

**Report of Commissioners
Classification of Benefits
Rand-Peterson Levee District
Harrison County, Iowa
December, 2018**

We, Rollie Roberts, John Erixon, and Tim Temeyer, engineer, have been appointed and filed oath to reclassify lands within the Rand-Peterson Levee District and proposed annexation areas in accordance with Section 468 of the code of Iowa. Following is our analysis and recommendations:

Background Information: During the Missouri River Flood of 2011, flood stages along the Missouri River in western Iowa caused some levees to be overtopped resulting in extensive flooding and flood damages behind the levees. In the area northwest, west, and southwest of Missouri Valley, Iowa there are levees operated by the Rand-Peterson, Cutoff Lake, Coulthard, and Vanman Levee Districts that provide protection from Missouri River flooding. Private levees also exist in this area. These levees extend from the Boyer River on the south to the Soldier River on the north, a length of approximately 28.2 miles. During the Flood of 2011, when flood forecasts indicated that the levees would be overtopped, a local flood fight coalition composed of several entities including the levee districts undertook emergency efforts to strengthen and raise the levees where necessary to prevent levee failure or overtopping. During the flood, although Missouri River water levels were within 1 to 2 feet of the top of the strengthened levees, upstream from Highway 30 the emergency measures were successful and the levees held. These efforts prevented flooding the cities of Modale and western Missouri Valley and inundation of approximately 49,000 acres of farmland north of the UPRR roadway. The efforts also prevented the overtopping and closure of Interstate 29 roadway north of Missouri Valley and prevented major damage from erosion to the UPRR embankment and Highway 30 roadway in areas west of Missouri Valley.

The Rand-Peterson and New Beck Levee Districts (which were recently combined into the single Rand-Peterson Levee District) currently encompass an area of approximately 30,000 acres. After review of the areas that could have been inundated if the levees had failed, it became apparent that additional study was necessary with the goal of annexation of appropriate parcels and reclassification of the area receiving benefits from the levees to more accurately reflect current conditions in the Missouri River floodplain. The Rand-Peterson Levee District Board of Trustees appointed an engineer to conduct an analysis to determine what areas are receiving material flood control benefits from the levees, and to recommend annexation of any additional lands that are receiving material flood control benefits but are not already within the levee district. The results of the analysis are contained in the report “Engineer’s Report – Annexation, Rand-Peterson Levee District, Harrison and Pottawattamie Counties, Iowa, November, 2018”. This analysis involved utilizing levee performance information during the 2011 Missouri River flood, computed water surface profiles from the U.S. Army Corps of Engineers, and identification of areas receiving material benefits from the levees using Iowa Lidar topographic mapping. The levees are located on the east bank of the Missouri River and extend approximately from River Mile 635.6 to River 663.9, a total of 28.2 river miles. The following Table 1 is a list of the levees beginning

near the confluence of the Soldier River with the Missouri River. Also included are the Desoto Bend roadway chute closure which also acts as a flood control embankment, and high ground areas where a levee is not required because existing high ground provides sufficient protection.

Table 1 – List of Missouri River Levees (Iowa) – Soldier River to Boyer River

	Approximate River Mileage	Approximate Levee Length (feet)	Average Levee Height (feet)
Private Levee	662.3 to 663.9	10,700	7
Rand-Peterson Levee	658.6 to 662.3	20,600	5
High Ground	658.3 to 658.6	2,100	0
Private Levee	656.8 to 658.3	7,800	3
High Ground	656.0 to 656.8	4,100	0
Rand-Peterson Levee	653.4 to 656.0	11,900	6
High Ground	653.3 to 653.4	700	0
Rand-Peterson Levee	648.3 to 653.3	34,300	7
2011 Flood Fight Levee	645.2 to 648.3	16,800	0 to 12
Cutoff Lake Levee	644.0 to 645.0	6,000	7
DeSoto Bend Roadway	641.8 to 645.2	14,900	N/A
Coulthard Levee	641.5 to 643.8	22,100	7
Vanman Levee	635.7 to 641.5	30,500	8
Total	28.2	176,500	

The attached Plate 1 shows the location of the levees and high ground areas. Also shown are water surface profiles for the 10-, 50-, 100- and 500-year floods, and high water mark elevations for the 2011 Missouri River flood. The water surface profiles were obtained from the Upper Mississippi River System Flow Frequency Study (UMRSFFS), U.S. Army Corps of Engineers, January, 2004. As shown on this plate, upstream from the Highway 30 bridge at Blair, the high water elevations for the 2011 flood are approximately equal to or slightly lower than the elevations for the 500-year flood event. This is consistent with the peak discharge of 209,000 cubic feet per second (cfs) at Blair, NE for the 2011 flood being slightly lower than the discharge of the 500-year flood, which is 237,800 cfs at Blair, NE. Additionally, in the Corps of Engineers hydraulic model for the 500-year flood event, the overbank flow was assumed to be unconfined by the local levee systems. However, for the 2011 flood event on the Iowa side Missouri River flood flows were confined riverward of the Rand-Peterson and private levees, which would have raised the flood elevations for the 2011 flood higher than would have been experienced if the overbank flow was unconfined by local levees. This may also account for the 2011 flood levels being very close to the 500-year flood levels, even though the 2011 discharge is less than the 500-year discharge.

Downstream from the Highway 30 bridge, the 2011 high water mark elevations are approximately 3 feet below the elevations for the 500-year flood event. This is consistent with the fact that there were major levee failures on the Iowa side in the reach from Highway 30 downstream to Council Bluffs which would have produced lower flood levels for the Missouri River.

