Up the Creek Without a Paddle but with a Very Elaborate HEC-RAS Model:

A Letter of Map Revision for a Small Community

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City of Deer Lodge

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Project Manger
Great West Engineering

2017 AMFM | March 7th | Missoula, Montana

Overview

- Setting
- Historical Context
- Flood Mitigation
- 2011 Flood
- Post Flood Actions
- LOMR Coordination
- Elected Officials
- Engineering (Technical Stuff)
- Public Engagement
- Local Floodplain Administrator
- Lessons Learned
- Questions

Setting

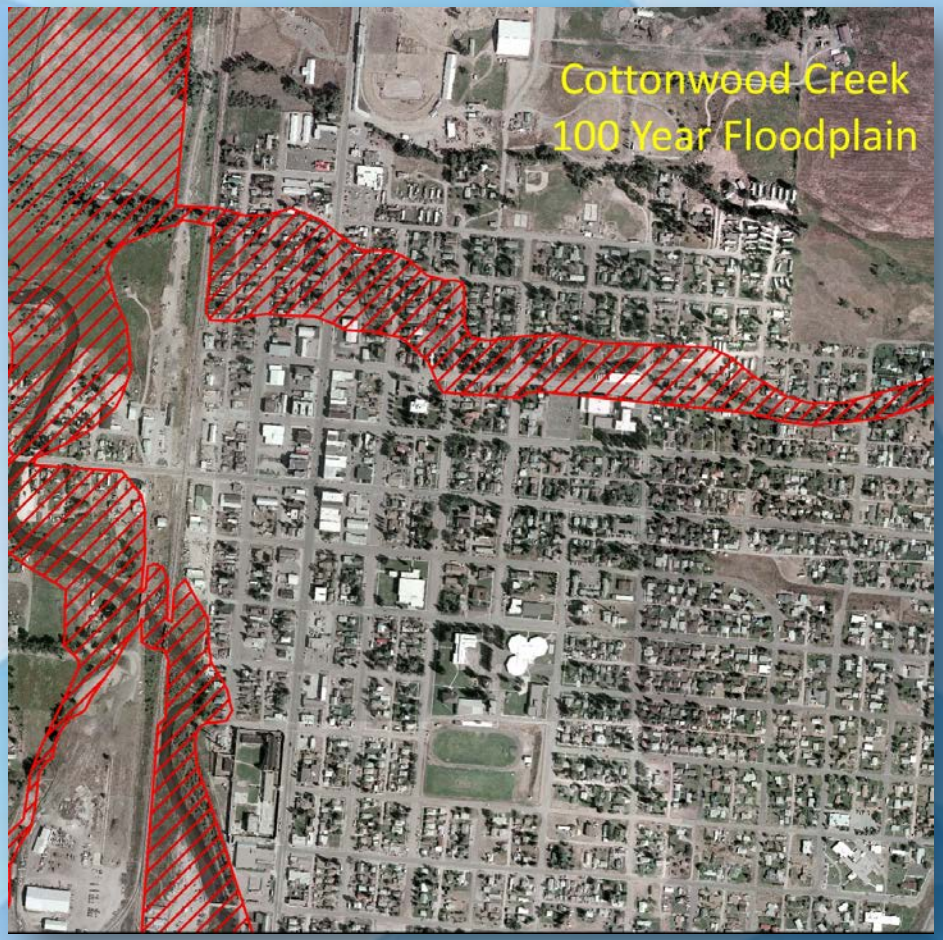
- Cottonwood Creek's watershed consists of 42 square miles.

- Flows through the City of Deer Lodge before draining into the Clark Fork River

Setting

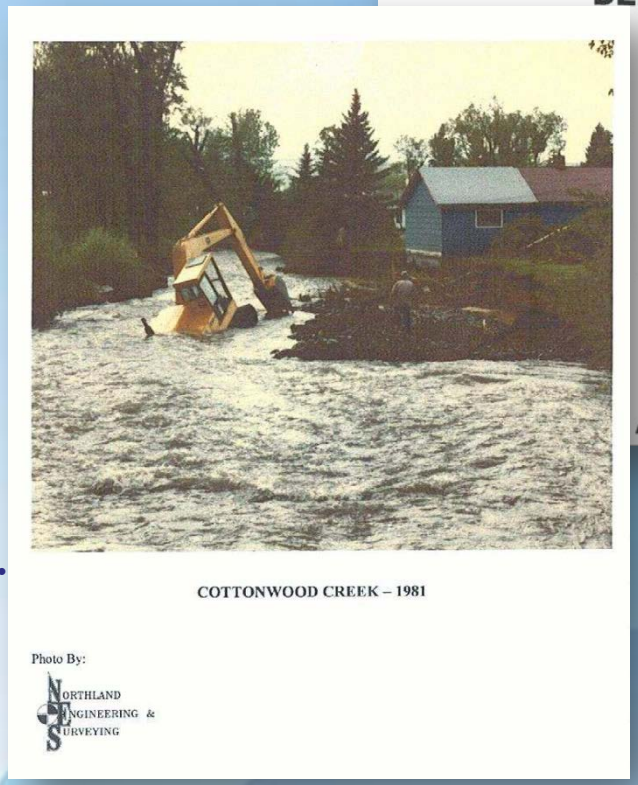
- Cottonwood Creek's 100 Year Floodplain Occupies 5% of the City.

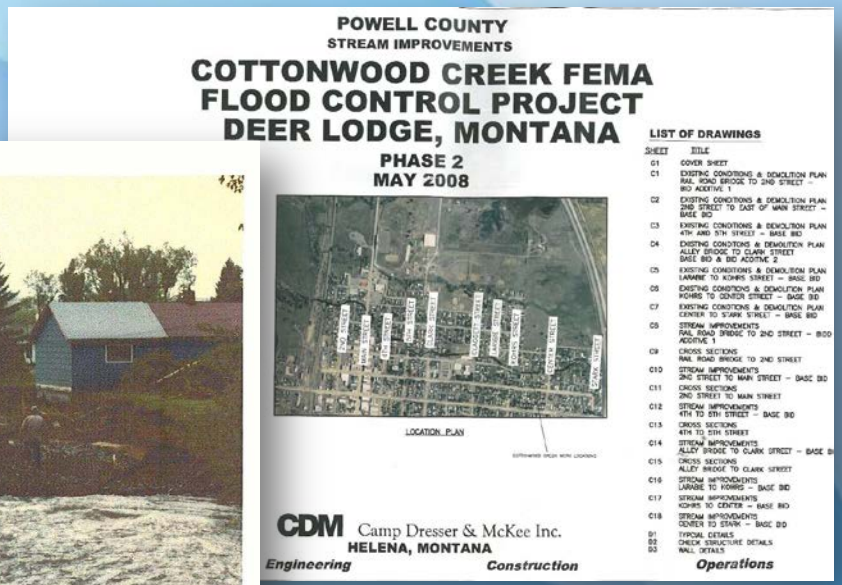
- An urbanized channel with armored banks, physical encroachments, and a history of public indifference.

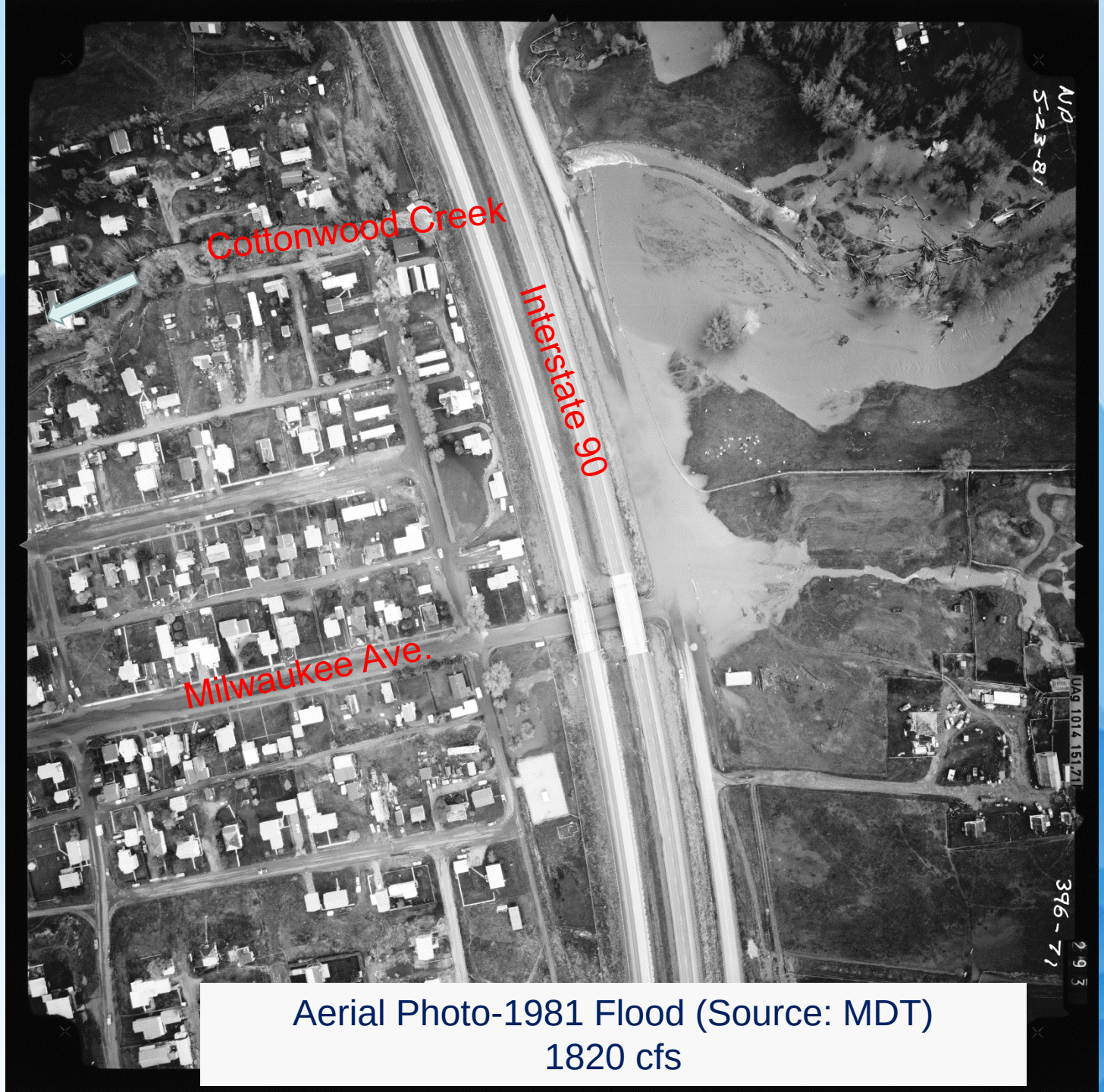


Historical Context

- The community experienced several flooding events with the most destructive being 1964 & 1981.
- Local officials after each event devised another project to lessen the damage from future floods.







Aerial Photo-1981 Flood (Source: MDT)
1820 cfs

2011 Flood

- Cottonwood Creek flooded in June 2011 after a significant rain on snow event.
- Flood waters rushed through the center of Deer Lodge causing mayhem.

2011 Flood

Post Flood Action

- The event occurred in the midst of a multi-phased flood control project.

- Post flood worked included rebuilding floodwalls and replacing Center Street & Main Street Bridges

Elected Officials

County Commissioners

- Is this really necessary?
- After the initial skepticism – they are fully committed to the project
- Recognized the LOMR validates all the improvements
- Confidence in Great West Engineering

Historical Context

Second Street Bridge

Main Street Bridge

Center Street Bridge

Bridge closed, hole in deck, scoured foundation

Historical Context

Coordination

POWELL COUNTY
Cottonwood Creek LOMR
Scoping Meeting
October 1, 2014
Sign-In Sheet

City of Deer Lodge
City/County Meeting Agenda
Wednesday, November 18, 2015
5:30 p.m. Community Center

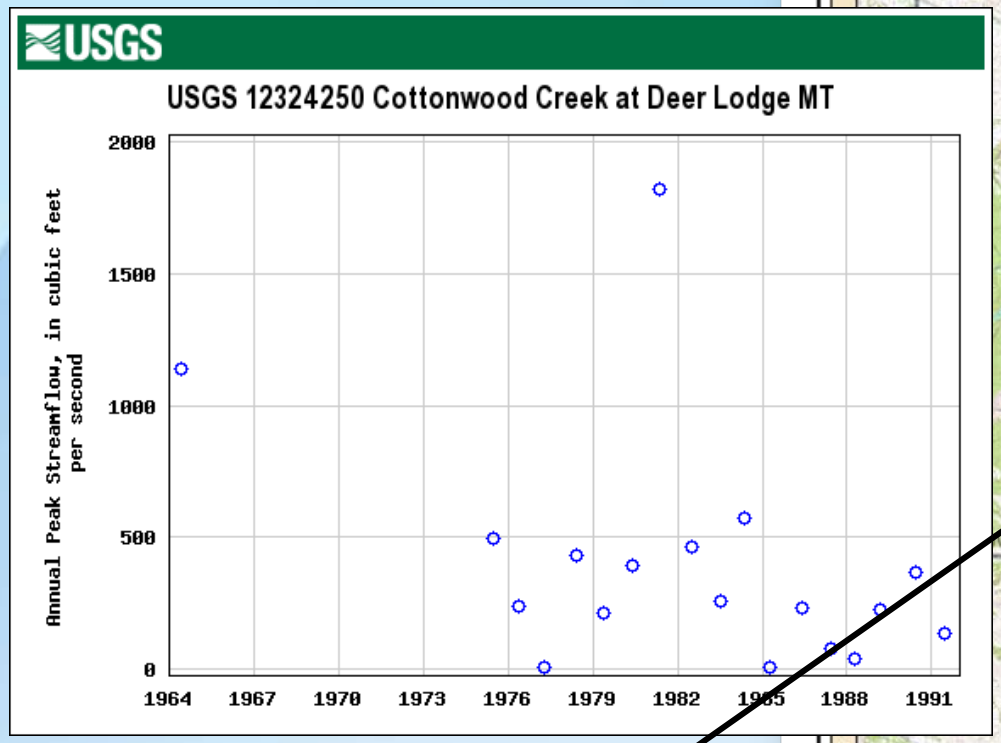
Cottonwood Creek LOMR Meeting – July 14, 2015, 2 pm
Meeting Minutes

