80,400	1940	2

Average assessed value (Total):	**$93,508**	1848	1.15
Average Market Value (Total):	**$139,564**		
Average assessed value (1 story):	**$92,145**	1809	1
Average Market Value (1 story):	**$137,531**		
Assessed/Market value:	0.67		

Map 26: Properties 24-94

Use	APN	Assessed Value	% improve	Assessed Structure Value	Structure Area	Stories	Market Price	Year	Assessed %
SFR	25	$94,000	0.8	$75,200	1260	1			
SFR	26	$93,500	0.8	$74,800	1144	1			
SFR	27	$121,000	0.8	$96,800	1722	1			
SFR	28	$110,000	0.8	$88,000	1640	1			
SFR	29	$99,500	0.8	$79,600	1440	1	$90,000	98	0.88
SFR	30	$106,500	0.8	$85,200	1539	1	$136,000	2000	0.63
SFR	33	$123,000	0.8	$98,400	2026	1			
SFR	34	$98,000	0.8	$78,400	1460	1			
SFR	35	$127,500	0.8	$102,000	1782	1	$183,000	2000	0.56
SFR	36	$96,000	0.8	$76,800	1352	1			
SFR	37	$113,500	0.8	$90,800	1760	1			
SFR	38	$116,500	0.8	$93,200	1860	1			
SFR	39	$120,000	0.8	$96,000	1948	1			
SFR	40	$118,000	0.8	$94,400	1948	1			
SFR	41	$102,500	0.8	$82,000	1560	1			
SFR	42	$120,000	0.8	$96,000	1771	1			
SFR	43	$133,500	0.8	$106,800	1918	1	$112,999	96	0.95
SFR	44	$149,500	0.8	$119,600	1961	1			
SFR	45	$115,000	0.8	$92,000	1648	1	$110,000	95	0.84
SFR	49	$110,000	0.8	$88,000	1574	1	$115,000	97	0.77
SFR	53	$123,500	0.8	$98,800	1825	1	$126,500	97	0.78
SFR	54	$98,000	0.8	$78,400	1352	1	$118,500	96	0.66
SFR	55	$103,000	0.8	$82,400	1591	1	$117,000	97	0.70
SFR	66	$110,500	0.8	$88,400	1758	1	$129,000	99	0.69
SFR	67	$103,500	0.8	$82,800	2106	1	$102,000	96	0.81
SFR	76	$106,000	0.8	$84,800	1593	1	$115,000	99	0.74
SFR	79	$107,500	0.8	$86,000	1500	1	$127,000	2000	0.68
SFR	81	$104,000	0.8	$83,200	1080	1	$83,500	97	1.00
SFR	82	$108,500	0.8	$86,800	1779	1	$135,900	98	0.64
SFR	83	$85,500	0.8	$68,400	1092	1	$85,500	2000	0.80
SFR	86	$92,000	0.8	$73,600	1333	1	$123,000	98	0.60
SFR	92	$96,500	0.8	$77,200	1438	1	$115,000	98	0.67
SFR	24	$119,500	0.8	$95,600	2072	2			
SFR	31	$278,552	0.8	$222,842	3283	2			
SFR	32	$187,000	0.8	$149,600	3250	2			

Average assessed value (Total):	**$93,510**	1725	1.09	average:	0.74
Average Market Value (Total):	**$139,567**			2000 average:	0.67
Average assessed value (1 story):	**$87,650**	1618	1		
Average Market Value (1 story):	**$130,821**				
Assessed/Market value:	0.67				

Table II: Estimate of Household Item Costs
(Family of 4)

Item	Cost
Couches & chairs - living room	$2,000
Kitchen table & chairs	$1,500
coffee table	$150
end tables	$200
book shelves	$200
books	$6,000
Entertainment center	$250
Lazy boy	$800
Wood bed frames	$2,100
dressers	$600
night stands	$100
piano	$3,000
computer & software	$3,000
Desk	$200
TV	$700
Family room couch set	$1,500
Nintendo	$250
Stereo components	$1,500
Electronic media	$2,000
Vacuum cleaner	$300
Lawn mower	$300
Power tools	$1,000
Food Storage	$500
Bar Stools	$200
Kitchen appliances	$800
VCR/DVD player	$200
video camera	$600
sewing machine	$900
plants	$100
exercise equipment	$1,000
Bar-B-Que	$500
Trimmer	$100
Clothing/Shoes	$3,000
Household cleaning supplies	$250
Toiletries	$400
Kitchen items	$500
Decorations	$500
Bedding	$200
Washer/Dryer	$1,000
Refrigerator	$1,000
Games	$200
Camping gear	$400
Jewelry/Guns	$3,000
Lamps	$250
Dining room table & chairs	$2,000
China cabinet	$900
Garage hardware	$400
Tools	$500
Toys	$500
Garden tools/hoses	$250
Beds	$2,000
Total:	**$49,800**
Content value/structure value ratio:	**0.35**
Cost of Home:	**$142,286**

Table III: Preliminary Cost Estimate of Potential Flood Damage
(During the assumed 100-year lifespan of the project)

	Location	Representative Assessor Map Location	Number of Homes at Risk of Flooding	Average Structure Market Value	Content Value (35% of structure)	Six inch flood: Structure Damage %	Structure Damage Cost per Home	Structure Damage Total	Content Damage %	Content Damage Cost per Home	Content Damage Total	Total Damage Cost	Total Structure & Content Value
1	North of McDowell	Map 23	84	$222,368	$77,829	12.9%	$28,685	$2,409,580	15.5%	$12,063	$1,013,334	$3,422,913	$25,216,548
	Between McDowell & Culver	Map 28 & 29	43	$137,531	$48,136	12.9%	$17,741	$762,884	15.5%	$7,461	$320,826	$1,083,711	$7,983,681
2	Between McDowell & Culver	Map 28 & 29	46	$137,531	$48,136	12.9%	$17,741	$816,109	15.5%	$7,461	$343,210	$1,159,319	$8,540,682
	Between Culver & Hermosa Vista												
	East of 78th Street	Map 28 & 29	46	$137,531	$48,136	12.9%	$17,741	$816,109	15.5%	$7,461	$343,210	$1,159,319	$8,540,682
	West of 78th Street	Map 26	70	$130,821	$45,787	12.9%	$16,876	$1,181,314	15.5%	$7,097	$496,789	$1,678,103	$12,362,560
	Between Hermosa Vista & McKellips												
	Existing	Map 28 & 29	39	$137,531	$48,136	12.9%	$17,741	$691,918	15.5%	$7,461	$290,982	$982,901	$7,241,013
	Future	Map 26	59	$130,821	$45,787	12.9%	$16,876	$995,679	15.5%	$7,097	$418,722	$1,414,401	$10,419,872
3	Existing	Map 28 & 29	4	$137,531	$48,136	12.9%	$17,741	$70,966	15.5%	$7,461	$29,844	$100,810	$742,668
	Future	Map 26	92	$130,821	$45,787	12.9%	$16,876	$1,552,584	15.5%	$7,097	$652,923	$2,205,506	$16,247,936