Also shown on Plate 1 are the top of levee elevations for the Rand-Peterson and private levees. These elevations indicate that except for one location during the 2011 flood event there was approximately 1 to 2 feet of freeboard available between the peak 2011 flood levels and the top of levee elevations. At River Mile 656.7 the profile indicates there was only 0.1 feet of freeboard available. However there was a setback levee constructed at this location that provided 1 to 2 feet of freeboard.

For purposes of defining the area provided material flood control benefits by the levee system, the area flooded during a 500-year flood event (237,800 cfs at Blair, NE) was plotted using the water surface elevations for the 500-year flood shown on Plate 1, and the latest topographic mapping for the floodplain. The 500-year flood was used because the 500-year water surface profile is similar to the 2011 high water marks, the 500-year water surface profile is an unconfined condition which better represents the flow conditions in the overbank areas landward of the levee, and the 500-year profile better represents conditions downstream of Highway 30 if the levees in this area are repaired and can contain a flow of 209,000 cfs. The mapping utilized was the 2 foot contour interval LIDAR mapping obtained by the state of Iowa.

Plate 2 shows in blue the resulting flooded area. Plate 3 shows the same area, only with parcel boundaries outlined in the map. This is the area that is considered to be provided flood protection material benefits due to the existence of the Rand-Peterson, Coulthard, Vanman, DeSoto Bend chute closure/roadway, and private levees from the Boyer River to the Soldier River. This area amounts to approximately 49,000 acres north of the UPRR embankment and 26,000 acres south of the UPRR embankment, for a total of 75,000 acres or 117 square miles. Note that during the 2011 flood event there was a flood fight levee constructed from Highway 30 in a southeasterly direction and connected to the Desoto Bend chute closure/roadway. Although this levee failed during the 2011 flood event and some portions were subsequently removed, for purposes of this study it was assumed that the levee is intact and capable of containing the 2011 flood event.

Development of Assessment Schedule: There are no reports available describing in detail the method used for development of the existing assessment schedule for the Rand-Peterson Levee District. Review of the existing assessment schedule indicates that assessment amounts are based upon the acreage for each parcel, with consideration for depth or frequency of flooding because some parcels have a higher assessment than other parcels that have the same acreage. Additionally the assessment for the railroads, state highways, and county secondary roads has a higher assessment rate per acre than private parcels, but there is no information available for how that assessment rate was determined. The following Table 2 is summary of the existing assessment schedule:

Table 2 – Summary of Existing Assessment Schedule

Iowa DOT	\$8,847
Union Pacific Railroad	\$10,532
Harrison County Secondary Roads	\$7,769
Private Parcels	\$42,319
Total	\$69,467

For development of the updated assessment schedule as part of this reclassification study, the following factors were used in development of the assessment schedule:

1. Extent of Area Receiving Benefits: For purposes of this reclassification study, the extent of the area receiving material flood control benefits from the Rand-Peterson levee will be the area flooded by the 500-year flood event as shown on Plate 2 of this report. This area flooded was developed in the report “Engineer’s Report – Annexation, Rand-Peterson Levee District, Harrison and Pottawattamie Counties, Iowa, November, 2018”. This area flooded utilizes the latest water surface profiles available from the Corps of Engineers which relates to the level of protection provided by the levees, and also utilizes the latest topographic mapping available for the Missouri River floodplain, which relates to the area that would be flooded if the levees were not in place.

Within the area receiving material benefits from the Rand-Peterson levees, there were several options which were considered by the Rand-Peterson Levee District Board of Trustees when determining the overall extent of the annexation that relates to the area that is subject to reclassification. Following is a description of the options.

a. At the northern end of the area receiving benefits there is a triangular area of about 1,300 acres downstream from the Soldier River (between River Mile 662 to 664) that is protected by a private levee. This area would not have to be annexed because there is high ground at the upstream end of the existing Rand-Peterson levee system that could provide a tie-off to the levee system. However this high ground would have to be closely monitored during a flood event to provide adequate freeboard for this tieoff area. This area will not be annexed at this time, but possibly considered for annexation at a later date if ongoing maintenance or improvements to the levee system would benefit from this annexation.

b. The Vanman Levee in Pottawattamie County is an integral part of the overall line of protection provided to the area receiving benefits from the levee system. However, since the Vanman Levee District Board of Trustees is already assessing parcel owners and operating and maintaining this section of levee independent from the actions of the Rand-Peterson Board of Trustees, it was decided not to annex parcels within the Vanman Levee District. If this area is not annexed, as long the Vanman Levee District Board of Trustees continues to operate and maintain the levee, the area outside the Vanman Levee District would continue to receive the material benefits as outlined in this report. Note that parcels that are within the Vanman Levee District but partially outside of the area of protection provided by the Vanman levee are included in this reclassification study.

c. Downstream from Highway 30 the primary line of protection as evaluated in this study extends from Highway 30 in a southeasterly direction for about 1.5 miles through a high ground area until it connects with service roads for the DeSoto Bend National Wildlife Refuge that also serve as a flood protection embankment. The line of protection then extends from the service roads and chute closure/roadway for the DeSoto Bend National Wildlife Refuge to the Vanman