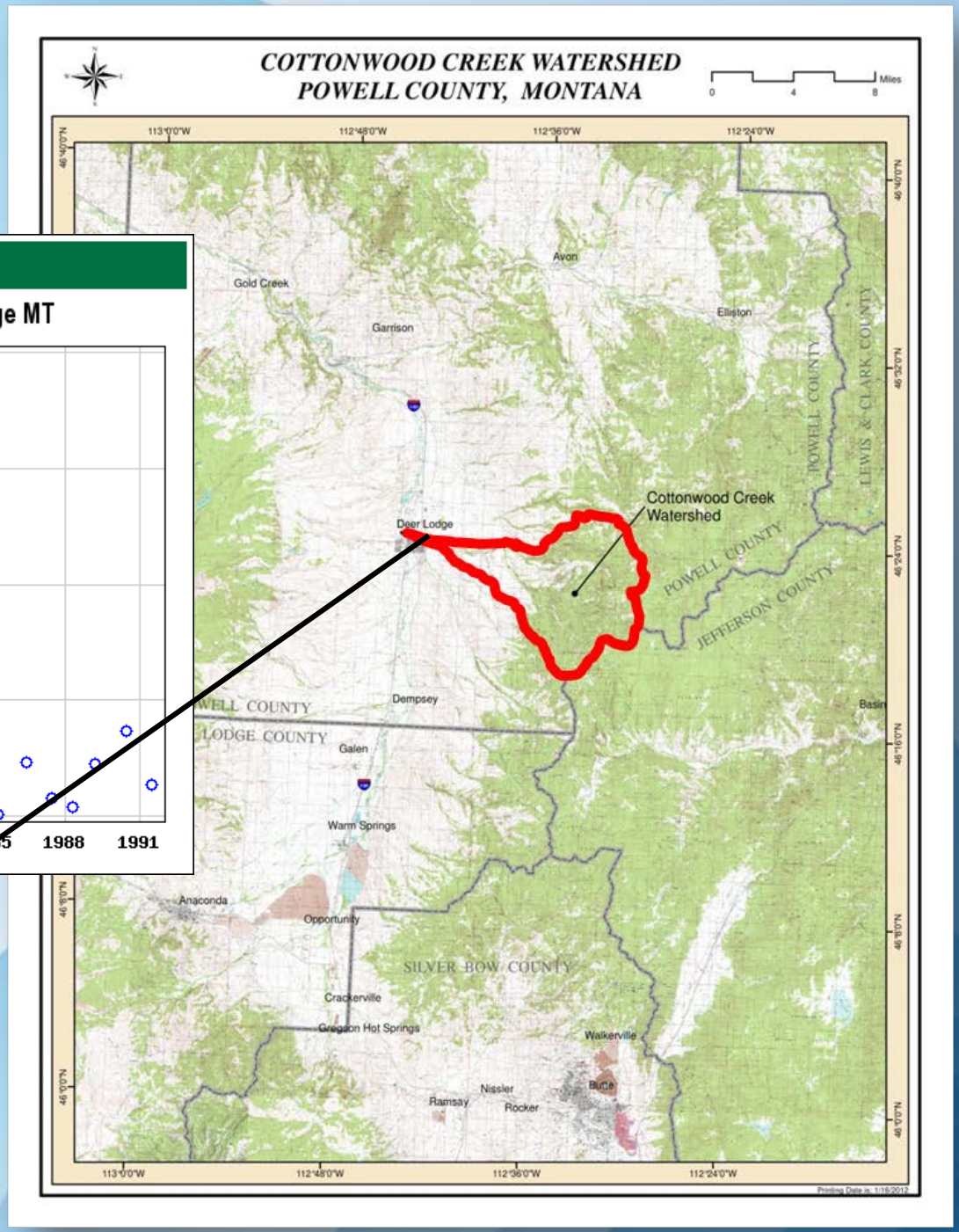
Cottonwood Creek LOMR Conference Call (Hydrology)
August 13, 2015, 9:30 pm
Meeting Minutes

KEEP
CALM
WE"RE DOING SOME
TECHNICAL
STUFF

N
WARREN LN
PRAIRIE LN
CONESTOGA LN
VIGILANTE DR
CHILCOTT LN
N BOULDER RD
GRANT CIR
N MAIN ST
ASPEN LN
TOWN PUMP CT
N WEST ST
N SECOND ST
FAIR ST
BERG ST
JOHNSON CREEK
90
CLARK FORK
COTTONWOOD CREEK
HIGGINS AVE
CALIFORNIA AVE
FIFTH ST
DIXON ST
CALIFORNIA AVE
LARABIE ST
REIERSON ST
GILBERT AVE
COTTONWOOD AVE
CLARK ST
CLAGETT ST
OLIN ST
PAVILION LN
WEST ST
PARK ST
RAILROAD ST
MITCHELL ST
W MILWAUKEE AVE
MISSOURI AVE
BROOKSIDE BLVD
KOHRS ST
CENTER ST
STARK ST
SECOND ST
MAIN ST
MILWAUKEE AVE
MONTANA AVE
MONTANA AVE
APPLEGATE LN
ST MARYS AVE
COLLEGE AVE
FOURTH ST
KOHRS ST
COLLEGE AVE
CARTER ST
MILL ST
BIELENBERG ST
BOULDER RD
PENNSYLVANIA AVE
DIXON ST
PENNSYLVANIA AVE
ONEILL ST
MARYLAND AVE
Johnson Creek culvert (location estimated)
Twin culverts at I-90 and Cottonwood Creek
USGS Gage 12324250
Milwaukee Ave underpass
36" culvert (location estimated)
Vicinity Map
Cottonwood Creek
at Deer Lodge, Montana
Aerial photograph source is the U.S. Farm Services Agency National Agricultural Imagery Program (NAIP), 2013.
0
500
1,000
Feet

Hydrology





USGS Gage 12324250 Cottonwood Creek at Deer Lodge MT

Hydrology

Return Interval	Effective FIS (cfs)
10-year	517
50-year	833
100-year	1,140
500-year	2,000

Hydrology

Table 2: Regional gage analysis of 1964 and 1981 peak discharge events. Observed peaks that do not correlate in timing with the Cottonwood 1964 and 1981 events are shaded.

USGS Station Number	USGS Station Name	Location		Drainage area (mi^2)	Datum of gage (ft above msl)	Period of Record	Q_{100} (Parrett & Johnson, 2004)	Observed 1964 and 1981 peak flow & timing					
								1964			1981		
		latitude	longitude					date	peak discharge (cfs)	Approx. return interval[3]	date	peak discharge (cfs)	Approx. return interval[3]
12324250	**Cottonwood Creek at Deer Lodge, MT**	**46°23'59"**	**112°43'00"**	**42.1**	**4579**	**1964, 1975-1991**	**1630**	**~ Jun 9[1]**	**1140**	**Q_{31}**	**May 22**	**1820**	**Q_{163}**
12324200	Clark Fork at Deer Lodge, MT	46°23'52"	112°44'33"	1001	4502	1979-2014	3860	no data			**May 23**	**2500**	**Q_{18}**
12324590	Little Blackfoot River near Garrison, MT	46°31'10",	112°47'35"	414	4344	1973-2014	8100	no data			**May 22**	**8650**	**Q_{186}**
12324100	Racetrack Cr bl Granite Cr near Anaconda, MT	46°16'44"	112°55'07"	39.5	5420	1958-1975	745	**Jun 9**	**342**	**Q_2**	no data		
6030500	Boulder River above Rock Creek, near Basin, MT	46°15'15"	112°30'03"	24.4	6260	1947-1953, 1955-1957, 1975, 1981	1170	no data			May 22	1070	Q_{80}
12323750	Silver Bow Creek at Warm Springs, MT	46°10'46"	112°46'50"	473	4788	1972-1979, 1989, 1993-2014	1930	no data			no data		
12324700	Clark Fork tributary near Drummond, MT	46°37'11"	113°02'02"	2.77	4080	1958-1995	361	Mar 31	21	$<Q_2$	Feb 19	43	Q_2
6062500	Tenmile Creek near Rimini, MT	46°31'27"	112°15'22"	30.9	4850	1915-1998	1240	**Jun 9**	**163**	**$<Q_2$**	**May 22**	**3,290**	**$>Q_{500}$**
6031950	Cataract Creek near Basin, MT	46°17'10"	112°14'33"	30.6	5450	1973-1998	1320	no data			**May 22**	**3,150**	**$>Q_{500}$**
12330000	Boulder Creek at Maxville, MT	46°28'18"	113°14'09"	70.5	4750	1940-2014	1360	**Jun 9**	**624**	**Q_7**	**May 22**	**1,410**	**Q_{121}**
12329500	Flint Creek at Maxville, MT	46°27'50"	113°14'25"	206	4828	1942-2014	1450	Jun 18	606[2]	Q_4	**May 22**	**839[2]**	**Q_{10}**
12324800	Morris Creek near Drummond, MT	46°39'56"	113°06'00"	12.7	4170	1960-1980	45	May 20	10	Q_2	no data		
12323500	German Gulch Creek near Ramsay, MT	46°00'50"	112°47'30"	40.6	5200	1955-1975	604	**Jun 9**	**278**	**Q_5**	no data		
12331700	Edwards Gulch at Drummond, MT	46°40'12"	113°08'44"	4.71	4000	1960-1962, 1974-2002	443	no data			Feb 19	33	Q_3
12323300	Smith Gulch near Silver Bow, MT	45°57'00"	112°40'00"	4.36	5510	1959-1998	289	Mar 30	10	$<Q_2$	**May 22**	**11**	**$<Q_2$**
12325500	Flint Creek near Southern Cross, MT	46°13'58"	113°18'00"	54	5630	1941-2014	296	Jun 20	171[2]	Q_{10}	Jun 10	131[2]	Q_5
6033000	Boulder River near Boulder, MT	46°12'40"	112°05'27"	381	4810	1929-1998	4570	**Jun 9**	**3,490**	**Q_{18}**	**May 22**	**7,000**	**$>Q_{500}$**
6029000	Whitetail Creek near Whitehall, MT	46°01'22"	112°12'27	30.8	5640	1950-1968, 1981	187	Jun 17	89	Q_4	**May 22**	**142**	**Q_{25}**
12332000	Middle Fork Rock Cr near Philipsburg, MT	46°11'04"	113°30'06"	121	5444	1938-2014	1290	**Jun 8**	**1,150**	**Q_4**	May 26	1,150	Q_4
6030300	Jefferson River trib no. 2 near Whitehall, MT	45°53'00"	111°59'00"	4.5	4330	1958-1997	955	**Jun 8**	**10**	**Q_2**	**May 22**	**5**	**$<Q_2$**
12340500	Clark Fork above Missoula, MT	46°52'38"	113°55'55"	6021	3198	1908, 1930-2014	38600	**Jun 10**	**31,700**	**Q_{28}**	**May 24**	**29,500**	**Q_{20}**

Hydrology

Q100 estimates (documented in FIS) ranged from 581 cfs to 2,360 cfs

Return Interval	Effective FIS (cfs)	At-site regression (cfs)	Regional regression (cfs)	At-site regression weighted with regional regression (cfs)
10-year				
50-year				
100-year				
500-year				

Hydrology

Return Interval	Effective FIS (cfs)	At-site regression (cfs)	Regional regression (cfs)	At-site regression weighted with regional regression (cfs)
10-year	517			
50-year	833			
100-year	1,140			
500-year	2,000			

Hydrology

Return Interval	Effective FIS (cfs)	At-site regression (cfs)	Regional regression (cfs)	At-site regression weighted with regional regression (cfs)
10-year	517	624		
50-year	833	1,170		
100-year	1,140	1,490		
500-year	2,000	2,480		

Hydrology

Return Interval	Effective FIS (cfs)	At-site regression (cfs)	Regional regression (cfs)	At-site regression weighted with regional regression (cfs)
10-year	517	624	305	
50-year	833	1,170	494	
100-year	1,140	1,490	581	
500-year	2,000	2,480	820	

Hydrology

Return Interval	Effective FIS (cfs)	At-site regression (cfs)	Regional regression (cfs)	At-site regression weighted with regional regression (cfs)
10-year	517	624	305	543
50-year	833	1,170	494	853
100-year	1,140	1,490	581	978
500-year	2,000	2,480	820	1,310