Total affected homes: 483 **Grand Total:** $13,207,000 $97,295,642

	Location	Representative Assessor Map Location	Number of Homes at Risk of Flooding	Average Structure Market Value	Content Value (35% of structure)	One foot flood: Structure Damage %	Structure Damage Cost per Home	Structure Damage Total	Content Damage %	Content Damage Cost per Home	Content Damage Total	Total Damage Cost	Total Structure & Content Value
1	North of McDowell	Map 23	84	$222,368	$77,829	15.3%	$34,022	$2,857,874	18.8%	$14,632	$1,229,076	$4,086,949	$25,216,548
	Between McDowell & Culver	Map 28 & 29	43	$137,531	$48,136	15.3%	$21,042	$904,816	18.8%	$9,050	$389,131	$1,293,948	$7,983,681
2	Between McDowell & Culver	Map 28 & 29	46	$137,531	$48,136	15.3%	$21,042	$967,943	18.8%	$9,050	$416,280	$1,384,223	$8,540,682
	Between Culver & Hermosa Vista												
	East of 78th Street	Map 28 & 29	46	$137,531	$48,136	15.3%	$21,042	$967,943	18.8%	$9,050	$416,280	$1,384,223	$8,540,682
	West of 78th Street	Map 26	70	$130,821	$45,787	15.3%	$20,016	$1,401,093	18.8%	$8,608	$602,557	$2,003,650	$12,362,560
	Between Hermosa Vista & McKellips												
	Existing	Map 28 & 29	39	$137,531	$48,136	15.3%	$21,042	$820,647	18.8%	$9,050	$352,933	$1,173,581	$7,241,013
	Future	Map 26	59	$130,821	$45,787	15.3%	$20,016	$1,180,921	18.8%	$8,608	$507,869	$1,688,791	$10,419,872
3	Existing	Map 28 & 29	4	$137,531	$48,136	15.3%	$21,042	$84,169	18.8%	$9,050	$36,198	$120,367	$742,668
	Future	Map 26	92	$130,821	$45,787	15.3%	$20,016	$1,841,436	18.8%	$8,608	$791,932	$2,633,368	$16,247,936

Total affected homes: 483 **Grand Total:** $15,769,000 $97,295,642

Note: Structure damage percent was obtained from Figure A-10 in Appendix A of *Flood Proofing - How to Evaluate Your Options*, USACE, 1993. Content damage percent was obtained from Figure A-14 in the same source.

Note: The above values assume that during the next 100 years it is likely that all of the homes within the Potential Flood Impact Zone shown on the No Action Alternative exhibit will experience flooding.

WOOD/PATEL

CIVIL ENGINEERS • HYDROLOGISTS • LAND SURVEYORS • CONSTRUCTION MANAGERS

PROJECT Spook Hill ADM7 Update NO. 99989

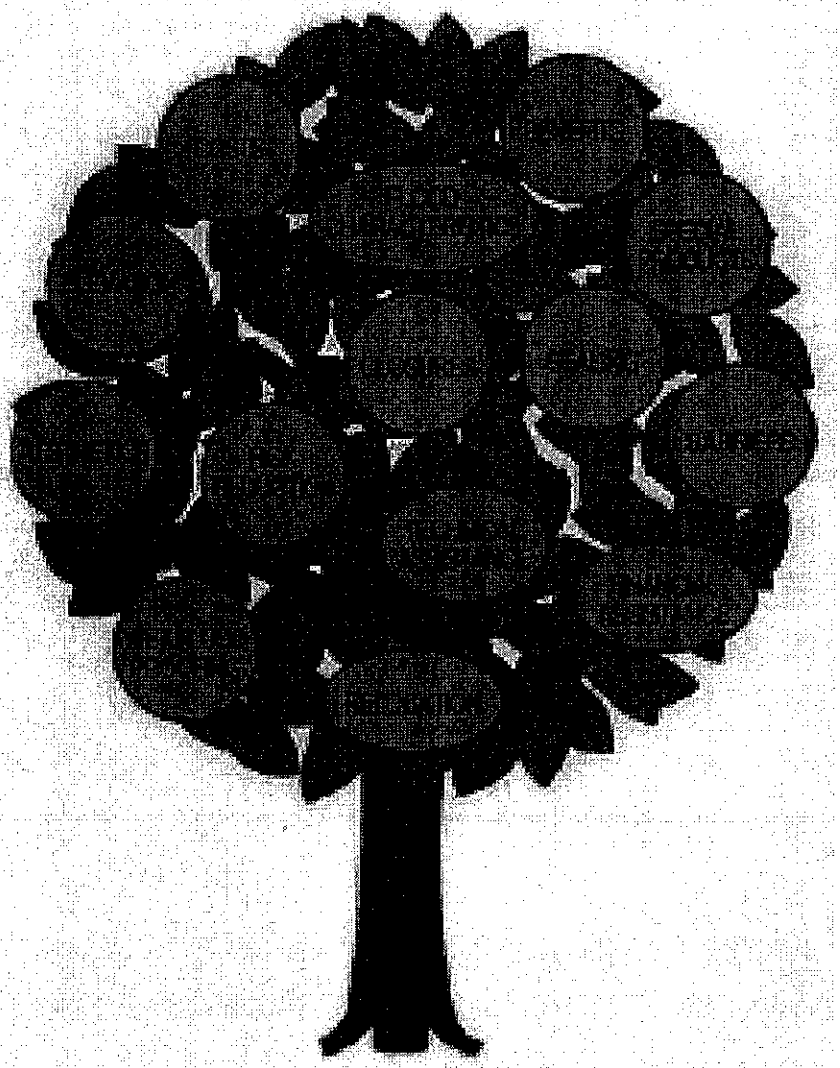
CALC'D BY JDS CHK'D BY

SHEET OF DATE 6/6/01

— Determine the value of contents in a typical home
see the attached spreadsheet.

FLOOD PROOFING

How to Evaluate Your Options



Decision Tree

July 1993

To estimate monetary damages to buildings for various flood depths, use the accompanying depth versus damage curves. These curves depict the relationship between flood depths and damage expressed as a percentage of the value of the building, with the zero-foot flood depth representing the top of the finished flooring of the lowest floor above any basement. Figures A-9 through A-12 relate flood depths to structural damage for a mobile home without basement, a one-story home without basement, a one-story home with basement, a split level home without basement, a split level home with basement, and a two-story home with and without basement, respectively. Figures A-13 and A-14 relate flood depths to home contents damage for a mobile home, a single-floor home (no basement), and a multi-floor home (basements are included as a floor). Contents damage includes damage to all furniture, small appliances, clothing, and other incidental items not included in building value. Figures A-9 through A-12 do not cover all types of buildings but do represent the most common residential structures. For other types of buildings, depth versus damage data may be available from another source or adjustments can be made to the provided curves to fit a particular building. The damage data in Figures A-9 through A-14 are shown as percentages of the total value of the building or its total contents depending on which curves are being used. For this analysis, the value of the building may be determined from tax assessments if they reflect market value or from a contractor's estimate of building replacement. The value of contents can be an estimate of replacement cost (which includes depreciation) of all of the building's contents or an average percentage of the value of the building, which has been estimated by insurance companies to be approximately 50 percent. However, to obtain the prevailing rates in the local community, contact insurance companies providing flood insurance. Note that on Figure A-14 the "First Floor Only" has higher percentages than the "First Floor and Above" because the multiple-floor structures are more expensive.