Levee. The Coulthard Levee, that is in both Harrison and Pottawattamie Counties, is therefore not part of the primary line of protection that provides the flood protection benefits as outlined in this report. However the Coulthard levee does provide a secondary line of protection to the area east of the Coulthard levee, and is also in integral part of the tieoff to high ground for the Vanman levee. The Coulthard Levee District is managed by the Harrison County Board of Supervisors. Similar to the Vanman Levee, since the Coulthard Levee District /Board of Supervisors are already assessing parcel owners and operating and maintaining this section of levee independent from the actions of the Rand-Peterson Board of Trustees, it was decided not to annex the parcels that are within the Coulthard Levee District. If this area is not annexed, as long as the Coulthard Levee District/Board of Supervisors continue to operate and maintain the levee, the area outside the Coulthard Levee District would continue to receive the material benefits as outlined in this report. Note however that there are three large scour holes remaining in the Coulthard levee as a result of overtopping during the Missouri River flood of 2011. If these holes are not repaired, consideration may be given to annexing the parcels within the Coulthard Levee District. Also note that parcels that are within the Coulthard Levee District but partially outside of the area of protection provided by the Coulthard levee are included in this reclassification study.

d. The Desoto Bend chute closure/roadway is part of the primary line of protection as outlined in this report, and parcels within the DeSoto Bend National Wildlife Refuge are within the area receiving material benefits from the levees. If assessments are made to these parcels, the federal government/U.S. Fish & Wildlife Service is not obligated to pay the assessments. However, the parcels within the DeSoto Bend National Wildlife Refuge that are also within the state of Iowa will be annexed, in the event that the federal government/U.S. Fish & Wildlife Service has the ability to pay the assessments. Parcels within the DeSoto Bend National Wildlife Refuge that are within the state of Nebraska can only be annexed if there is a cooperative agreement with another levee district in Nebraska. Since this is not the case, parcels within Nebraska will not be annexed.

e. During the 2011 flood event there was a flood fight levee constructed downstream from Highway 30 in a southeasterly direction and connected to the Desoto Bend chute closure/roadway. Although this levee was subsequently removed, current operational plans for the Rand-Peterson Levee District include reconstructing this emergency levee in the event that flood forecasts by the Corps of Engineers or National Weather Service indicate that extensive flooding would occur without the emergency levee. A functional levee at this location, whether an emergency levee or a permanent levee, is necessary in order to provide the material benefits as outlined in this report. After the annexation and reclassification process is complete, consideration may be given to constructing a permanent levee at this location.

The attached Plate 3 shows the resulting area that is subject to reclassification as part of this study. This is the same overall area as shown on Plate 2, only with existing and new parcel boundaries outlined in the map, and with the Coulthard and Vanman parcels removed.

2. Quantification of Value of Each Parcel – Under the existing assessment schedule, the assessment to each parcel was based at least partially on depth of flooding and acreage of each parcel. With that method, a 40 acre parcel that is bare land could be assessed the same amount as a 40 acre parcel with a house, buildings, or other high value facilities. The updated assessment schedule for this reclassification study will be based upon depth of flooding for the 500-year for each parcel, similar to the existing assessment. However, instead of using acreage for each parcel to quantify the value of the parcel and amount of benefits received, the parcel valuation in dollars that has been determined by the Harrison County Assessor’s Office will be used to quantify the value of each parcel and the subsequent amount of flood control benefits that are received from the Rand-Peterson levees. This approach gives a better method of allocating the dollar cost of constructing levees to the parcels that are receiving the resulting dollar flood control benefits. Additionally, because the assessor’s office has broken out valuation into categories of land, dwelling, buildings, and buildings on leased land, the depth of flooding can be determined for each category, which can provide an even more accurate allocation of cost to the parcels that are receiving a benefit from the levees. More details about valuation of roadways and utilities are contained in Appendix A.

3. Frequency of Receiving Benefits: The 10-, 50-, 100-, and 500-year water surface profiles shown on Plate 1 give a good indication of Missouri River flood elevations for various frequency flood events. Flood depths for each of these flood events could be determined for each parcel, which could be correlated to frequency of receiving benefits for each parcel. However, since the water surface profiles for each of these events are reasonably parallel, using only the 500-year flood depth for determining frequency of receiving benefits can achieve the same result, and significantly reduce the parcel by parcel analysis time for this study. The attached Plate 4 shows a map with the 500-year flood elevations within the area receiving material flood control benefits. The 500-year flood elevation for each parcel was determined and the 2 foot contour interval LIDAR topographic mapping obtained by the state of Iowa was used to determine land elevations for each parcel so flood depths could be determined by subtracting the land elevation from the 500-year flood elevation. For the land portion of the parcel the lowest and highest elevation of the land portion of the parcel was determined and then averaged. For agricultural parcels, the elevations of creeks, drainageways, and low lying wetlands were excluded from determining the low elevation. For the dwelling, the land elevation next to the dwelling was used to determine the dwelling elevation. For buildings, the land elevation next to the building was used to determine the building elevation. If there were multiple buildings, the average land elevation near the buildings was used, unless there was one large building, in which case the elevation near the large building was used. For roadways, the elevation of natural ground next to the roadway was used for the roadway elevation. Using the road ditch elevation was considered but not used similar to the approach for agricultural parcels. More details about evaluation of roadways and utilities are contained in Appendix A.