Hydrology

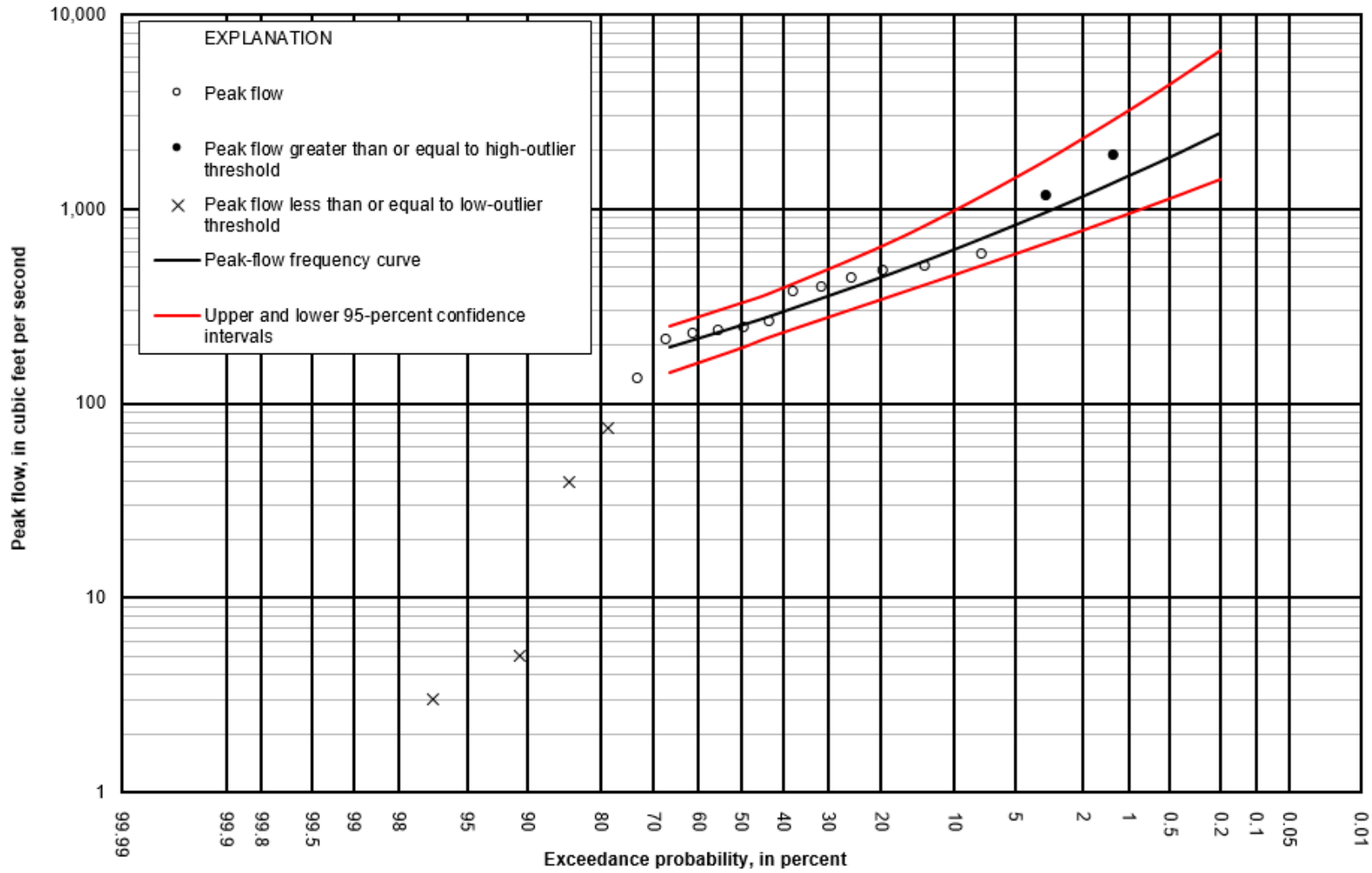


Figure 1-1. Annual peak flows (plotting positions determined using the Cunnane formulation; Helsel and Hirsch, 2002) and peak-flow frequency curve.

Effective Flood Maps and Model

THIS RUN EXECUTED 10/01/79

2

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*****************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED FEB 1977
  ERROR CORR -  01
  MODIFICATION -  50,51,52
*****************************************************
```

UPPER COTTONWOOD - REACH 3

```
T1      10 YEAR FLOOD
T2      UPPER COTTONWOOD CREEK
T3      DEER LODGE POWELL COUNTY

J1   ICHECK    INQ      NINV     IDIR     STRT     METRIC   HVINS    Q        WSEL     FQ
       0.       2.       0.       0.   0.0        0.0      0.0      0.   4539.297   0.0

J2   NPROF    IPLOT    PRFVS    XSECV    XSECH    FN       ALLDC    IBW      CHNIM    ITRACE
     1.000     0.0     -1.000    0.0      0.0      0.0      0.0      0.0      0.0      0.0

J3   VARIABLE CODES FOR SUMMARY PRINTOUT
     150.000  201.000    0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0

     202.000    2.000   29.000    0.0      0.0      0.0      0.0      0.0      0.0      0.0

NC      0.045    0.045    0.040    0.300    0.500    0.0      0.0      0.0      0.0      0.0
QT      5.000  517.000  833.000 1140.000 1700.000 1140.000    0.0      0.0      0.0      0.0
ET      0.0      0.0      0.0      0.0      0.0      9.100    0.0      0.0   1865.000 2150.000

X1      7.000   11.000 2003.000 2016.000    0.0      0.0      0.0      0.0      0.0      0.0
GR   4541.797 1684.000 4541.000 1684.000 4540.398 1684.000 4541.898 1684.000 4544.398 1684.000
GR   4540.898 1863.000 4540.898 2003.000 4534.598 2003.000 4536.199 2016.000 4541.098 2016.000
GR   4541.898 2217.000    0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
ET      0.0      0.0      0.0      0.0      0.0      3.400    0.0      0.0      0.0      0.0

X1      8.100   18.000 1087.000 1130.000   40.000   40.000   40.000    0.0     -3.000    0.0
GR   4547.500 1000.000 4544.199 1000.000 4542.797 1000.000 4542.598 1000.000 4542.398 1000.000
GR   4542.199 1025.000 4542.199 1087.000 4539.398 1100.000 4539.398 1100.000 4538.797 1112.000
GR   4538.797 1123.000 4538.699 1123.000 4541.797 1130.000 4541.199 1145.000 4541.398 1185.000
GR   4542.297 1250.000 4542.500 1270.000 4542.500 1300.000    0.0      0.0      0.0      0.0

X1      8.200    0.0      0.0      0.0     60.000   60.000   60.000    0.0      2.100    0.0

X1      8.300    0.0      0.0      0.0     10.000   10.000   10.000    0.0      0.900    0.0
BT     10.000 1025.000 4542.199    0.0   1087.000 4543.098    0.0   1100.000 4543.297 4539.398
BT   1100.000 4543.297 4542.000 1112.000 4543.297 4541.898 1123.000 4543.297 4541.797 1123.000
BT   4543.297 4538.699 1130.000 4532.199    0.0   1145.000 4542.699    0.0   1185.000 4541.398
BT      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0

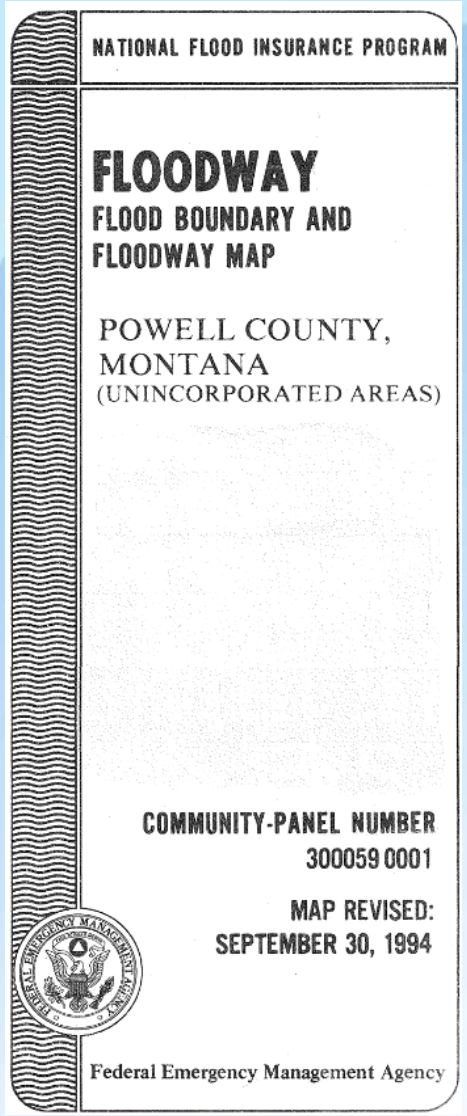
X1      8.012    0.0      0.0      0.0     [illegible].000   16.000   16.000    0.0      0.0      0.0
X2      0.0      0.0      0.0      0.0      [illegible].0      0.0      1.000    0.0      0.0      0.0