Figure A-9 - Depth Versus Damage For A Mobile Home Without Basement

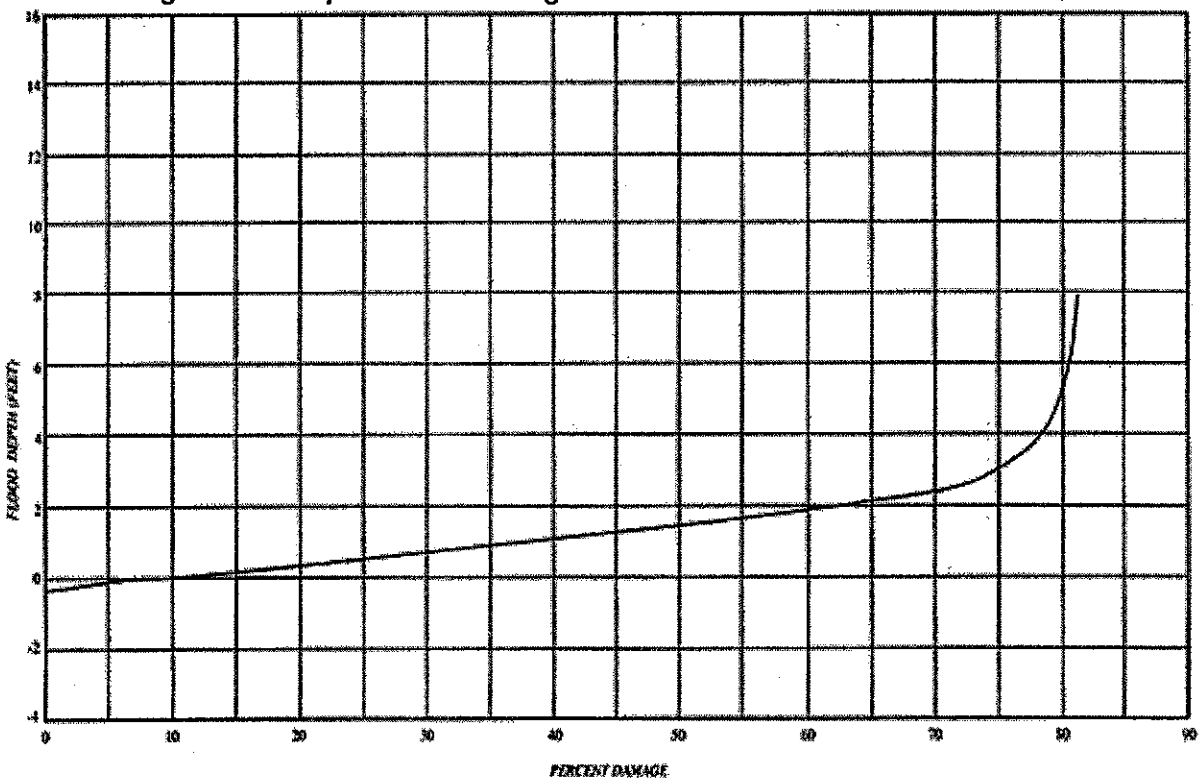
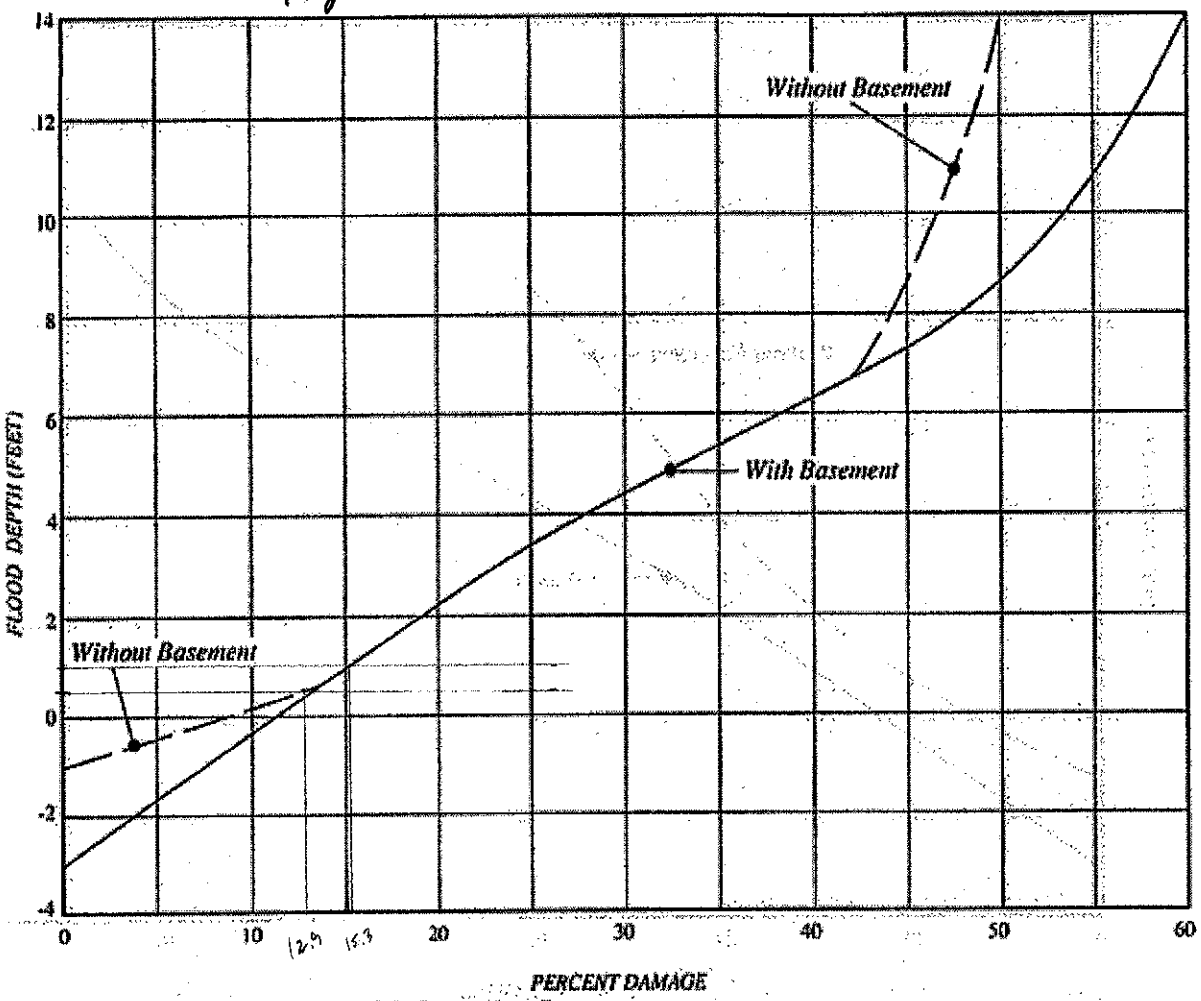


Figure A-10 - Depth Versus Damage For A One-Story Home

Figure A-10



Based on FEMA Actuarial Information System

Figure A-11 - Depth Versus Damage For A Split-Level Home (next page)