4. Development of Assessment Rates – Since the 500-year flood has been the flood event used for determining the area receiving benefits from the existing levee system, this event was to be used to assign assessment percentages to individual parcels. Assuming 2 foot of freeboard, the levee height to contain the Missouri River 500-year flood event from the Boyer River to the Soldier River ranges from

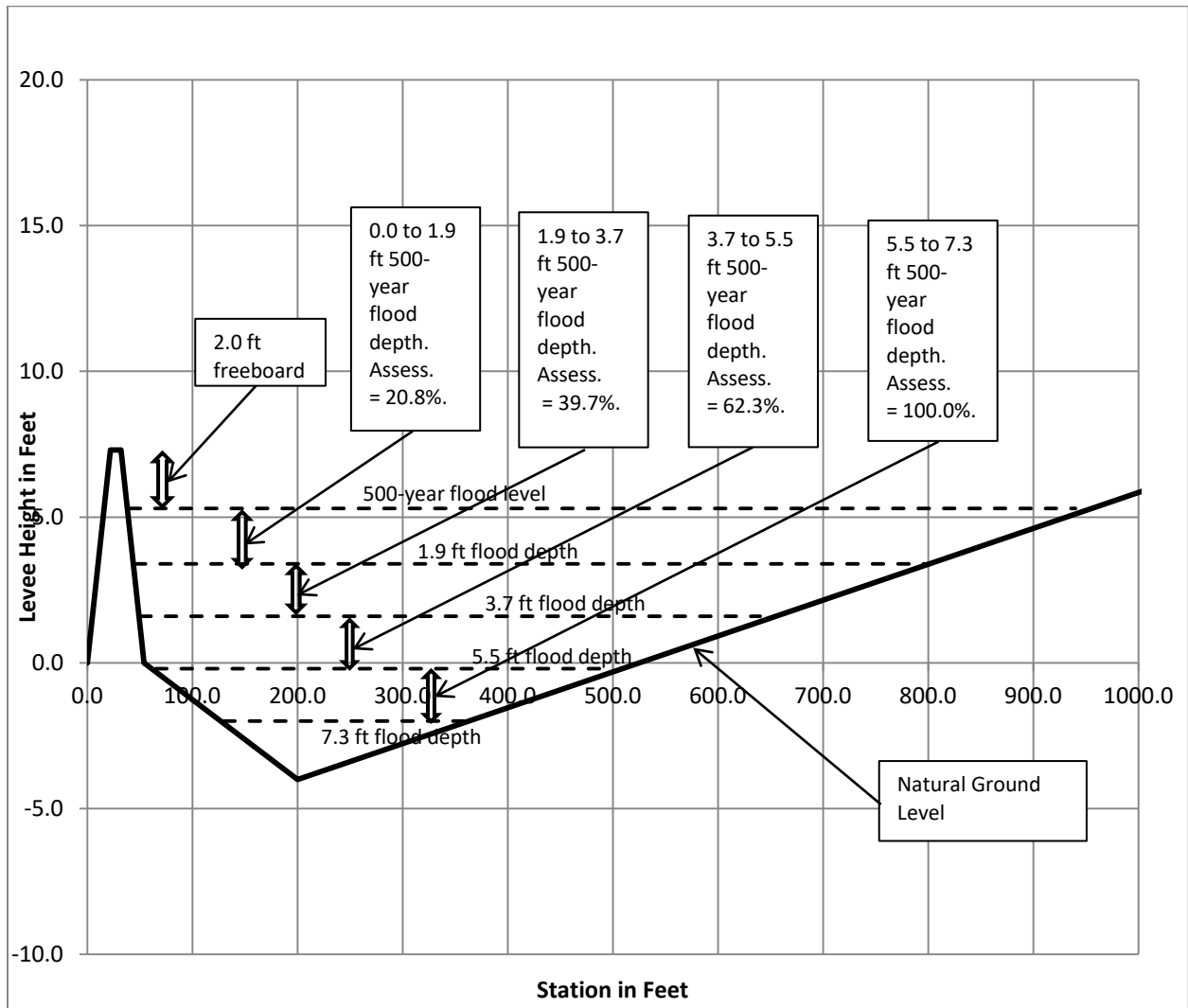
0.0 to 12.9 feet, with an average of 7.3 feet. This levee height was used in this analysis and additional lower levee heights were evaluated by dividing the 7.3 ft. levee height by four, resulting in levee heights for analysis of 1.8 ft, 3.6 ft., 5.4 ft., and 7.3 ft. The percentage assigned for the varying levels of flood risk was based upon an average of the construction cost for a levee of that level, and allocation of those costs to the parcels receiving benefits from a levee of that height. The following Table 3 shows in Column 4 the resulting assessment percentages for each 500-year flood depth range. As per Iowa Code Section 468.39, "The lands receiving the greatest benefit shall be marked on a scale of one hundred, and those benefited in a less degree with such percentage of one hundred as the benefits received bear in proportion thereto". Therefore the assessment percentages in Column 4 were normalized so that the highest assessment percentage is 100%. These normalized assessment percentages are shown in Column 5. Figure 1 shows a typical levee cross section along with the flood depth assessment ranges and corresponding assessment for that depth range.

Table 3 – Assignment of Assessment Percentages

Levee Height Range	500-year Flood Depth Range	Average of Depth Range (ft.)	Column 4 Assessment %	Column 5 Normalized Assessment %
5.4 to 7.3 ft	0 to 1.9 ft	0.95	9.3%	20.8%
3.5 to 5.4 ft	1.9 to 3.7 ft	2.8	17.8%	39.7%
1.8 to 3.5 ft	3.7 to 5.5 ft	4.6	27.9%	62.3%
0.0 to 1.8 ft	5.5 to 7.3 ft	6.4	44.9%	100.0%
			100.0%	

Note: Assess. % was normalized to make highest assessment rate equal to 100%. Adjusted % = Assessment % * 2.579

Figure 1 – Typical Assessment Percentages vs. Depth of 500-year Flood



The average of each depth range was plotted against the normalized assessment percentage and is shown on Figure 2. A straight line plot was developed from 0 to 100% that was consistent with the normalized assessment percentage. Then a table of assessment percentages for 0.5 foot increments of 500-year flood depths was developed and is shown on the following Table 4.