X1      8.400    0.0      0.0      0.0     10.000   10.000   10.000    0.0      0.100    0.0
```

Effective Flood Maps and Model

	Effective Model (1994 FIS)										Duplicate Effective Model						Effective and Duplicate Effective Comparison			
				Regulatory Base Flood Water Surface Elevation (WSE)				Floodway Widths				Base Flood Water Surface Elevation (WSE)		Floodway Widths						
Col #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Cross Section ID / Description	River Station(s)	Down-stream Distance (feet)	Without Floodway from FWDT (feet NGVD)	Without Floodway from HEC-2 (feet NGVD)	With Floodway from FWDT (feet NGVD)	With Floodway from HEC-2 (feet NGVD)	Left Encroach-ment Station	Right Encroach-ment Station	Floodway Width (feet) (Source of Effective Data varies - see notes)	River Station	Without Floodway (feet NGVD)	With Floodway (feet NGVD)	Left Encroach-ment Station	Right Encroach-ment Station	Floodway Width (feet)	Without Floodway WSE Difference, Col 12 - Col 5 (feet)	With Floodway WSE Difference, Col 13 - Col 7 (feet)	Floodway Width Difference (feet)	Notes
		8.800	37		4546.62		4546.72	1043.7	1203.6	159.90	5548	4546.66	4547.14	1043.70	1203.60	159.90	0.04	0.42	0.00	Effecitive FW width is calcualted from distance between encroachment stations.
	Larabie Street Bridge	8.013 and 8.700									5530									
		8.600	70		4544.21		4544.59	1087	1190.23	103.23	5511	4544.08	4544.50	1087.00	1190.23	103.23	-0.13	-0.09	0.00	Effecitive FW width is calcualted from distance between encroachment stations.
		8.500	60		4543.61		4543.86	1087	1166.9	79.90	5441	4543.36	4544.12	1087.00	1166.90	79.90	-0.25	0.26	0.00	Effecitive FW width is calcualted from distance between encroachment stations.
		8.400	36		4543.49		4544.01	1059.23	1230.65	171.42	5381	4543.43	4544.19	1059.23	1230.65	171.42	-0.06	0.18	0.00	Effecitive FW width is calcualted from distance between encroachment stations.
	Alley Bridge	8.012 and 8.300									5363									
		8.200	60		4542.84		4543.14	1047.87	1242.57	194.70	5345	4542.88	4544.03	1047.87	1242.57	194.70	0.04	0.89	0.00	Effecitive FW width is calcualted from distance between encroachment stations.