Figure A-11

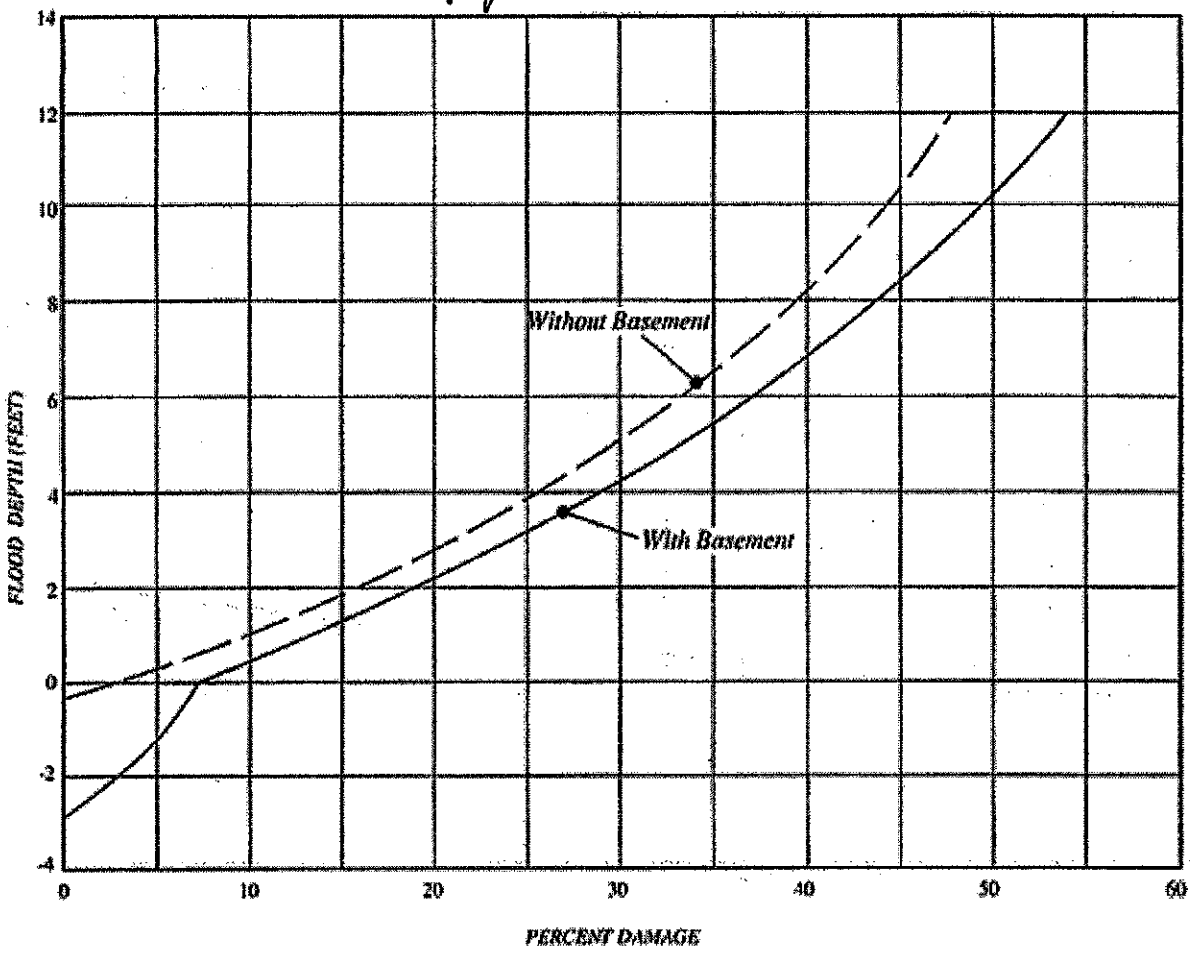
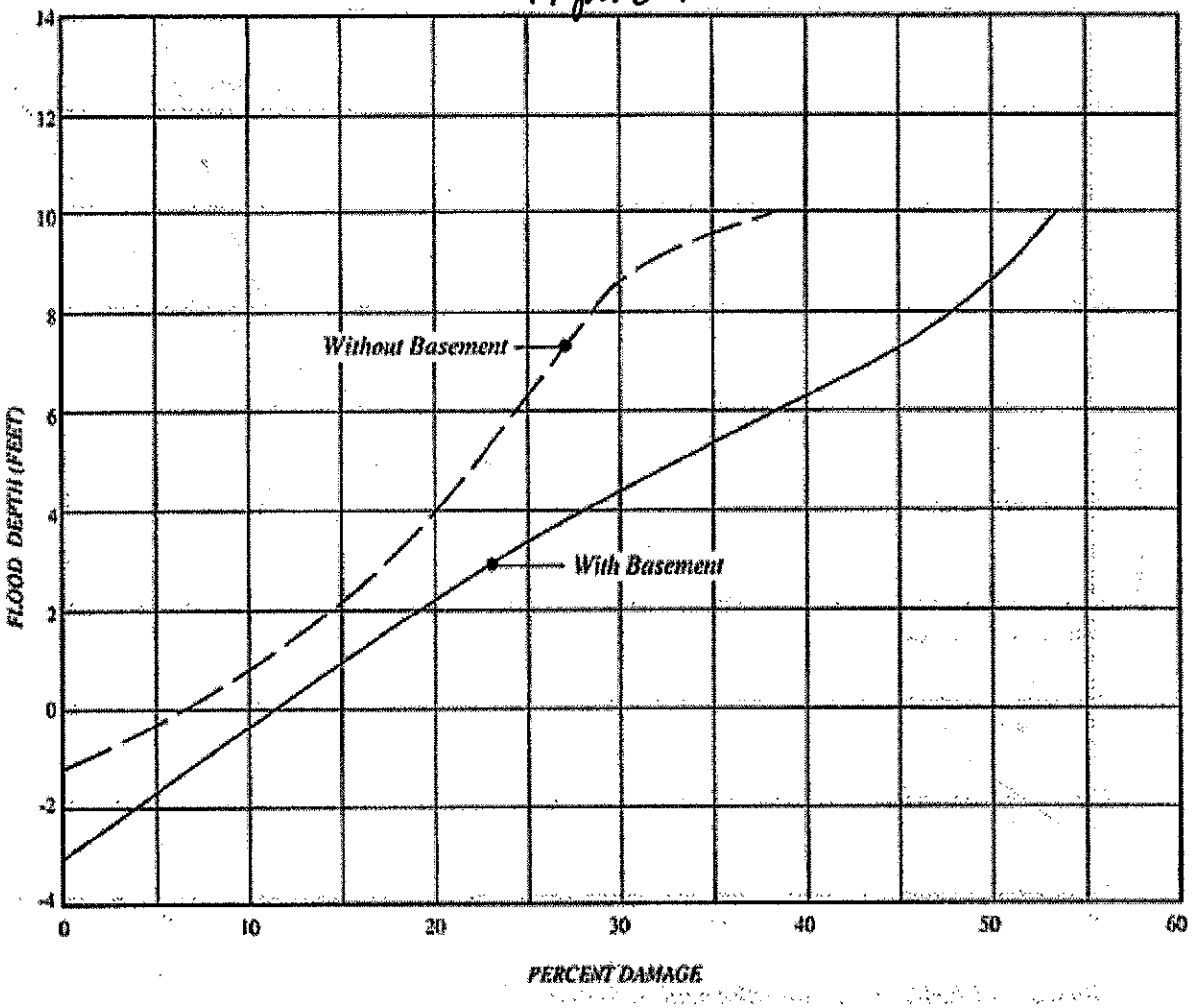


Figure A-12 - Depth Versus Damage For A Two-Story Home (next page)

Figure A-12



Based on FEMA Actuarial Information System

Figure A-13 - Depth Versus Damage For Mobile Home Contents (Next page)