Figure 2 – 500-year Flood Depth vs. Assessment Percentage

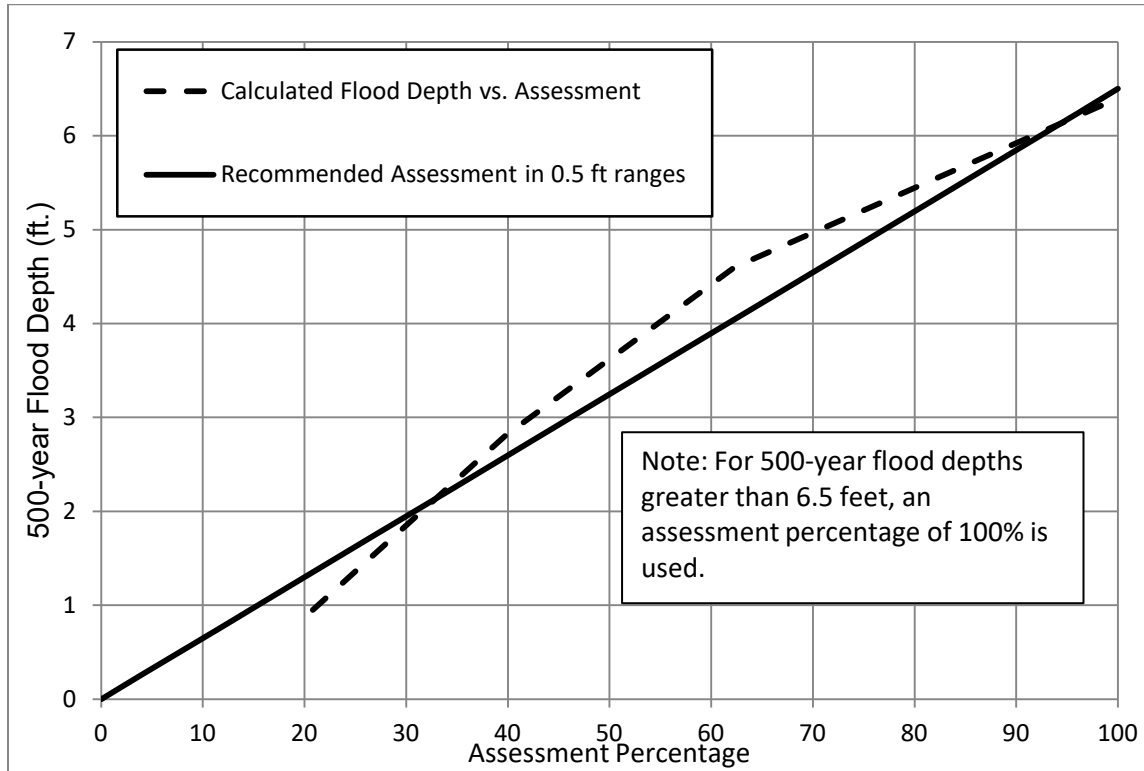


Table 4 – Final Flood Depth vs. Assessment Percentage

Table 4 – Final Flood Depth vs. Assessment Percentage	
500-year Flood Depth Range (ft.)	Assessment Percentage
0 to 0.5	3.9
0.5 to 1.0	11.6
1.0 to 1.5	19.3
1.5 to 2.0	27.0
2.0 to 2.5	34.7
2.5 to 3.0	42.4
3.0 to 3.5	50.1
3.5 to 4.0	57.8
4.0 to 4.5	65.5
4.5 to 5.0	73.2
5.0 to 5.5	80.9
5.5 to 6.0	88.6
6.0 to 6.5	96.2
>6.5	100.0

Land, dwelling, buildings, and buildings on leased land elevations were extracted for each parcel, and the associated flood depths were determined by subtracting these elevations from the 500-year flood elevation. Then the assessment percentages were determined from the appropriate flood depth range in Table 4. These assessment percentages were then applied to the valuation for each parcel for land, dwelling, buildings, and if needed the buildings on leased land category. The result is an adjusted total valuation for a parcel that has been reduced based upon flood risk and depth of flooding. Following is a sample calculation for several parcels.