		8.100	40		4542.86		4543.16	1021.03	1275.02	253.99	5285	4542.90	4544.04	1021.03	1275.02	253.99	0.04	0.88	0.00	Effecitive FW width is calcualted from distance between encroachment stations.
	G	7.000	10	4542.8	4542.80	4543.1	4543.10	1865	2150	285.00	5245	4542.83	4544.02	1865.00	2150.00	285.00	0.03	0.92	0.00	Effecitive FW width is calcualted from distance between encroachment stations.
		7.400	47		4542.51		4542.55	Not Available		232.22	5235	4542.41	4543.96	1157.41	1389.63	232.22	-0.10	1.41	0.00	Effective encroachment stations not available in HEC-2 print outs. Effective FW width assumed to be same as 'TOPWID' pg 58-59.
	Clagett Steet Bridge	7.011									5211.5									
		7.300	97		4541.82		4542.14	Not Available		213.91	5188	4541.91	4540.58	1173.39	1387.30	213.91	0.09	-1.56	0.00	Effective encroachment stations not available in HEC-2 print outs. Effective FW width assumed to be same as 'TOPWID' pg 58-59.
		6.600	306		4537.67		4537.75	Not Available		107.68	5091	4537.68	4537.75	1494.32	1602.00	107.68	0.01	0.00	0.00	Effective encroachment stations not available in HEC-2 print outs. Effective FW width assumed to be same as 'TOPWID' pg 58-59.

Effective Flood Maps and Model


NATIONAL FLOOD INSURANCE PROGRAM

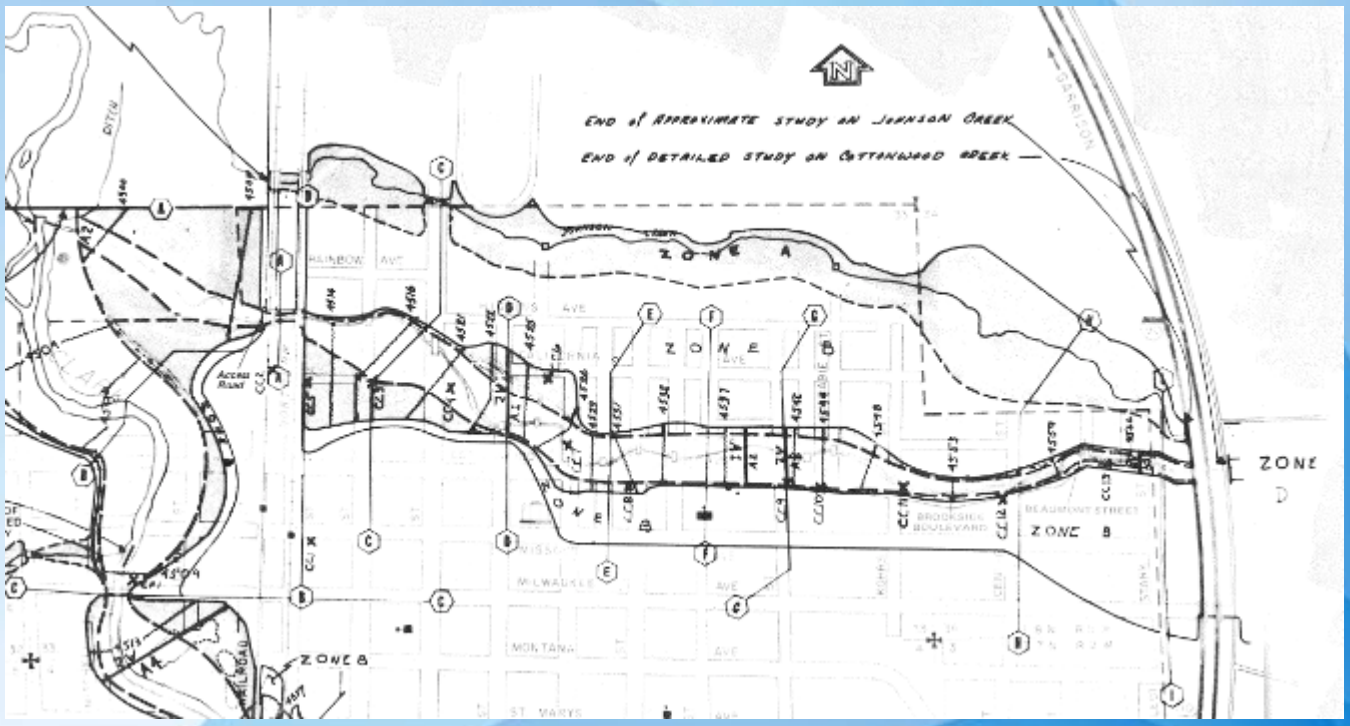
FLOODWAY
FLOOD BOUNDARY AND
FLOODWAY MAP

POWELL COUNTY,
MONTANA
(UNINCORPORATED AREAS)

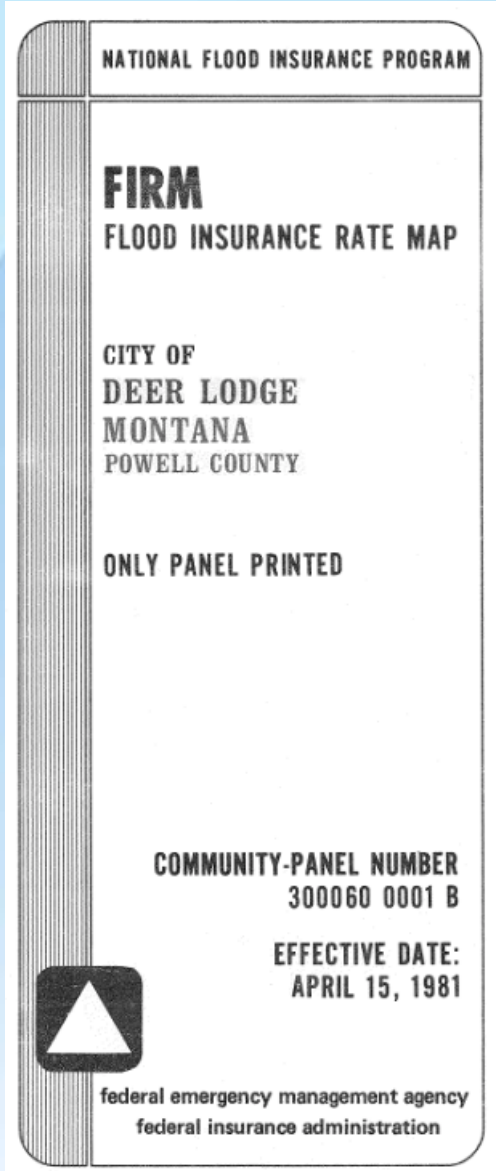
COMMUNITY-PANEL NUMBER
300059 0001

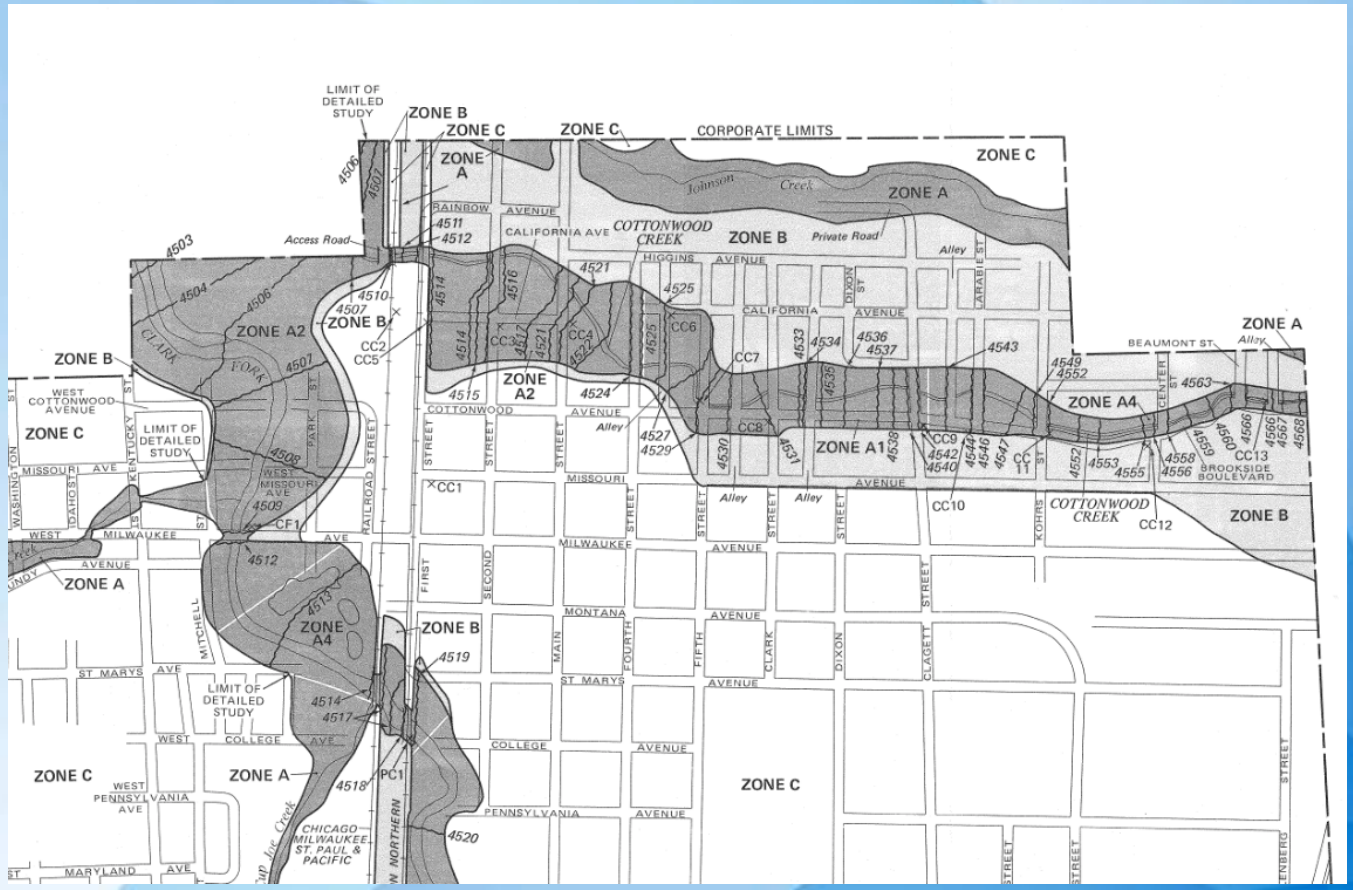
MAP REVISED:
SEPTEMBER 30, 1994

Federal Emergency Management Agency



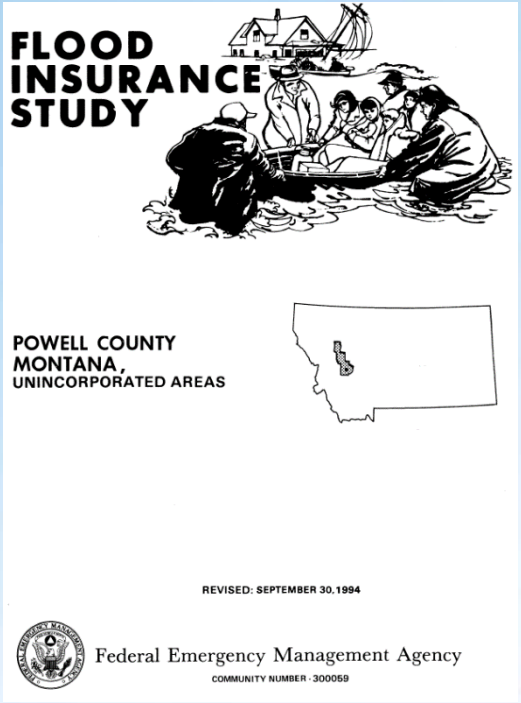
Effective Flood Maps and Model

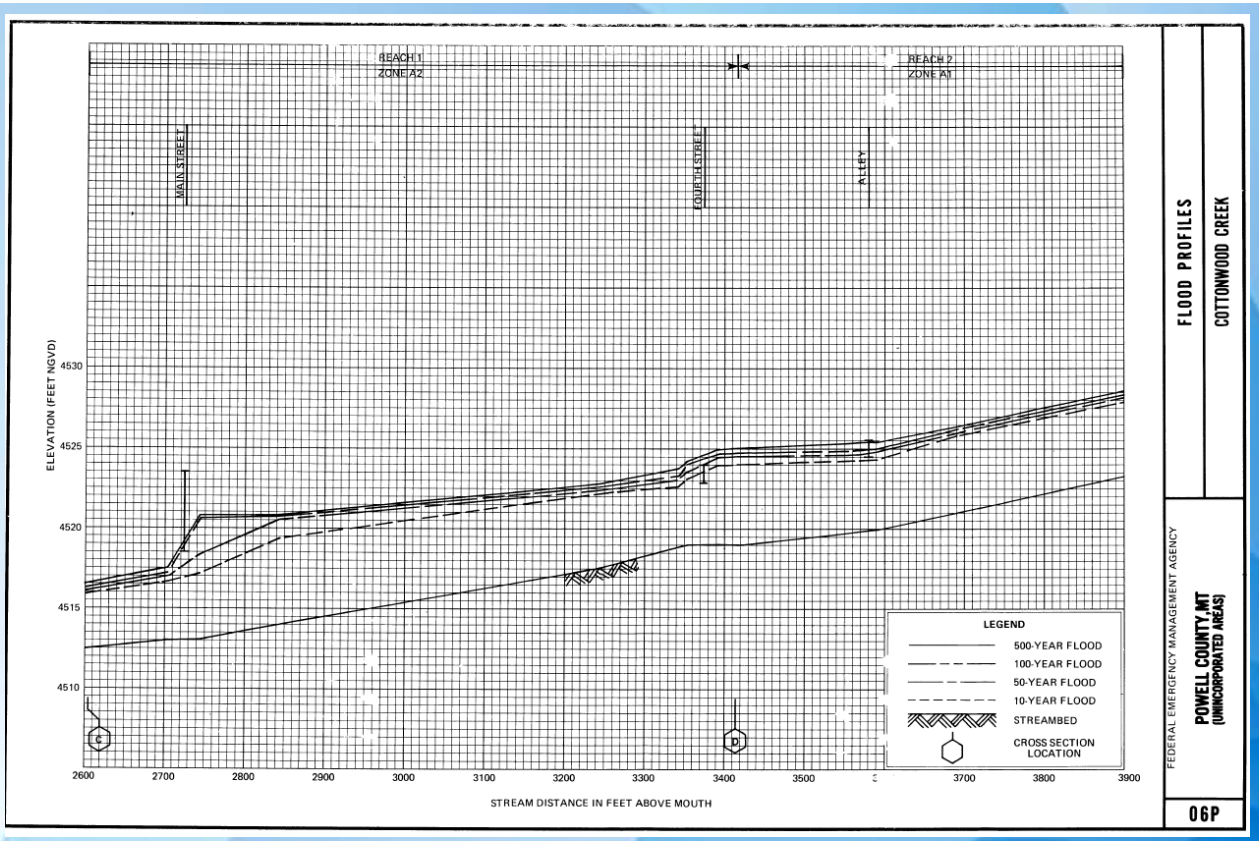




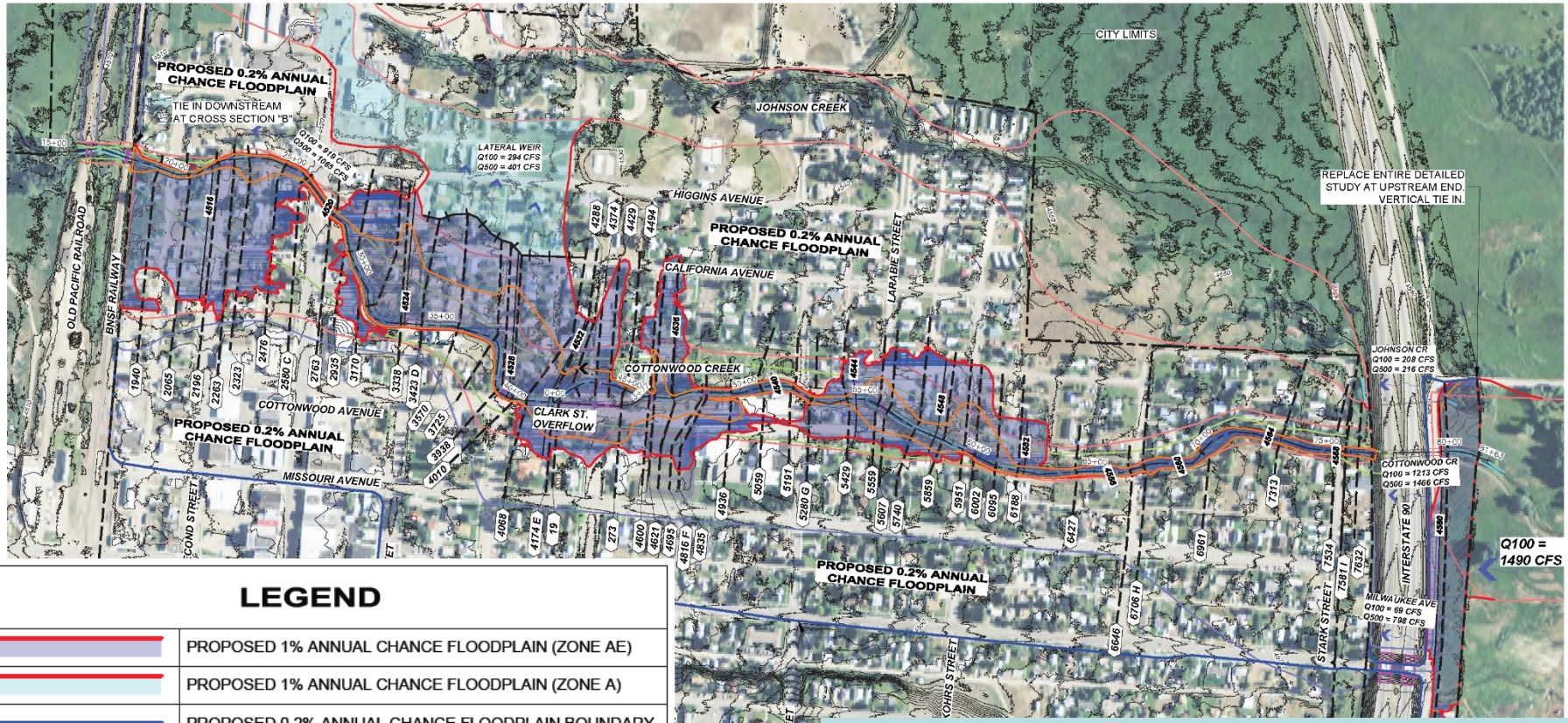
Effective Flood Maps and Model

Cottonwood Creek Just upstream of Interstate Highway 90 and Frontage Road	45.4	517	833	1,140	2,000





Hydraulics

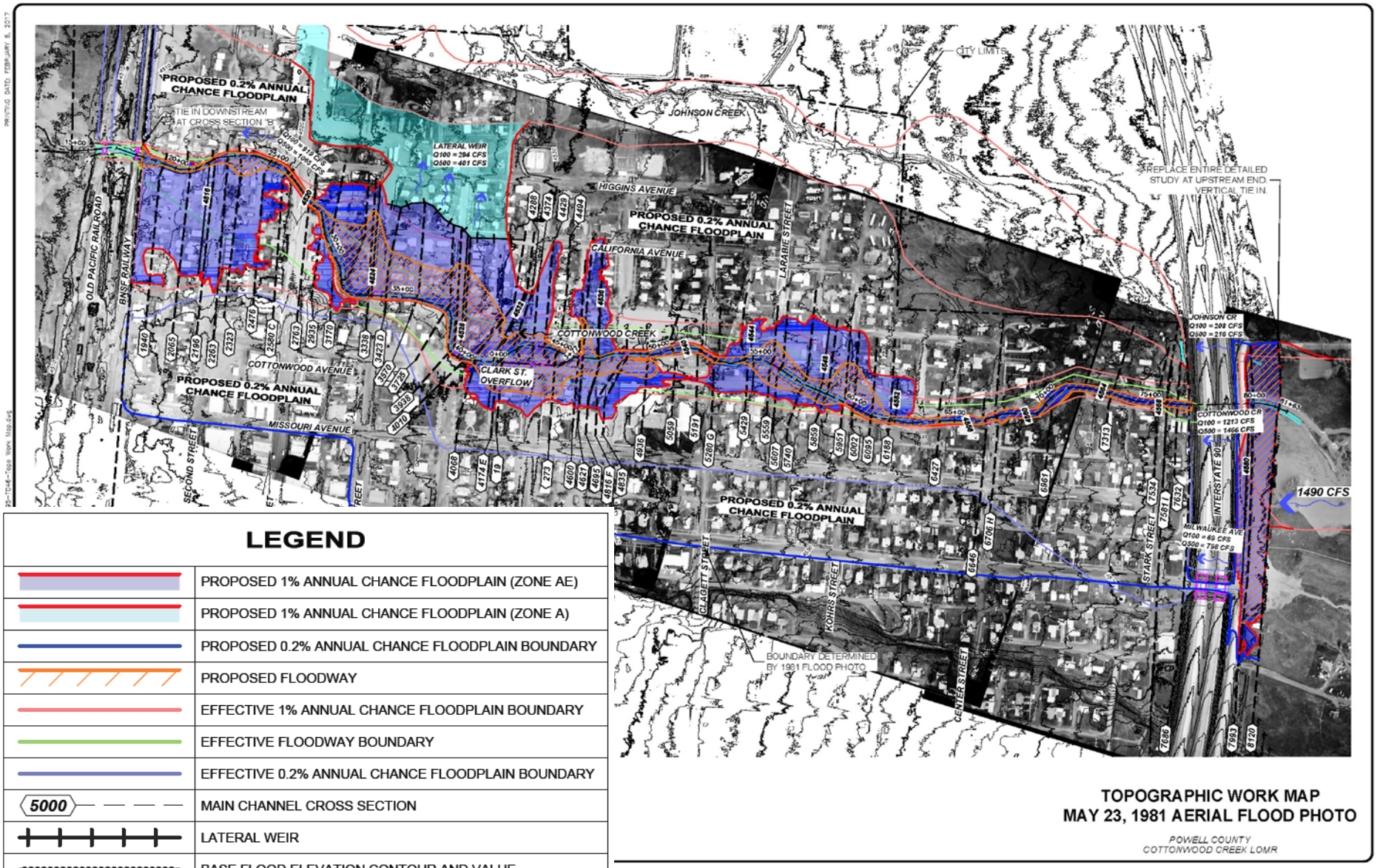


LEGEND

	PROPOSED 1% ANNUAL CHANCE FLOODPLAIN (ZONE AE)
	PROPOSED 1% ANNUAL CHANCE FLOODPLAIN (ZONE A)
	PROPOSED 0.2% ANNUAL CHANCE FLOODPLAIN BOUNDARY
	PROPOSED FLOODWAY
	EFFECTIVE 1% ANNUAL CHANCE FLOODPLAIN BOUNDARY
	EFFECTIVE FLOODWAY BOUNDARY