Figure A-13

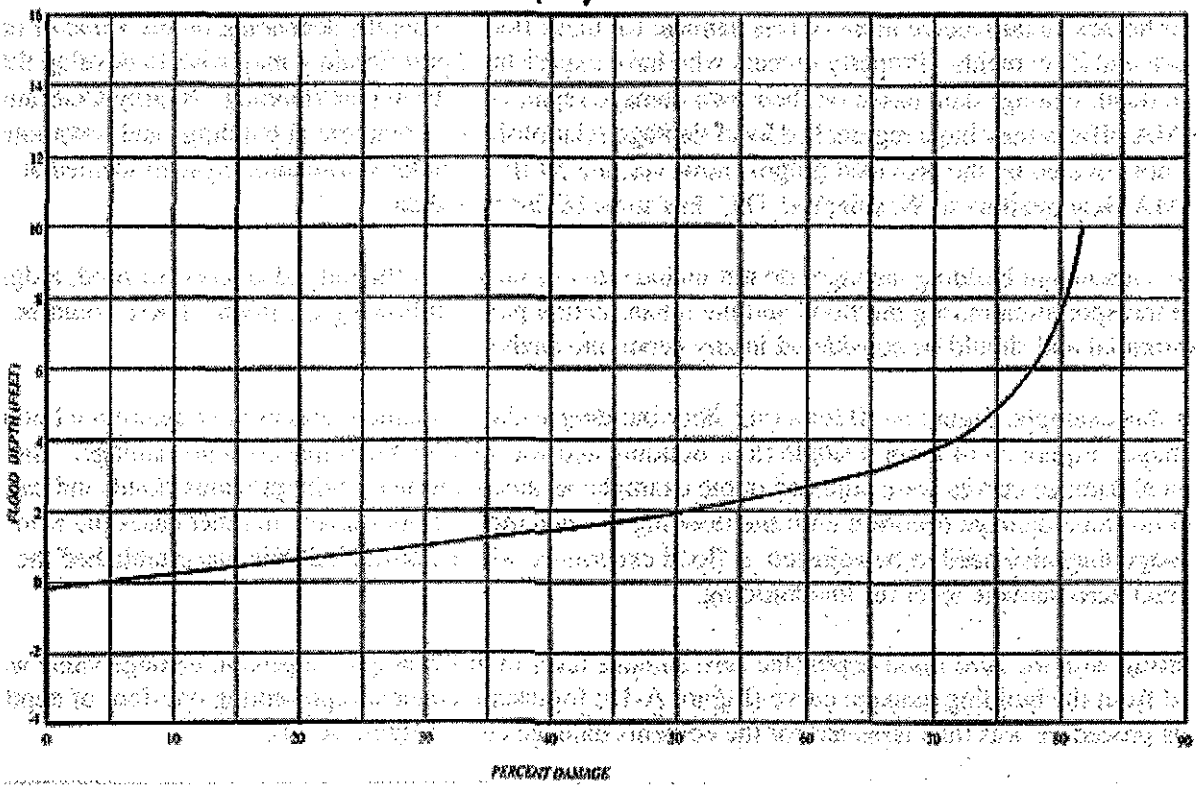
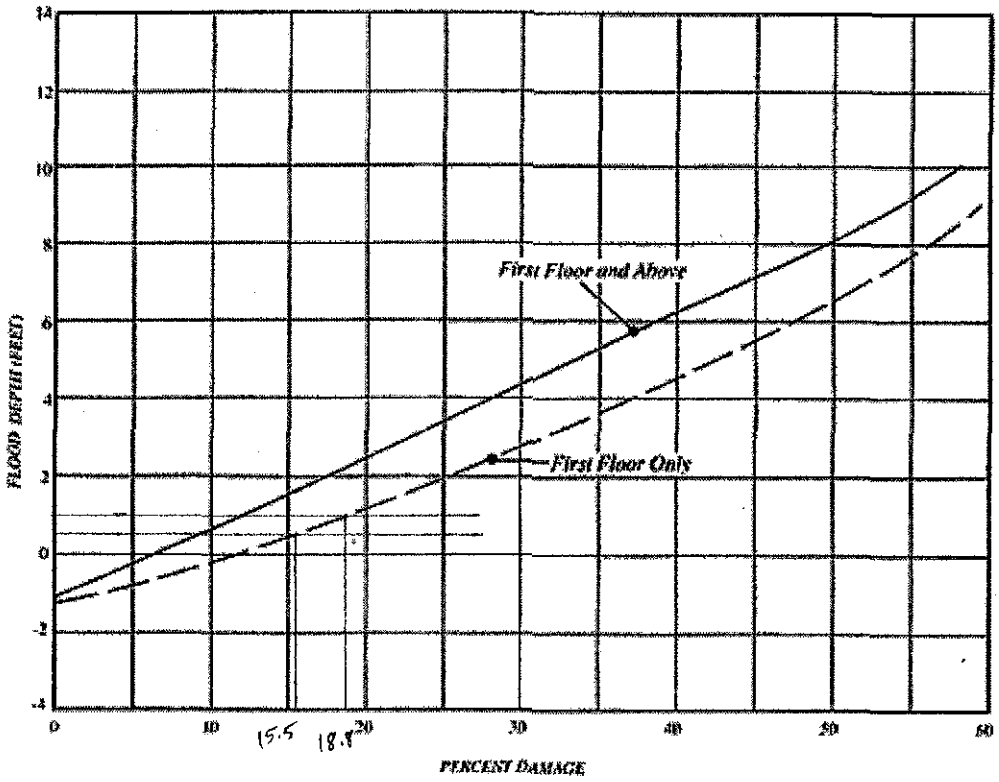


Figure A-14 - Depth Versus Damage For Home Contents



Based on FEMA Actuarial Information System

These depth versus damage curves are based on statistical analyses of flood insurance claims data by the Federal Insurance Administration. Property owners should realize that, since these are average values, their homes could receive more or less damage for these flooding depths depending on the value of the house and its contents. Property owners who have experienced past flooding may wish to develop their own depth-damage data based on their own damage repair costs from past flooding. Nearby COE and/or FEMA offices may have regional or local damage relationships. Commercial buildings and townhouses are not covered by the provided graphs; however, the NFIP Actuarial Information System located at FEMA Headquarters in Washington, D.C. has some of this type data.

The content and building damages do not include loss of income or the individual costs of food, lodging, and transportation during the flood and the rehabilitation period following the flood. These could be substantial and should be considered in any economic analysis.

For this example, Figure A-10 for a one-story building without basement was used to determine building damage. Figure A-14 is for a single floor building and was used to determine contents damage. The typical damage curves were adjusted in the example because experience with previous floods indicated that no flood damage occurred until the flooding reached the first floor level. In other cases the zero damage may also need to be adjusted, if flood experience with an actual building has established the correct zero damage level for that building.

Starting with the zero flood depth (the zero damage level in this example), a percent damage value was read from the building damage curve (Figure A-10) for each increment representing one-foot of depth. This procedure was then repeated for the contents damage curve (Figure A-14).

The percent damages to the building and contents were converted to dollar values. The latest tax assessment for this home indicated the value of the building as $75,000 and the land value as $25,000 for a total assessed value of $100,000. However, information provided by a local Realtor indicated that similar property in the same community sold for an average of $120,000. From the tax assessment, it was determined that the value of the building was 75 percent of the total assessed value. Thus, the market value of the property ($120,000) was multiplied by 75 percent to determine a fair market value of $90,000 for the building. For the contents, based on the types and quality of furniture, appliances, and other contents, a value of 50 percent ($45,000) of the fair market value of the building was selected. Next, these dollar values for building damage and contents damage were multiplied by the percentage for building damage and contents damage, respectively, at each one-foot increment. The dollar values for building and contents damage were then added together to get the total damage at each one-foot increment.

Then, the flood depths were converted into elevations based on the first floor elevation. In this example, the flood elevations were determined by adding the flood depths to 122.1 feet NGVD (the first floor elevation). Next, a discharge was found for each elevation from the discharge versus elevation curve (Figure A-4). Then the exceedance probability for each discharge was determined from the discharge versus probability curve (Figure A-5). Table A-3 shows the results.