Table 5 - Sample Calculations for Adjusted Parcel Valuation

Gross Acres	Flooded Acres	500-year Flood Depths (ft.)					Assessment Percentage					Current Valuation (\$)				Adjusted Valuation (\$)				Total
		Land	Bldg	Dwell	Bldg LL	Land	Part. Fld. Adj.	Bldg	Dwell	Bldg LL	Land	Bldg	Dwell	Bldg LL	Land	Bldg	Dwell	Bldg LL		
0.3	0.3	1.6	0.9	0.0	0.0	31%	31%	15%	0%	0%	5,217	99,176	0	0	1,607	15,273	0	0	16,880	
7.0	7.0	4.9	4.0	0.0	0.0	77%	77%	69%	0%	0%	69,312	729,595	0	0	53,370	505,609	0	0	558,980	
9.8	8.3	3.6	0.0	0.0	0.0	62%	52%	0%	0%	0%	29,931	76,875	0	0	15,647	0	0	0	15,647	
0.2	0.2	3.5	3.2	0.0	0.0	54%	54%	54%	0%	0%	6,263	131,256	0	0	3,376	70,747	0	0	74,123	
0.0	0.0	0.0	0.0	0.0	1.7	0%	0%	0%	0%	31%	0	0	0	134,531	0	0	0	41,436	41,436	
36.1	36.1	1.8	0.0	0.0	0.0	31%	31%	0%	0%	0%	101,844	0	0	0	31,368	0	0	0	31,368	
27.1	27.1	8.7	6.7	0.0	0.0	100%	100%	100%	0%	0%	52,327	8,115	0	0	52,327	8,115	0	0	60,442	
39.7	21.9	1.2	0.0	0.0	0.0	23%	13%	0%	0%	0%	92,708	0	0	0	11,814	0	0	0	11,814	
39.0	13.6	0.9	0.0	0.0	0.0	15%	5%	0%	0%	0%	110,826	10,249	79,865	0	5,952	0	0	0	5,952	
36.4	36.4	5.4	3.4	2.4	0.0	85%	85%	54%	39%	0%	61,244	22,750	80,478	0	51,874	12,262	30,984	0	95,120	

The individual parcel assessments were then calculated by multiplying the adjusted parcel valuation by the ratio of the total levee district assessment (\$69,467.35) divided by the total adjusted valuation of all parcels (\$144,712,700). The formula for assessment for each parcel is as follows, and the following Table 6 shows sample calculations with this formula.

$$(\text{Parcel Adjusted Valuation in \$}) \times \frac{(\text{Total Levee District Assessment in \$})}{(\text{Total Adjusted Valuation of All Parcels in \$})}$$

Table 6 - Sample Calculations for Parcel Assessment

Adjusted Valuation (\$)	Initial Assessment
\$16,880	\$8.10
\$558,980	\$268.33
\$15,647	\$7.51
\$74,123	\$35.58
\$41,436	\$19.89
\$31,368	\$15.06
\$60,442	\$29.01
\$11,814	\$5.67
\$5,952	\$2.86
\$95,120	\$22.83
\$144,712,700	\$69,467.25
(Total Adjusted Valuation of All Parcels)	(Total Initial Assessment of All Parcels)

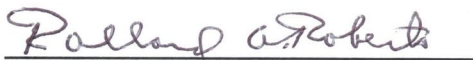
The resulting assessments are shown in Appendix B. Harrison County parcels are listed first. Pottawattamie County parcels and features that are not identified as parcels are listed last. The following Table 7 provides some pertinent statistics relative to the assessments.

Table 7 – Assessment Statistics

	Within Existing Levee District	Within Annexation Area	New Total	
Number of Harrison County Individual Parcels	1,121	1,553	2,674	
Number of Pottawattamie County Individual Parcels	0	58	58	
Total area of Harrison Co. Individual Parcels (acres)	28,029	36,878	64,907	
Total area flooded of Harrison Co. Individual Parcels (acres)	24,664	32,090	56,754	
Total area of Pottawattamie County Parcels (acres)	0	2,132	2,132	
Total area flooded of Pottawattamie County Parcels (acres)	0	1,553	1,553	
Total area of Roads/Railroads (acres)			2,064	
	Initial Valuation (\$)	Adjusted Valuation Based on Flood Depth (\$)	New Assessment (\$)	Existing Assessment (\$)
Individual Parcels	\$187,721,923	\$78,036,986	\$38,980	\$42,319
Harrison County Secondary Roads	\$13,708,464	\$9,580,078	\$4,785	\$7,769
Pottawattamie County Secondary Roads	\$683,760	\$328,889	\$164	\$0
Iowa DOT Highway 30	\$19,451,520	\$14,039,330	\$7,013	\$8,847
Iowa DOT Interstate 29	\$49,062,240	\$26,416,462	\$13,195	\$0
Union Pacific Railroad	\$17,165,549	\$9,313,607	\$4,652	\$10,532
Modale Streets	\$338,184	\$169,261	\$85	\$0
Mo. Valley Streets	\$687,456	\$343,728	\$172	\$0
Elec. Utilities	\$1,844,048	\$842,493	\$421	\$0
Total	\$290,663,144	\$139,070,833	\$69,467	\$69,467
Individual Parcel Maximum Assessment			\$264	\$1,126

We recommend that this Commissioner's Report containing the assessment schedule in Appendix B be adopted.