	EFFECTIVE 0.2% ANNUAL CHANCE FLOODPLAIN BOUNDARY
5000	MAIN CHANNEL CROSS SECTION
	LATERAL WEIR
	BASE FLOOD ELEVATION CONTOUR AND VALUE

- 60 cross sections
- 6000 linear feet
- 14 bridges or culverts
- Buildings modeled as obstructions (or ineffective flow)

Hydraulics


PROPOSED 0.2% ANNUAL CHANCE FLOODPLAIN
TIE IN DOWNSTREAM AT CROSS SECTION "B"
LATERAL WEIR
Q100 = 294 CFS
Q500 = 401 CFS
JOHNSON CREEK
CITY LIMITS
HIGGINS AVENUE
CALIFORNIA AVENUE
LARABIE STREET
COTTONWOOD CREEK
CLARK ST. OVERFLOW
COTTONWOOD AVENUE
MISSOURI AVENUE
OLD PACIFIC RAILROAD
BNSF RAILWAY
SECOND STREET
REPLACE ENTIRE DETAILED STUDY AT UPSTREAM END. VERTICAL TIE IN.
JOHNSON CR
Q100 = 208 CFS
Q500 = 216 CFS
COTTONWOOD CR
Q100 = 1213 CFS
Q500 = 1466 CFS
1490 CFS
INTERSTATE 90
MILWAUKEE AVE
Q100 = 69 CFS
Q500 = 798 CFS
STARK STREET
CENTER STREET
KOHRS STREET
CLAGETT STREET
BOUNDARY DETERMINED BY 1981 FLOOD PHOTO
LEGEND
PROPOSED 1% ANNUAL CHANCE FLOODPLAIN (ZONE AE)
PROPOSED 1% ANNUAL CHANCE FLOODPLAIN (ZONE A)
PROPOSED 0.2% ANNUAL CHANCE FLOODPLAIN BOUNDARY
PROPOSED FLOODWAY
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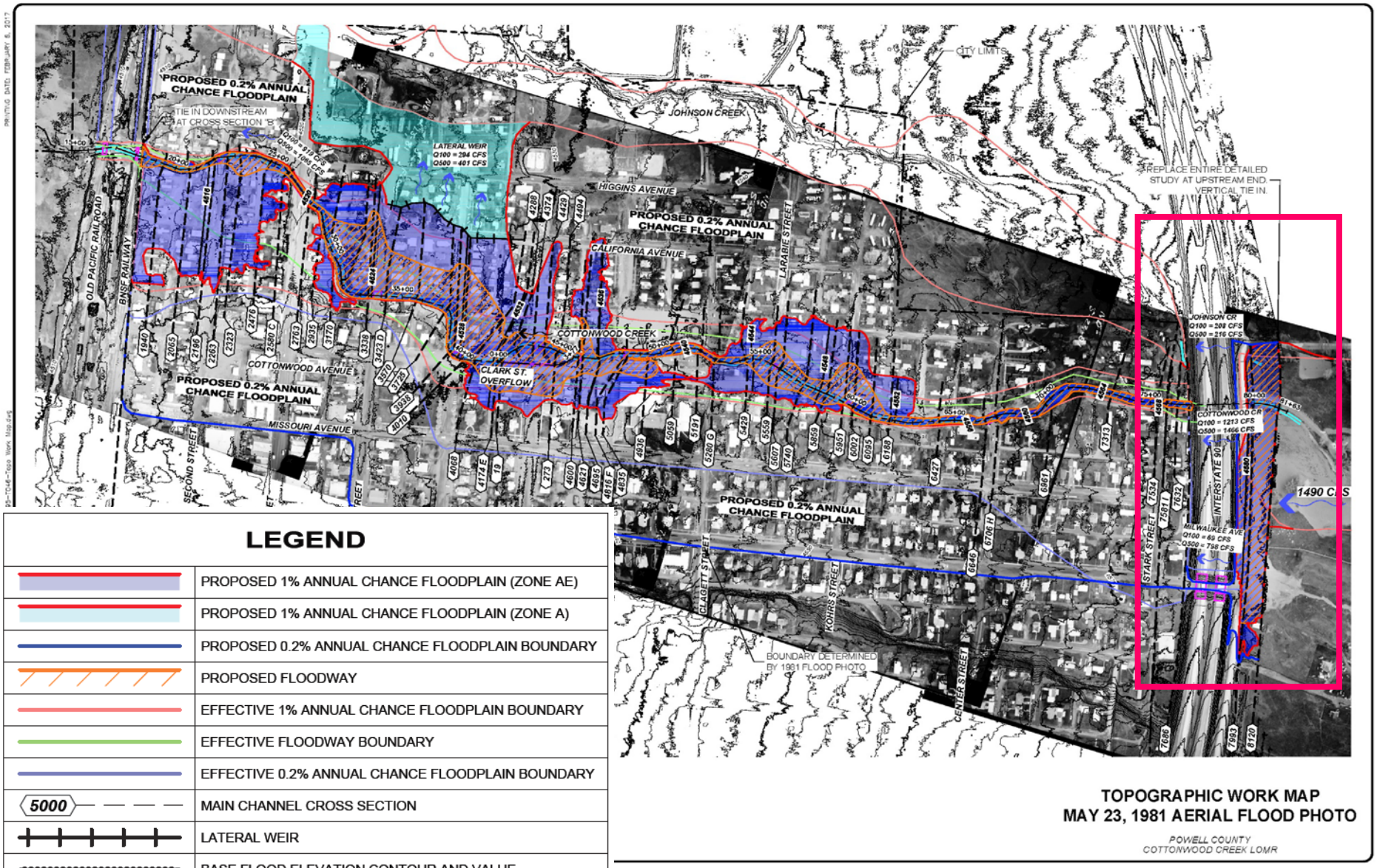
EFFECTIVE 0.2% ANNUAL CHANCE FLOODPLAIN BOUNDARY
5000
MAIN CHANNEL CROSS SECTION
LATERAL WEIR
BASE FLOOD ELEVATION CONTOUR AND VALUE
TOPOGRAPHIC WORK MAP
MAY 23, 1981 AERIAL FLOOD PHOTO
POWELL COUNTY
COTTONWOOD CREEK LOMR

Hydraulics



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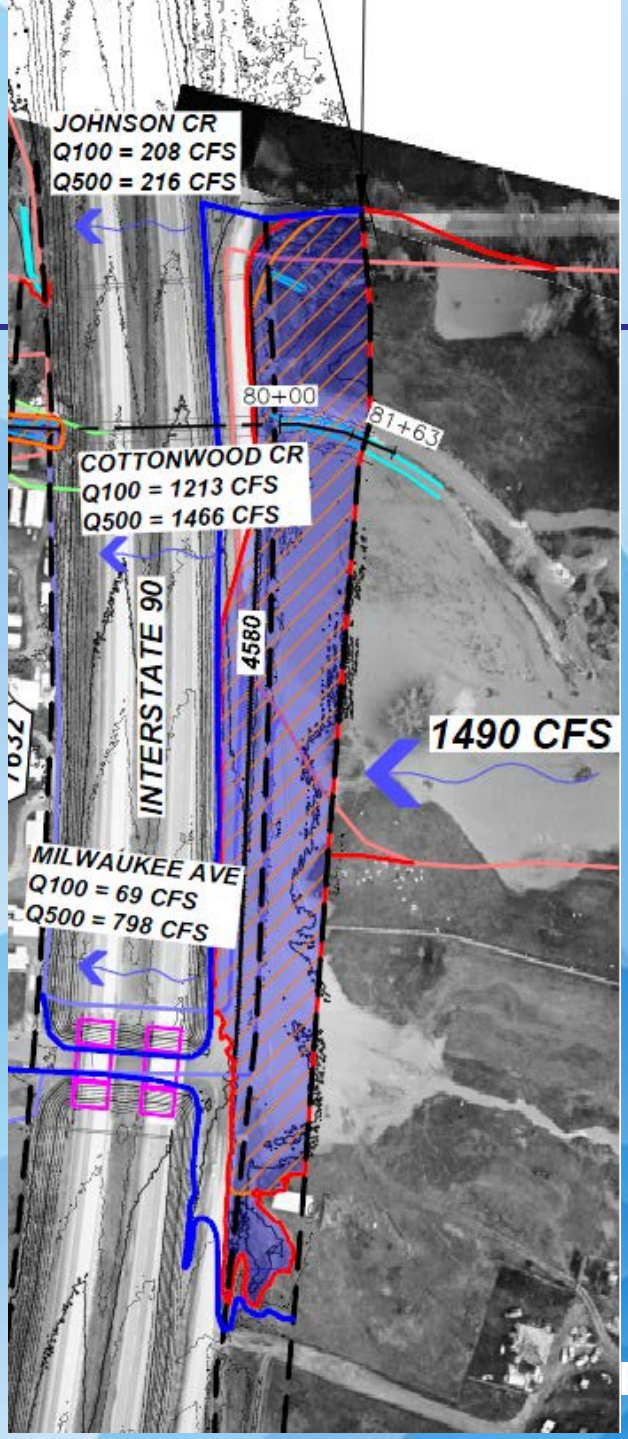
5000	MAIN CHANNEL CROSS SECTION
	LATERAL WEIR
	BASE FLOOD ELEVATION CONTOUR AND VALUE

Hydraulics

Interstate 90 Crossing



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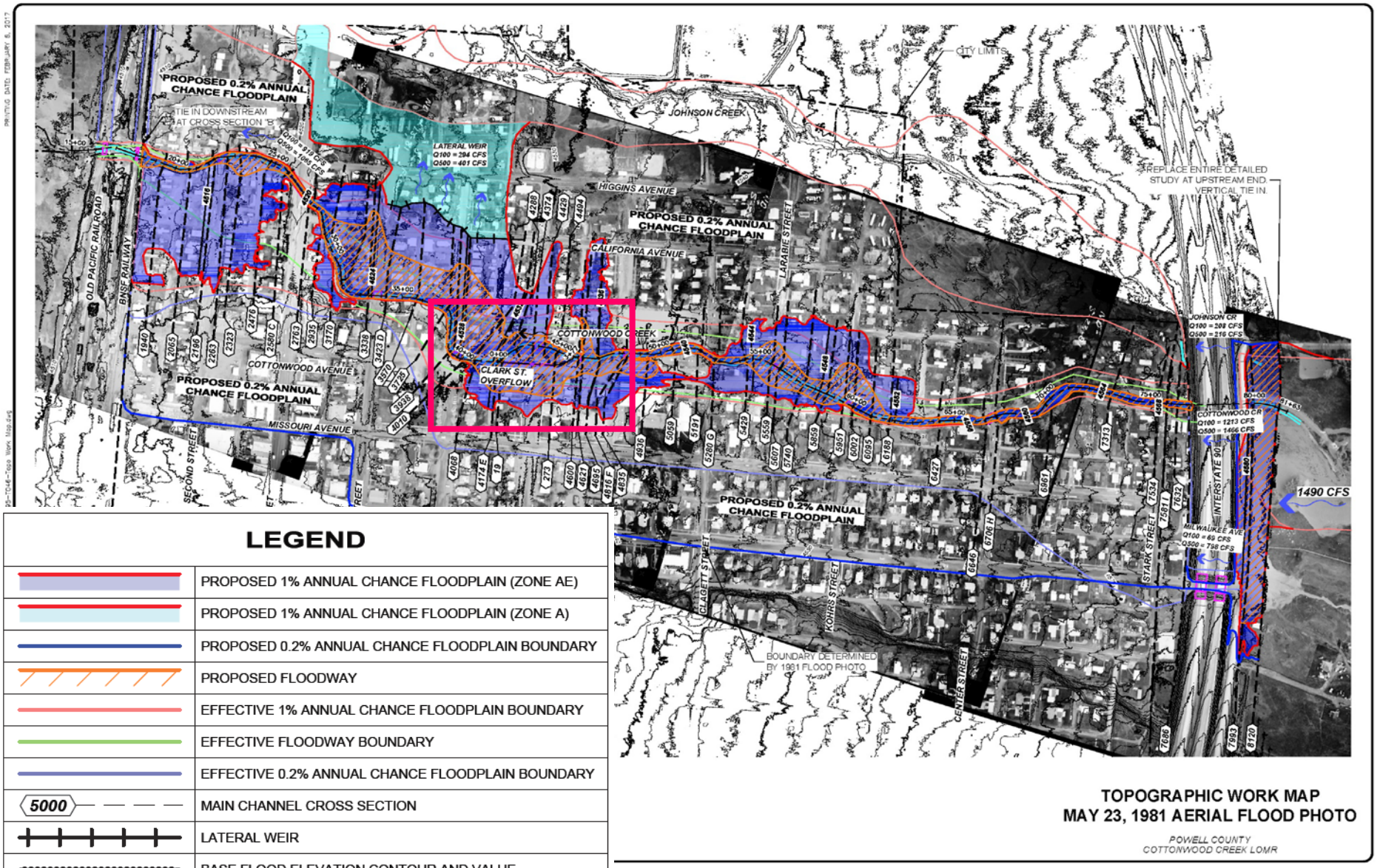
	BASE FLOOD ELEVATION CONTOUR AND VALUE

Hydraulics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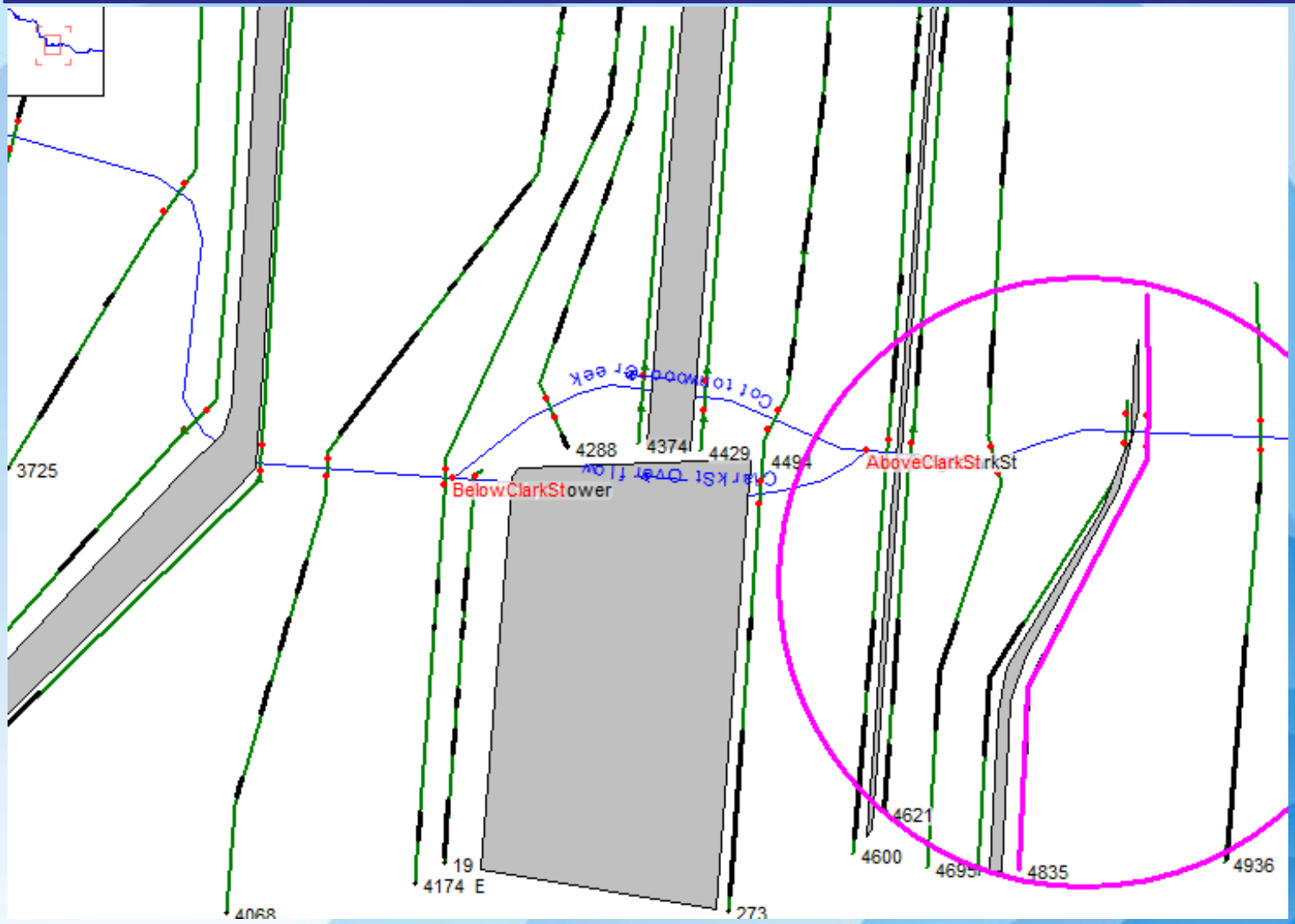
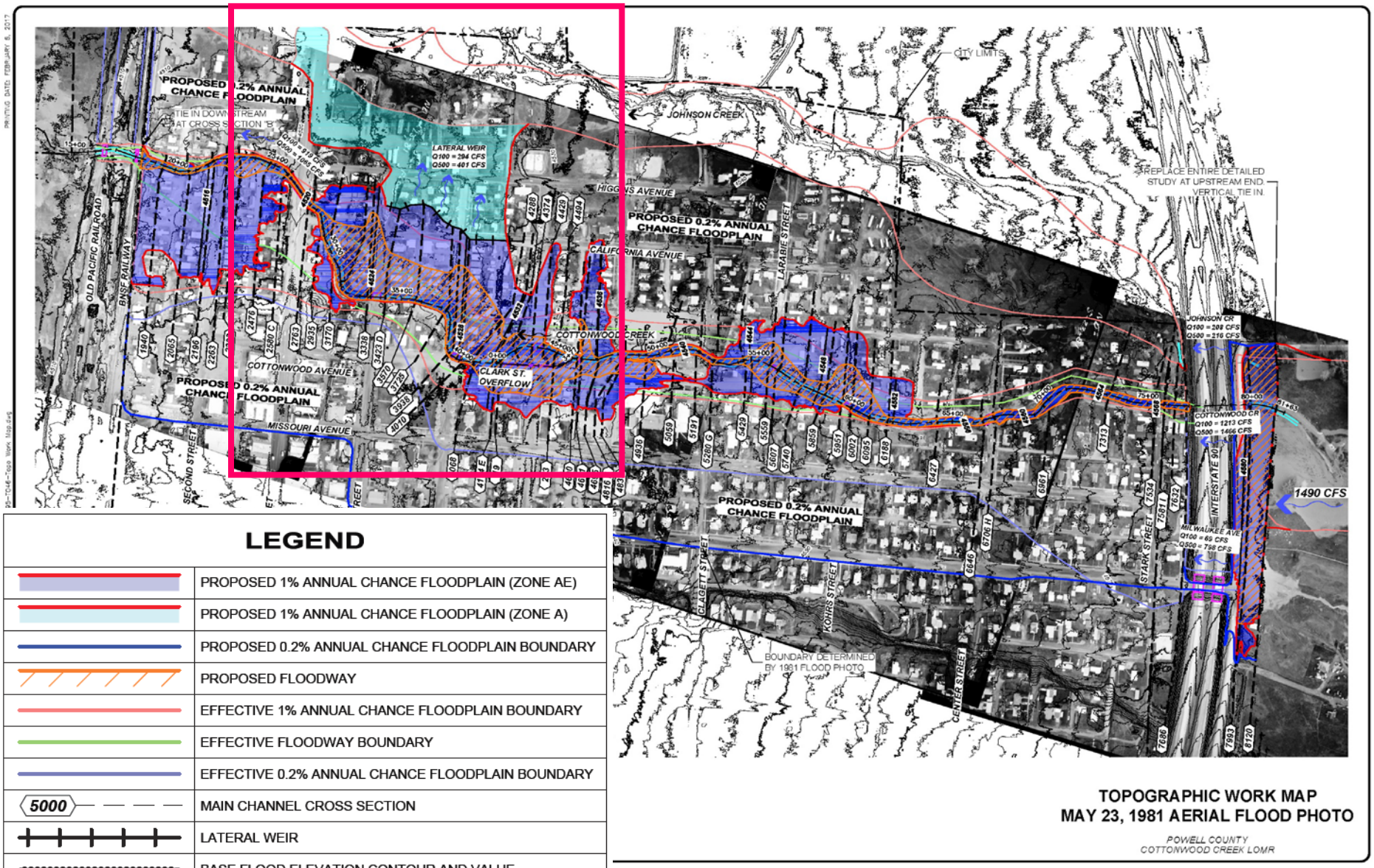
POWELL COUNTY
COTTONWOOD CREEK LOMR

Hydraulics

Clark St. Overflow



Hydraulics



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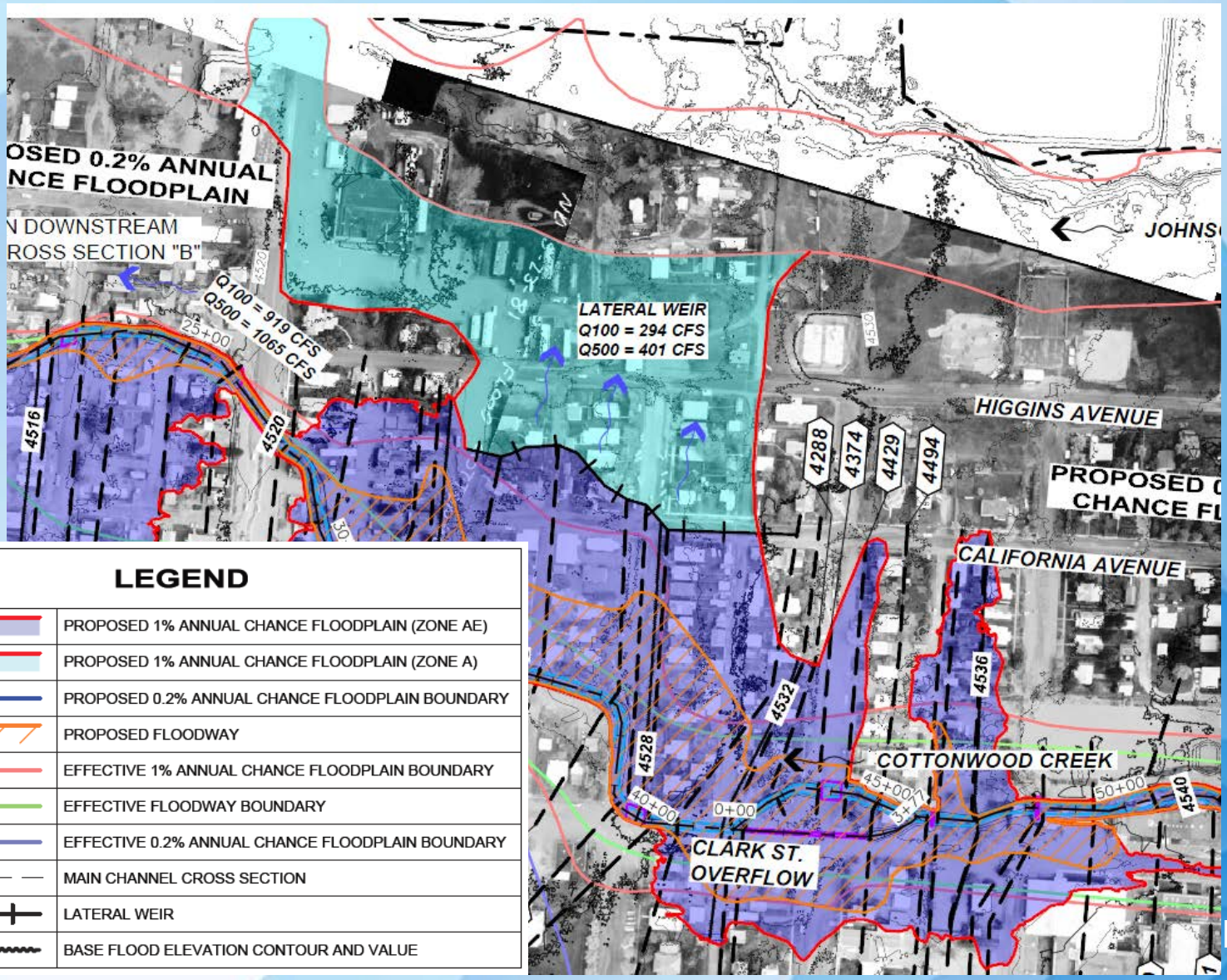
5000	MAIN CHANNEL CROSS SECTION
	LATERAL WEIR