Table A-3 - Depth-Damage Data For Example Home

Depth *feet*	Building Damage *$*	Contents Damage *$*	Total Damage *$*	Elevation *feet, NGVD*	Discharge *cfs*	Exceedance Probability *%*
0.0	0	0	0	122.1	280	50.0
1.0	13,500	8,100	21,600	123.1	400	30.0
2.0	17,100	11,700	28,800	124.1	560	15.0
3.0	20,700	14,400	35,100	125.1	780	6.5
4.0	25,200	17,100	42,300	126.1	1,100	2.2
5.0	29,700	18,900	48,600	127.1	1,315	1.0
6.0	34,200	21,150	55,350	128.1	1,980	0.2
7.0	38,700	23,400	62,100	129.1	---	---

A discharge and probability could not be determined for the 129.1 foot elevation and above because this point is beyond the 500-year discharge-the limit of the rating curve.

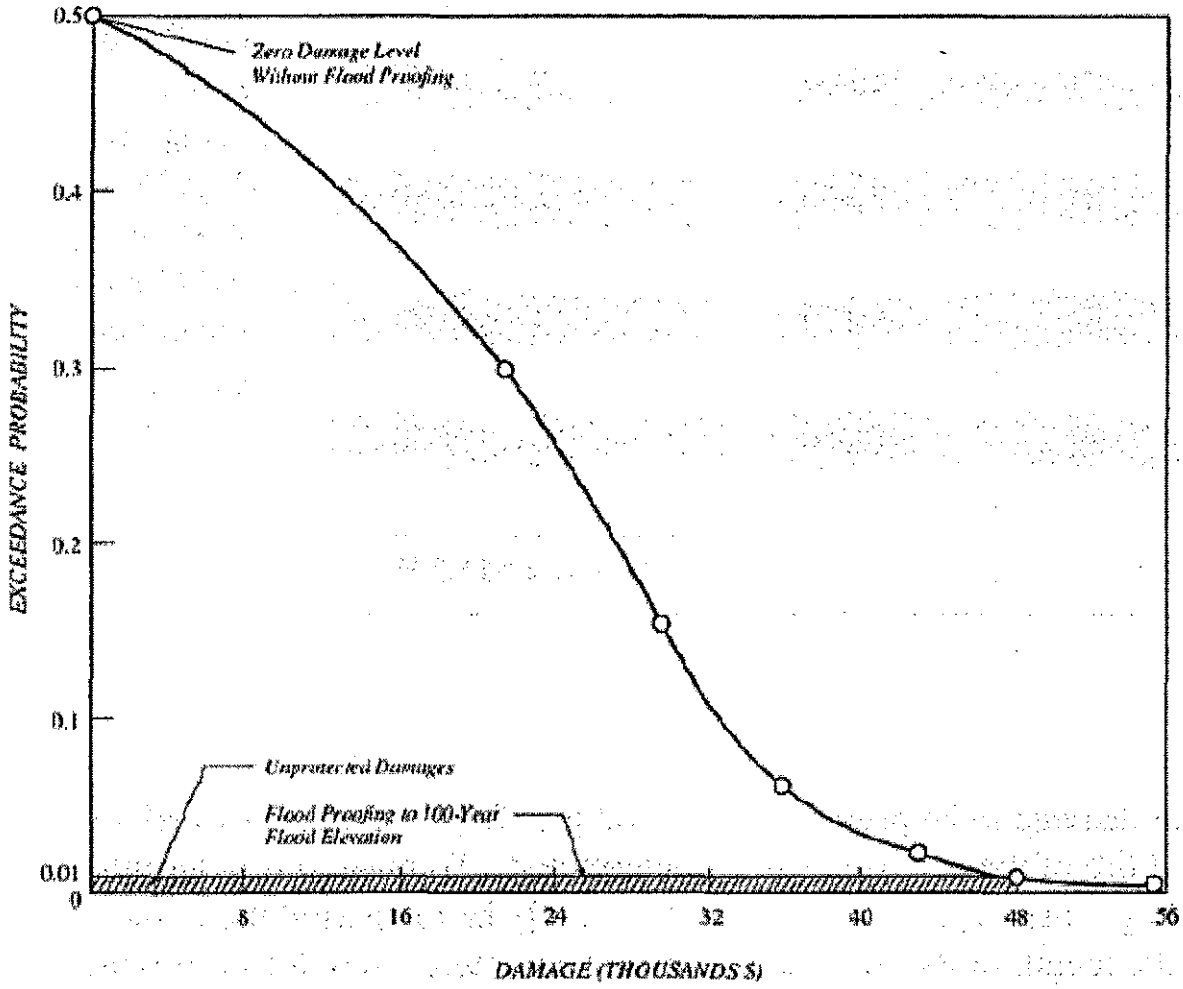
Probability Versus Damage Curve

The relationship between exceedance probability and damage for the home was plotted. The probability is expressed on the graph as a fraction of 100 percent. For example, 48 percent is expressed as .48 (48 percent divided by 100). For each probability in this table, a point for the probability and the corresponding damage was plotted and a smooth curve sketched through the points, as shown in Figure A-15. The area underneath this curve represents the average annual damage caused to the home by flooding.

Benefits Of Flood Proofing

The benefit from flood proofing to a property owner is the prevention of damages that otherwise would have occurred without flood proofing. By flood proofing the building to a certain level, the property owner raises the zero-damage level, meaning that floodwaters will have to rise higher, above the flood proofing level, to damage the building. Annual average damage prevented by flood proofing can be determined by first drawing a horizontal line on the probability versus damage curve at the desired level of flood proofing. This line will represent the new zero-damage level after flood proofing. Then, the area underneath the probability versus damage curve but above the new zero-damage level is calculated. This area represents the annual average damage prevented by flood proofing.

Figure A-15 - Probability Versus Damage For Example Home



For this example, the property owner chose to flood proof to the 100-year flood level, which has a probability of 1 percent (100 divided by 100-year). Therefore, a horizontal line was drawn on the probability versus damage curve at the 0.01(1 percent divided by 100) level. This line represents the new zero-damage level with flood proofing. The damage that could be prevented by flood proofing the home to the 100-year flood level is represented by the area above the new zero-damage level with flood proofing and underneath the probability versus damage curve. This area was calculated in the following manner:

- Beginning with the zero-damage level without flood proofing, a probability and damage were selected from the probability versus damage curve (.50, $0).
- Next, a lower point on the vertical axis of the probability versus damage curve was selected and recorded (.40, $15,000).
- The interval between the two probability levels was calculated (.50-.40 = .10).
- The average damage between the two probability levels was calculated ($0 + $15,000 / 2 = $7,500).
- The probability interval and the average damage were multiplied (.10 x $7,500 = $750). This product represents the average annual damage prevented between these two probability levels.
- The above steps were repeated for probability levels at lower increments until the desired flood proofing level of .01 probability was reached.
- The incremental annual average damages were added to get the total annual average damage prevented by flood proofing.

These computations are shown in Table A-4.

Table A-4 - Flood Damage Prevented

Probability	Damage $	Probability Interval	Average Damage $	Incremental Average Annual Damage Prevented $
.50	0			
		.10	7,500	750
.40	15,000			
		.10	18,300	1,830
.30	21,600			
		.10	23,800	2,380
.20	26,000			
		.10	29,250	2,925
.10	32,500			
		.09	40,550	3,650
.01	48,600			
				TOTAL $11,535

From this analysis, it was determined that by flood proofing to the 100-year flood level an average of $11,535 in flood damages could be prevented per year.