Respectfully Submitted,



Rollie Roberts, Landowner



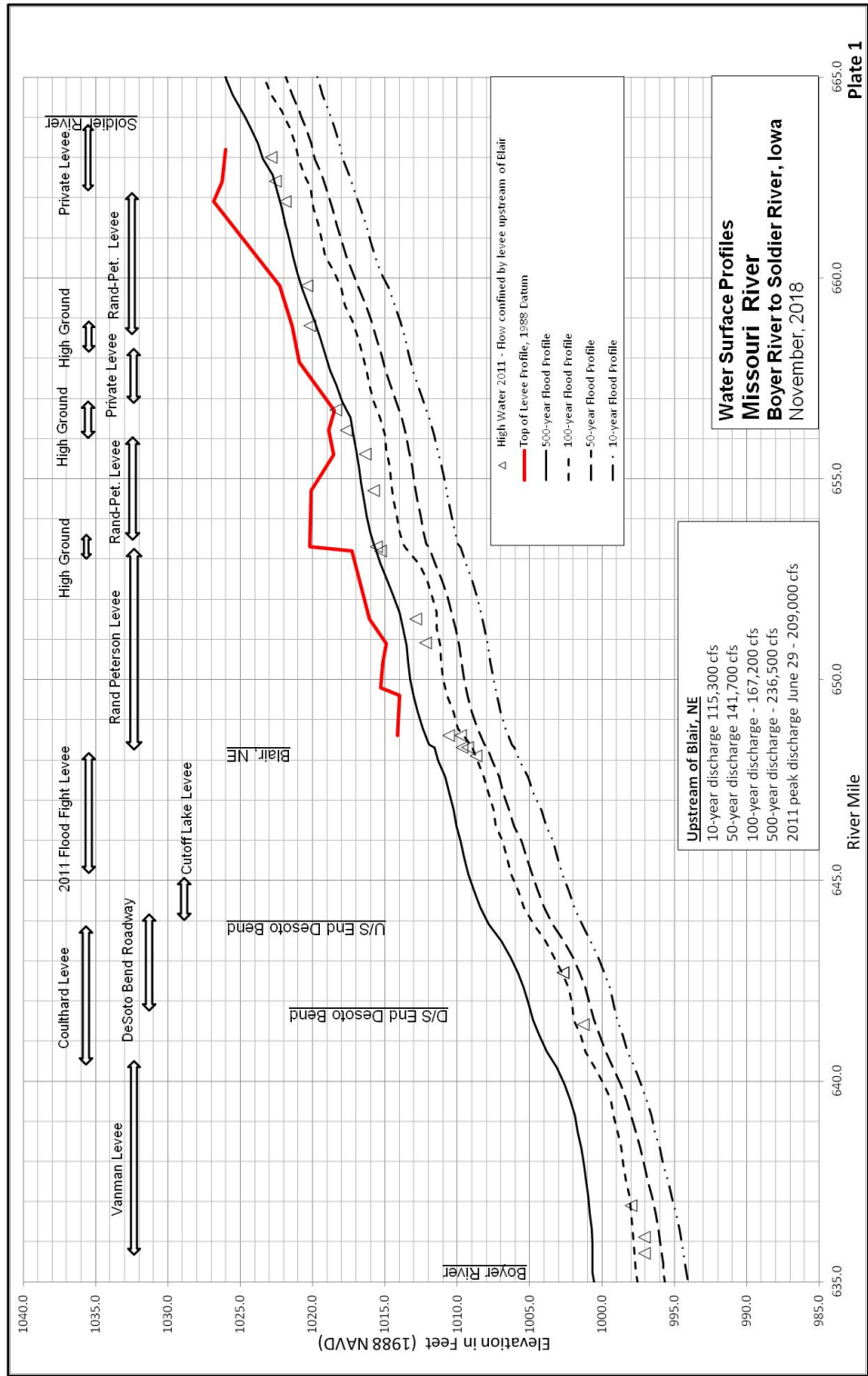
Tim Temeyer, P.E., Engineer



John Erixon, Landowner



Date



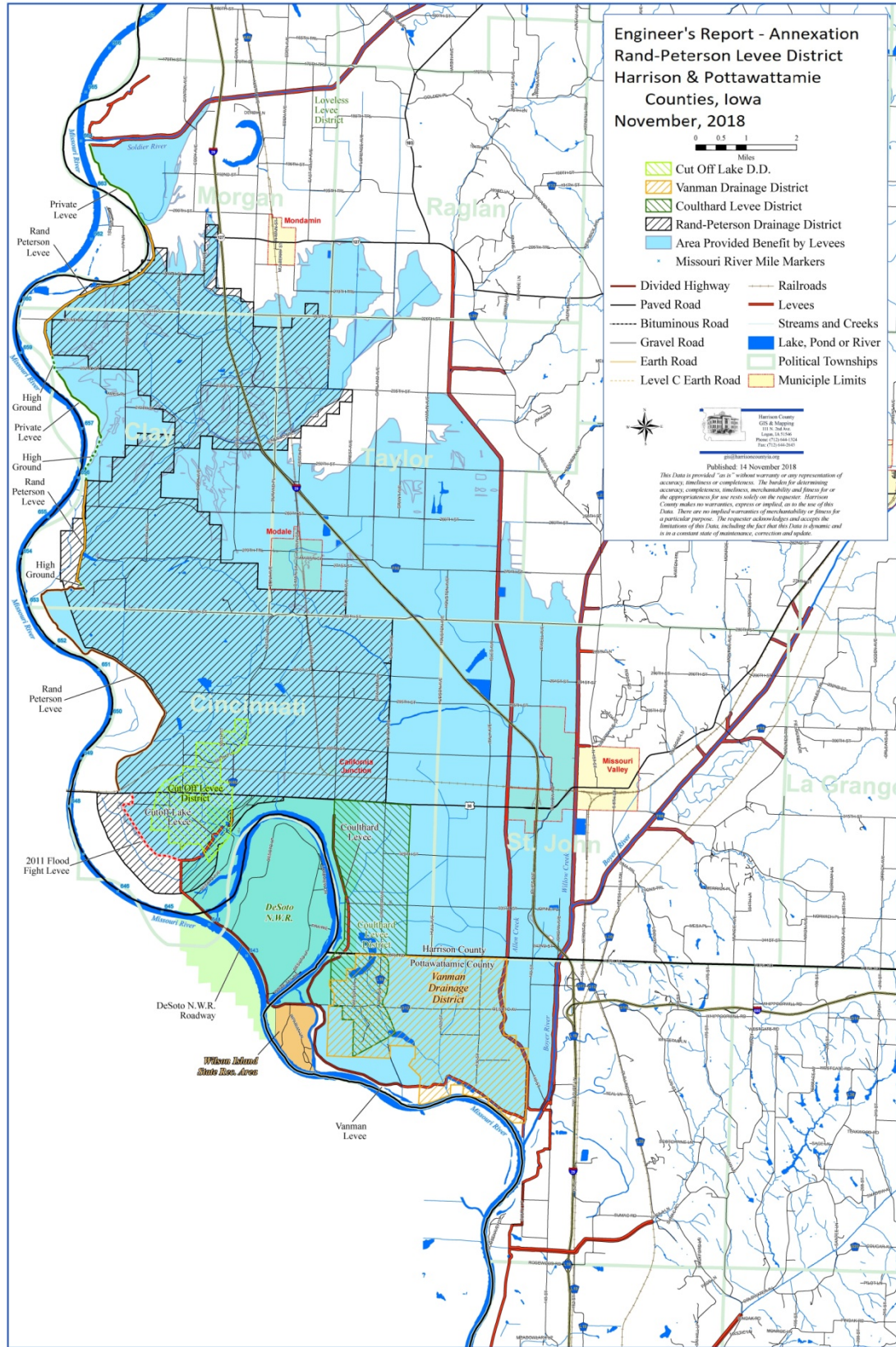