	BASE FLOOD ELEVATION CONTOUR AND VALUE

Hydraulics

Overflow to north



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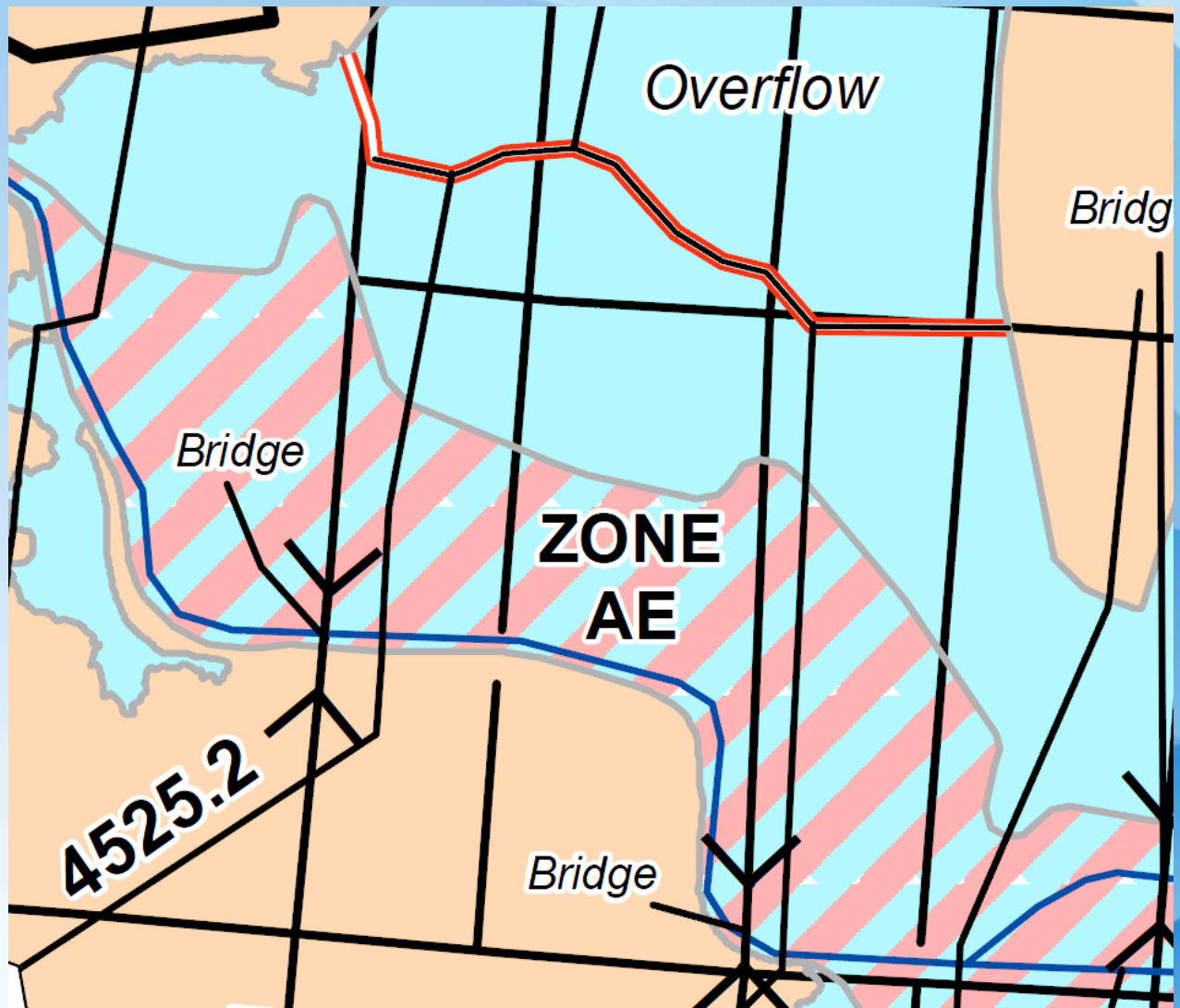
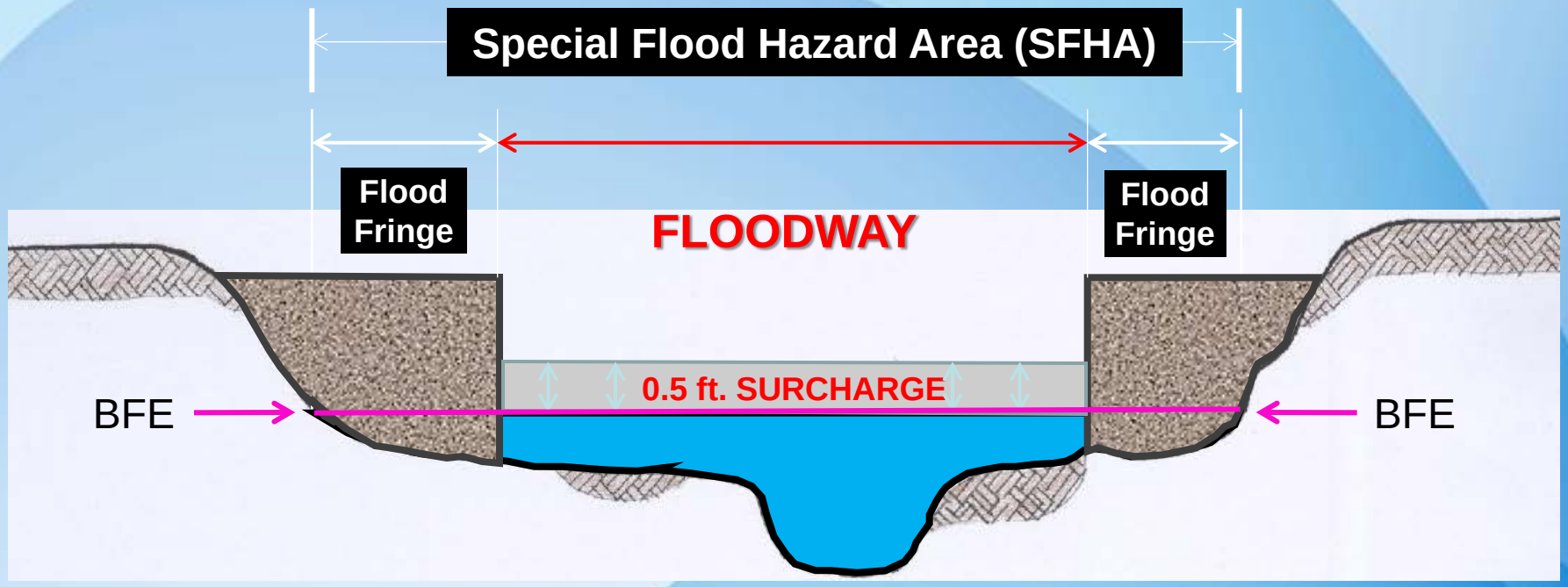
Hydraulics

Encroachment Analysis (Floodway)

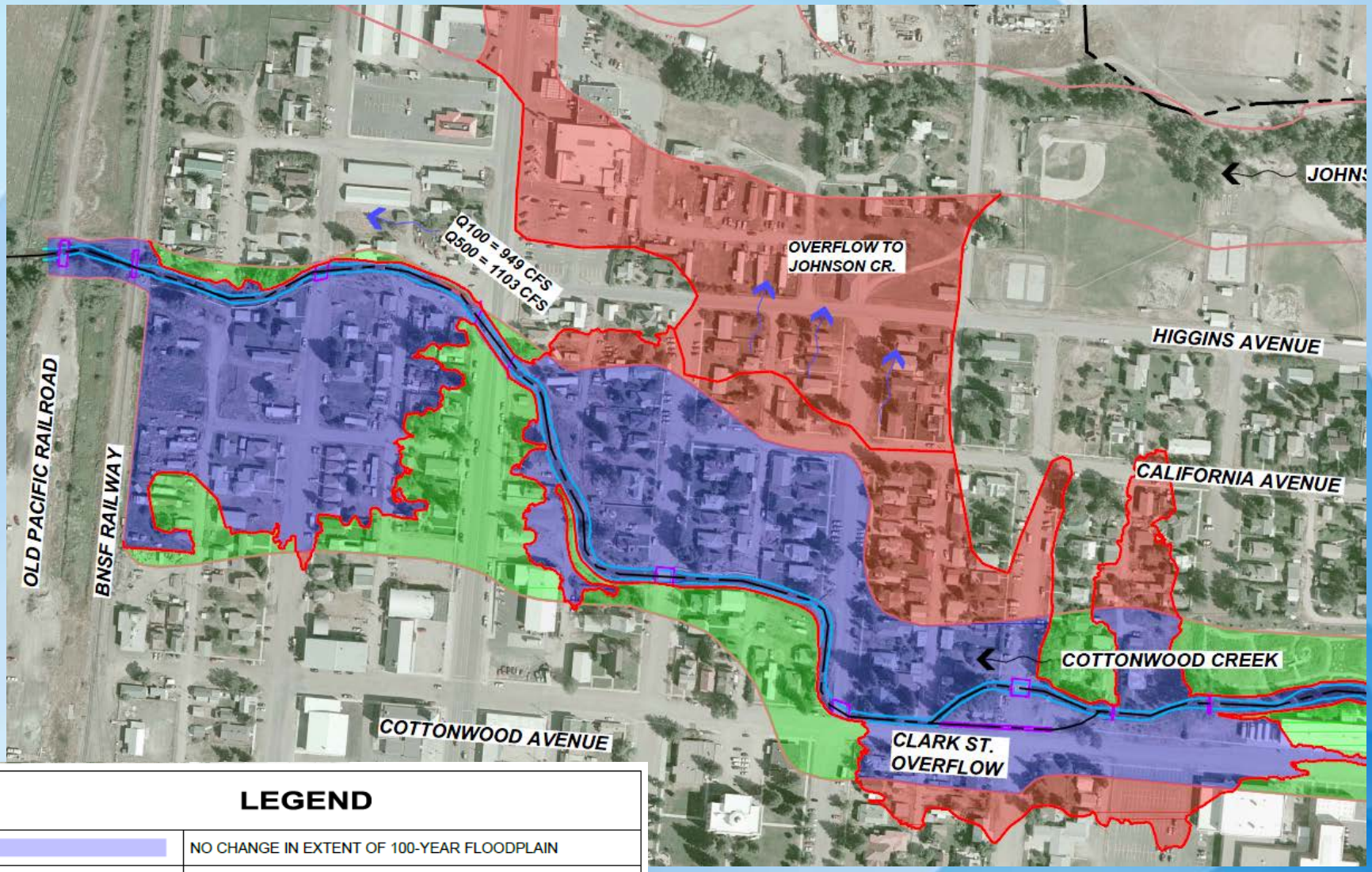


How is a Floodway Determined?



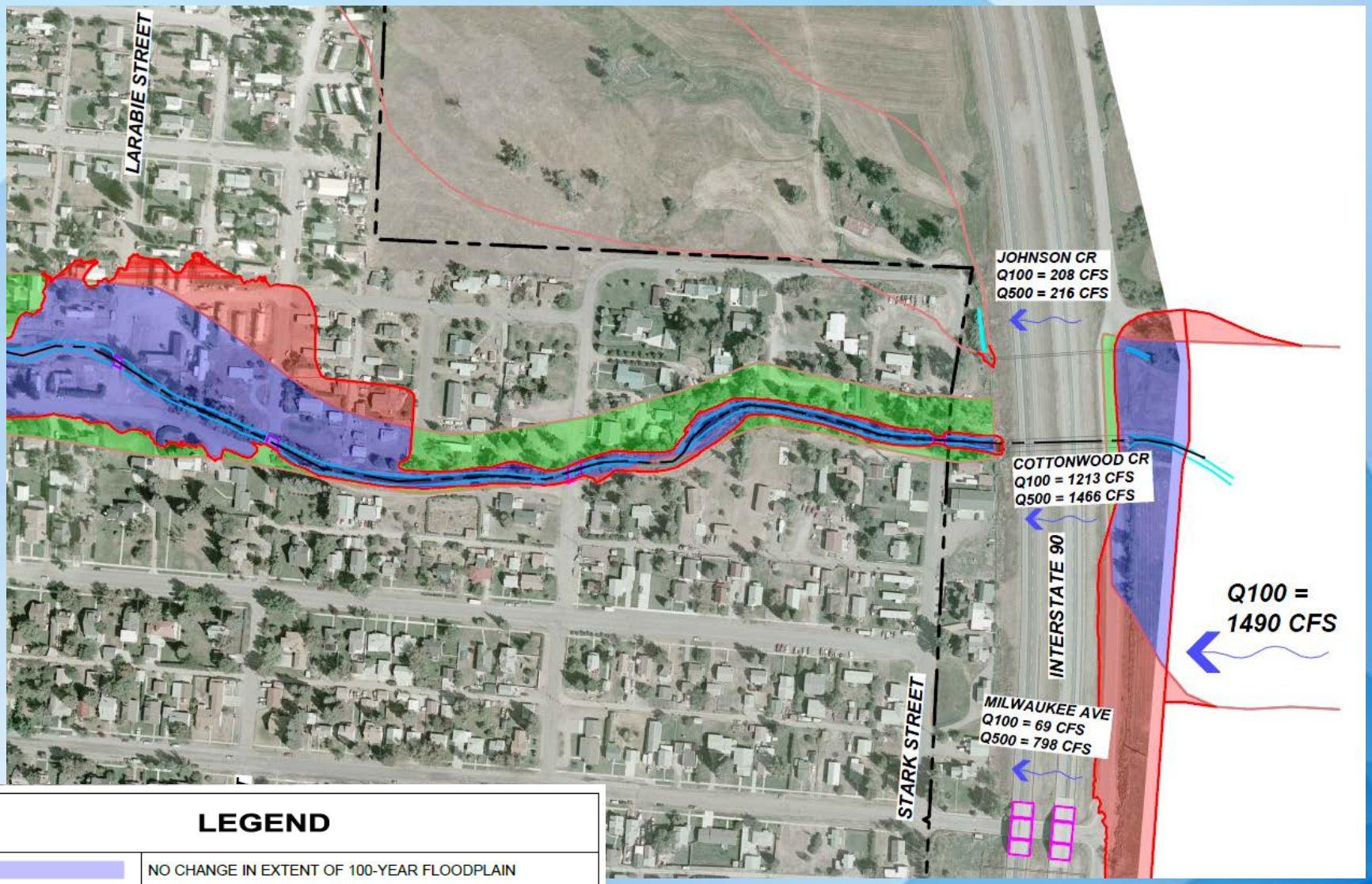
- Flood Fringe - Encroachment Area or Area of the Floodplain that could be used for development by raising the ground
  - Encroachment cannot cause more than 0.5 ft. rise
- FLOODWAY – Regulatory Area Only - Limited Development and no Encroachment allowed – Not a Physical Feature.

Effective/Proposed Comparison



LEGEND	
	NO CHANGE IN EXTENT OF 100-YEAR FLOODPLAIN
	INCREASE IN EXTENT OF 100-YEAR FLOODPLAIN
	DECREASE IN EXTENT OF 100-YEAR FLOODPLAIN

Effective/Proposed Comparison



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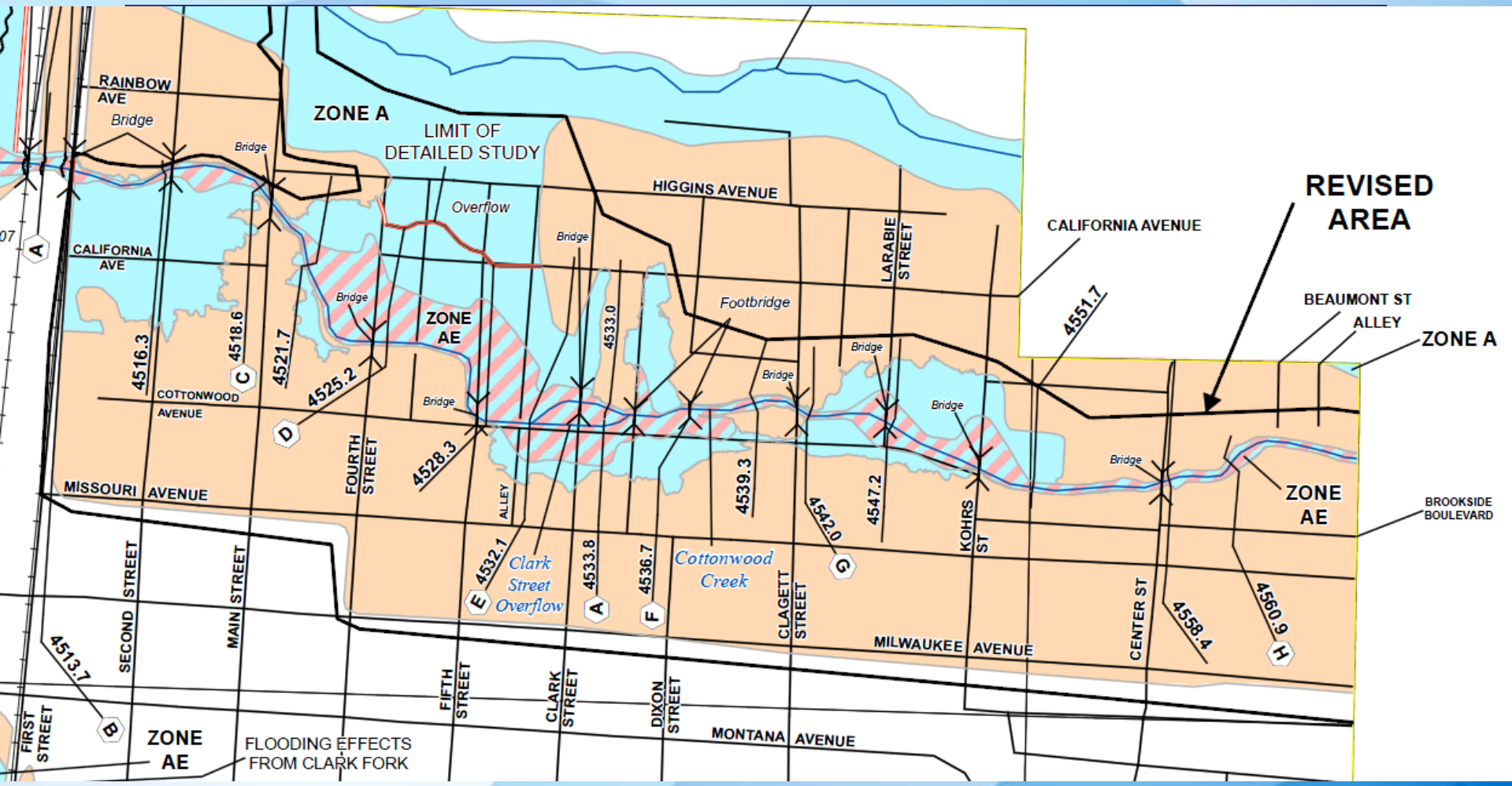
	INCREASE IN EXTENT OF 100-YEAR FLOODPLAIN
	DECREASE IN EXTENT OF 100-YEAR FLOODPLAIN

Effective/Proposed Comparison

Col ID		A	B	C	D	E
River Station	Cross Section ID / Description	Pre-Project Conditions Base Flood WSEL	Post-Project Conditions Base Flood WSEL	Difference (B-A)	Regulatory Base Flood WSEL	Difference (B-D)
8120		4580.94	4580.94	0		
7993		4580.88	4580.88	0		
7857	I-90					
7686		4570.9	4570.9	0		
7632		4570.09	4570.09	0		
7581 I		4570.24	4570.24	0	4571.11	-0.87
7561	Stark Street					
[illegible]		[illegible]	[illegible]	[illegible]		
4404	Clark Street					
4374		4532.65	4532.65	0		
4288		4532.16	4532.16	0		
4174 E		4532.13	4532.13	0	4530.45	1.68
4068		4531.42	4531.42	0		
4050	Lateral Weir-Upstream of Fifth St					
4010		4528.29	4528.29	0		
3981	Fifth Street					
3938		4527.38	4527.38	0		
3930	Lateral Weir-Downstream of Fifth St					
3725		4526.53	4526.53	0		
3570		4525.85	4525.85	0		
3423 D		4525.24	4525.24	0	4524.73	0.51
3382	Fourth Street					
3338		4523.76	4523.76	0		
3170		4522.9	4522.9	0		
2935		4522.67	4521.72	-0.95		
2763		4522.53	4520.39	-2.14		
2669	Main Street					
2580 C		4518.65	4518.59	-0.06	4516.23	2.36
2476		4518.46	4517.94	-0.52		