After determining the average annual damage to be prevented by flood proofing, the present worth of damages prevented over the expected life of the structure can be determined. To make this determination, one must first assume the building's life expectancy; this will normally be the period the homeowner plans to occupy the home or the length of the mortgage. Second, an interest rate for borrowing money to flood proof must be assumed. This rate may be obtained from any bank. The property owner can then use Table A-5 to obtain a present worth factor for the assumed life of the structure and interest rate.

For interest rates and/or life of structure not provided in Table A-5, the present worth factor can be obtained by the following formula:

Present Worth Factor =

$$\frac{(1+i)^n - 1}{i(1+i)^n}$$

n = *assumed life of structure*

i = *assumed interest rate for borrowing money*

Multiply the average annual damage prevented by flood proofing by the present worth factor to determine the present-day value of these expected flood damages.

Table A-5 - Present Worth Factors

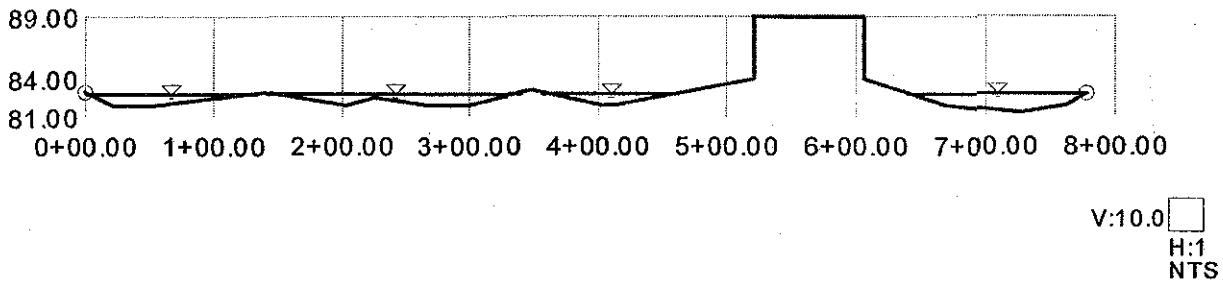
Life of Structure *years*	Assumed Interest Rate					
	7%	8%	9%	10%	11%	12%
1	.9346	.9259	.9174	.9091	.9009	.8929
2	1.8080	1.7833	1.7591	1.7355	1.7125	1.6901
3	2.6243	2.5771	2.5313	2.4869	2.4437	2.4018
4	3.3872	3.3121	3.2397	3.1699	3.1024	3.0373
5	4.1002	3.9927	3.8897	3.7908	3.6959	3.6048
6	4.7665	4.6229	4.4859	4.3553	4.2305	4.1114
7	5.3893	5.2064	5.0330	4.8684	4.7122	4.5638
8	5.9713	5.7466	5.5348	5.3349	5.1461	4.9676
9	6.5152	6.2469	5.9952	5.7590	5.5370	5.3282
10	7.0236	6.7101	6.4177	6.1446	5.8892	5.6502
11	7.4987	7.1390	6.8052	6.4951	6.2065	5.9377
12	7.9427	7.5361	7.1607	6.8137	6.4234	6.1944
13	8.3577	7.9038	7.4869	7.1034	6.7499	6.4235
14	8.7455	8.2442	7.7862	7.3667	6.9818	6.6282
15	9.1079	8.5595	8.0607	7.6061	7.1909	6.8109
16	9.4466	8.8514	8.3126	7.8237	7.3792	6.9740
17	9.7632	9.1216	8.5436	8.0216	7.5488	7.1196
18	10.0591	9.3719	8.7556	8.2014	7.7016	7.2497
19	10.3356	9.6036	8.9501	8.3649	7.8393	7.3658
20	10.5940	9.8181	9.1285	8.5136	7.9633	7.4694
21	10.8355	10.0168	9.2922	8.6487	8.0751	7.5620
22	11.0612	10.2007	9.4424	8.7715	8.1757	7.6446
23	11.2722	10.3711	9.5802	8.8832	8.2664	7.7184
24	11.4693	10.5288	9.7066	8.9847	8.3481	7.7843
25	11.6536	10.6748	9.8226	9.0770	8.4217	7.8431
26	11.8258	10.8100	9.9290	9.1609	8.4881	7.8957
27	11.9867	10.9352	10.0266	9.2372	8.5478	7.9426
28	12.1371	11.0511	10.1161	9.3066	8.6016	7.9844
29	12.2777	11.1584	10.1983	9.3696	8.6501	8.0218
30	12.4090	11.2578	10.2737	9.4269	8.6938	8.0552

In this example, the life of the home was assumed to be 30 years along with an interest rate of 10 percent for borrowing money for flood proofing. From Table A-5, a present worth factor of 9.4269 was obtained. Multiplying this factor by average annual damages of $11,535 prevented by flood proofing, a present-day worth of $108,700 for damage prevented over the life of the home was computed. If future flood events occurred like past ones, flood proofing costs equal to or less than the present-day value of damage would normally be economically justified.

Section 2
Cross Section for Irregular Channel

Project Description	
Worksheet	Section 2
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.060	
Slope	0.016670	ft/ft
Water Surface Elevation	82.93	ft
Elevation Range	81.30 to 89.00	
Discharge	973.00	cfs



Section 2
Worksheet for Irregular Channel

Project Description	
Worksheet	Section 2
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	0.016670	ft/ft
Discharge	973.00	cfs

Options	
Current Roughness Method	Improved Lotter's Method
Open Channel Weighting Method	Improved Lotter's Method
Closed Channel Weighting Method	Horton's Method

Results		
Mannings Coefficient	0.060	
Water Surface Elevation	82.93	ft
Elevation Range	81.30 to 89.00	
Flow Area	392.1	ft²
Wetted Perimeter	573.63	ft
Top Width	573.38	ft
Actual Depth	1.63	ft
Critical Elevation	82.64	ft
Critical Slope	0.065582	ft/ft
Velocity	2.48	ft/s
Velocity Head	0.10	ft
Specific Energy	83.02	ft
Froude Number	0.53	
Flow Type	Subcritical	

Calculation Messages:
Flow is divided.
Water elevation exceeds lowest end station by 0.12753446 ft.

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00.00	7+78.70	0.060

Natural Channel Points

Station (ft)	Elevation (ft)
0+00.00	83.00
0+20.90	82.00
0+51.90	82.00
1+39.70	83.00
2+03.50	82.00
2+25.90	82.50
2+67.80	82.00
3+00.00	82.00
3+47.00	83.10

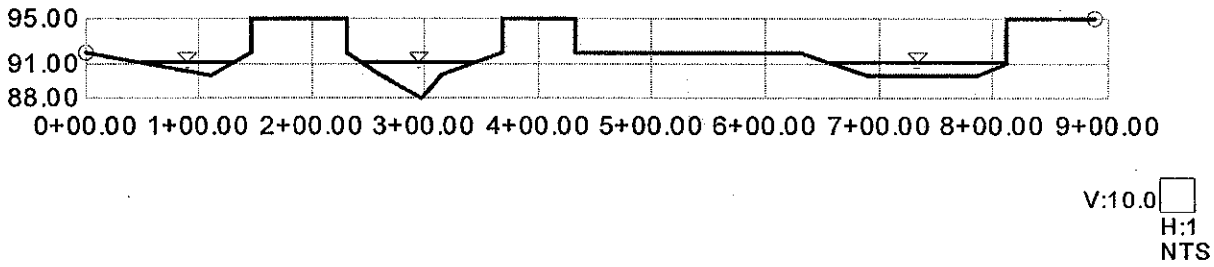
Section 2
Worksheet for Irregular Channel