Plate 2 – Area Receiving Material Flood Control Benefits

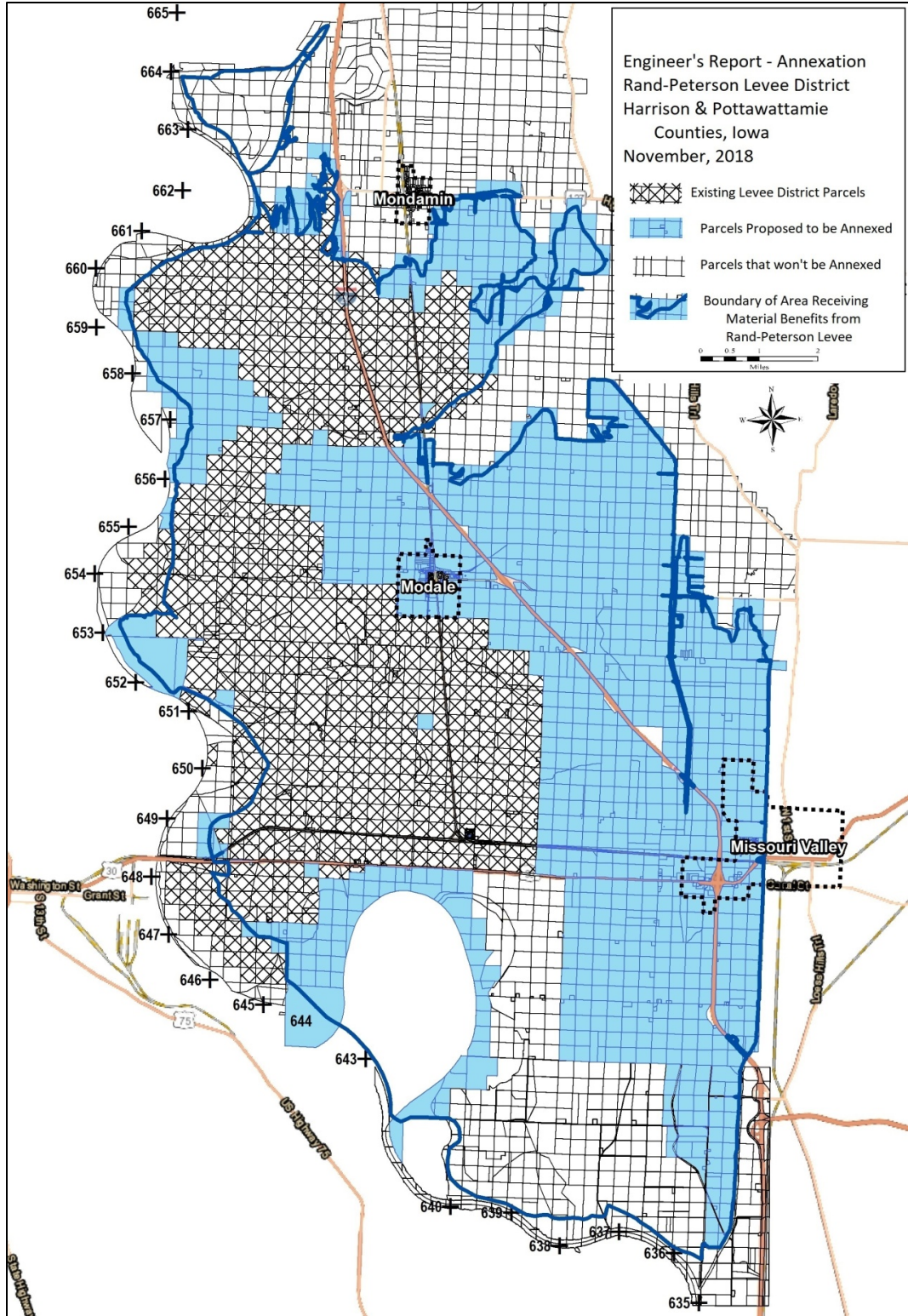


Plate 3 – Existing and New Parcels Within Area Receiving Material Flood Control Benefits