Final Maps & FIS



Clark Street Overflow At Clark Street	--*	157	525	666	757
Cottonwood Creek Just upstream of Interstate Highway 90 and Frontage Road	42.1	624	1,170	1,490	2,480
Cottonwood Creek Just downstream of Interstate Highway 90 and Frontage Road	42.1	461	974	1,213	1,466

REVISED DATA

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE
Cottonwood Creek								
A	1660	29	142	8.0	4511.1	4511.1	4511.2	0.1
B	1830	100	602	1.5	4513.7	4513.7	4513.8	0.1
C	2580	25	112	8.2	4518.6	4518.6	4519.1	0.5
D	3423	218	320	2.9	4525.2	4525.2	4525.7	0.5
E	4174	254	556	2.2	4532.1	4532.1	4532.6	0.5
F	4816	98	193	6.3	4536.7	4536.7	4537.1	0.4
G	5280	30	177	6.9	4542.0	4542.0	4543.5	0.5
H	6961	51	176	6.9	4560.9	4560.9	4560.9	0.0
I	7581	34	217	5.6	4570.2	4570.2	4570.2	0.0

REVISED DATA

[1] Feet Above Mouth

REVISED TO REFLECT LOMR EFFECTIVE: July 6, 2017

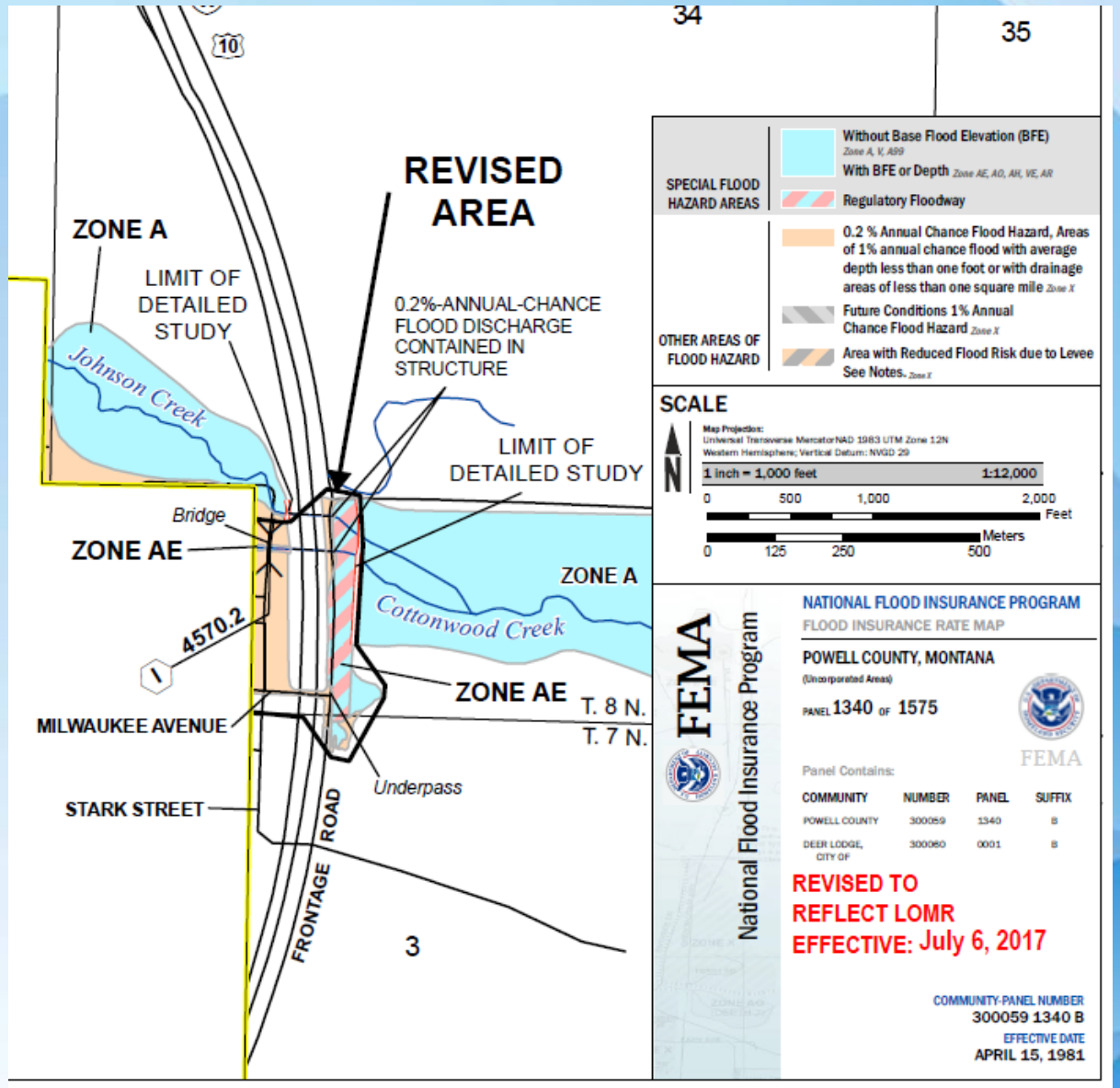
FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF DEER LODGE AND POWELL COUNTY, MT

FLOODWAY DATA

COTTONWOOD CREEK

Final Maps & FIS



Public Engagement

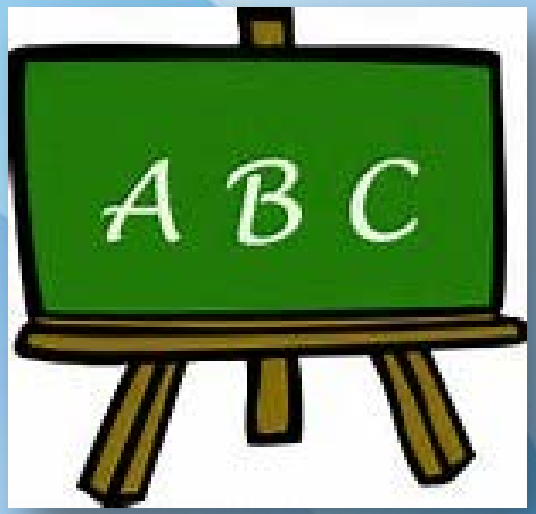
Applied multiple ways to involve the public

- Letters directly to property owners
- Announcements at public meetings:
  - ✓ Including combined sessions between County Commissioners & City Council
- Notices in the *Silver State Post*
- Map displays
- Website postings

Floodplain Administrator

Education!

- **Advised elected officials of:**
  - ✓ **Technical requirements**
  - ✓ **Timelines and schedules**
  - ✓ **Importance (legality)**
  - ✓ **Nuances of the process**
  - ✓ **Explanations to the public**



Brian's Lessons Learned

- Have fun!
- Be an advocate for community.
- Gain & keep the trust of elected officials.
- Do not use jargon when talking with property owners.
- Be patient.

Jonathan's Lessons Learned

- Early coordination with DNRC and FEMA is important.
- Use software that can do integrated modeling and mapping.
- Topographic work maps don't communicate to the public very well.
  - Use pre- and post- comparison maps.

Questions?

Contact Information:

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406.495.6171