Natural Channel Points	
Station (ft)	Elevation (ft)
4+01.50	82.00
4+13.60	82.00
5+20.40	84.00
5+20.50	89.00
6+06.10	89.00
6+06.20	84.00
6+69.30	82.00
7+27.80	81.30
7+63.40	82.00
7+78.70	82.80

Section 1
Cross Section for Irregular Channel

Project Description	
Worksheet	Section 1 - No Action
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.060	
Slope	0.015000	ft/ft
Water Surface Elevation	91.11	ft
Elevation Range	88.00 to 95.00	
Discharge	973.00	cfs



Section 1 - Potential Flood Impact Zone
Worksheet for Irregular Channel

Project Description	
Worksheet	Section 1 - No Action
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	0.015000	ft/ft
Discharge	973.00	cfs

Options	
Current Roughness Method	Improved Lotter's Method
Open Channel Weighting Method	Improved Lotter's Method
Closed Channel Weighting Method	Horton's Method

Results		
Mannings Coefficient	0.060	
Water Surface Elevation	91.11	ft
Elevation Range	88.00 to 95.00	
Flow Area	327.2	ft²
Wetted Perimeter	336.94	ft
Top Width	336.51	ft
Actual Depth	3.11	ft
Critical Elevation	90.68	ft
Critical Slope	0.058036	ft/ft
Velocity	2.97	ft/s
Velocity Head	0.14	ft
Specific Energy	91.24	ft
Froude Number	0.53	
Flow Type	Subcritical	

Calculation Messages:
Flow is divided.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	8+88.40	0.060

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	92.00
1+08.80	90.00
1+11.30	90.00
1+46.00	92.00
1+46.10	95.00
2+31.00	95.00
2+31.10	92.00
2+61.10	90.00
2+97.10	88.00
2+98.50	88.00

Section 1 - Potential Flood Impact Zone
Worksheet for Irregular Channel

Natural Channel Points	
Station (ft)	Elevation (ft)
3+14.00	90.00
3+68.90	92.00
3+69.00	95.00
4+33.00	95.00
4+33.10	92.00
6+28.90	92.00
6+89.20	90.00
7+88.40	90.00
8+10.60	91.00
8+10.70	95.00
8+88.40	95.00

WOOD/PATEL

CIVIL ENGINEERS • HYDROLOGISTS • LAND SURVEYORS • CONSTRUCTION MANAGERS

PROJECT Spook Hill NO. 99989

CALC'D BY JDS CHK'D BY

SHEET OF DATE 5/21/01

- identify washes that would be analyzed as part of the non-structural alternative.

  - Assume that areas or washes with drainage areas over 0.5 mi^2 would be analyzed.

  - Use landiscor images to verify location of drainages based on vegetation density.

  - Assume that quadrangle topo info is out-dated.

WOOD/PATEL

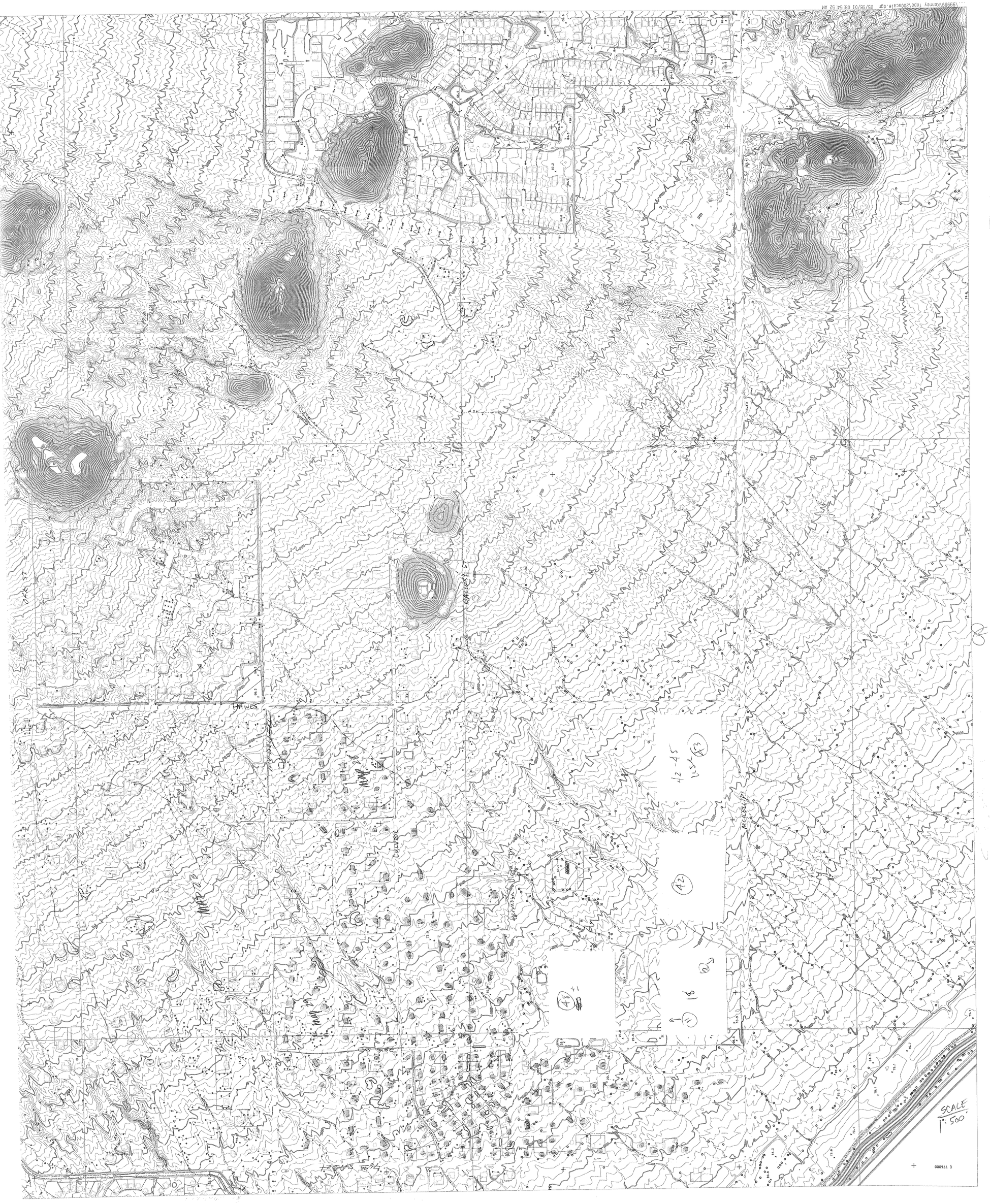
CIVIL ENGINEERS • HYDROLOGISTS • LAND SURVEYORS • CONSTRUCTION MANAGERS

PROJECT Spook Hill NO. 99989

CALC'D BY LW CHK'D BY

SHEET 1 OF 1 DATE 11/12/01

Area1	1,110
Area2	135
Area3	652
Area4	158
Area5	32
	2,087



8

N-21 N22 N-23
O-22

R7E

2N	31	32	33	34
	6	5	4	3
1N	7	8	9	10
	18	17	16	15

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PHOTO DATE:

PH