

37,995 ; 45,259

REVISED OPERATIONS PLAN
FOR
HORSE THIEF RESERVOIR
MULTI-PURPOSE DAM NO. 4-10

APRIL 12, 2010

APPROVED BY: Brit Hayes
BRIT HAYES, CHAIRMAN

PAWNEE WATERSHED JOINT DIST. NO. 81
514 US HWY 156
JETMORE, KS 67854

DATE APPROVED: 5/17/2010

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OPERATIONS PLAN
HORSE THIEF RESERVOIR
MULTI-PURPOSE DAM 4-10

- A. Pawnee Watershed Joint District No. 81 is responsible for the operation of Horse Thief Dam and Reservoir, including the following activities:
1. Install, operate, and maintain the drawdown outlet valve at Horse Thief Dam.
 2. Install, operate, and maintain stream gages and/or modify existing gages to monitor surface flows.
 3. Calibrate the drawdown outlet valve to provide for accurate releases.
 4. Calibrate the principal spillway so flow rates can be accurately estimated during uncontrolled discharges.
- B. Pawnee Watershed Joint District No. 81 will install continuous recording stream gages at the following locations:
1. Above the reservoir to measure the inflow to Horse Thief Reservoir.
 2. In Horse Thief Reservoir to measure the elevation of the reservoir surface.
 3. Jetmore stream gage to include outflow from Jetmore City Lake, located on Buckner Creek immediately downstream from the confluence with Spring Creek as possible.
 4. Stream gage on Buckner Creek immediately upstream from the confluence with Sawlog Creek. The Kansas Department of Agriculture, Division of Water Resources may install and operate this gage in connection with a study of the Buckner Creek Watershed.
 5. See attached map of gage locations (page 9).
- C. Ground water levels will be monitored by Kansas Department of Agriculture, Division of Water Resources, Groundwater Management District No. 5 and Pawnee Watershed Joint District No. 81. Kansas Department of Agriculture, Division of Water Resources will coordinate this activity between agencies and evaluate any changes that might be attributed to Horse Thief Dam and Reservoir. Any changes that can be reliably attributed to Horse Thief Dam and Reservoir will be resolved with Pawnee Watershed District Joint No. 81 along with any needed changes in the Operations Plan.
- D. Pawnee Watershed Joint District No. 81 will estimate seepage rates by subtracting the estimated net evaporation volumes and outflow volumes from inflow volumes. Pawnee Watershed Joint District No. 81 will install, operate, and maintain a precipitation gage at the reservoir. Data from this gage and the Dodge City weather station will be used to make the seepage rate calculations.
- E. Operation of the outlet valve of the Horse Thief Dam will be based on a set of predetermined conditions that will trigger the action by Pawnee Watershed Joint District No. 81. A blank worksheet and operations plan release rules, with examples, are attached.

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- F. The Division of Water Resources may require release rates higher than those shown if necessary to properly administer water rights for downstream surface water users.
- G. To offset the recreational water use associated with the recreation facilities at Horse Thief Reservoir, the planned releases from the reservoir will be increased based on the following procedure:
1. The diverted volume from the well associated with Water Appropriation No. 45,259 will be monitored monthly.
 2. The planned release rate from the reservoir will be increased once annually to offset the withdrawal of water from the alluvial aquifer adjacent to the reservoir.
 3. The increased release rate will occur annually during July, which is the month during the peak water use period with the lowest historical average monthly flow rate in Buckner Creek, downstream from the dam.
 4. The planned release rate from the reservoir will be increased by 1.0 cfs until the additional volume of release equals the volume of water diverted for recreational water use during the previous calendar year from Water Appropriation File No. 45,259.
 5. The release period equals 0.5 times the volume of water in Acre-Feet diverted for recreational water use from Water Appropriation File No. 45,259 during the previous calendar year. The product is then rounded up to the next whole day. See Table 4 for release periods.

OPERATIONS PLAN RELEASE RULES

STEP 1: Determine the downstream flow condition status from Table 1:

TABLE 1

MONTH	FLOW AT:			DOWNSTREAM FLOW STATUS
	JETMORE (cfs)	HANSTON (cfs)	BURDETT (cfs)	
Nov., Dec., Jan., Feb., March	<1.0 ≥1.0	<1.0 ≥1.0	<1.0 ≥1.0	Dry Normal
April, May, Sept., Oct	<2.0 ≥2.0	<3.0 ≥3.0	<2.0 ≥2.0	Dry Normal
June, July, August	<2.0 ≥2.0	<2.0 ≥2.0	<1.0 ≥1.0	Dry Normal

Notes:

1. On this table "<" means less than and "≥" means greater than or equal to.
2. cfs means cubic feet per second
3. If any condition on the "Dry" status line is true, then the status is dry. Otherwise, the status is normal.

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STEP 2: Determine the reservoir level status from Table 2:

TABLE 2

RESERVOIR ELEVATION (mean sea level)	RESERVOIR LEVEL STATUS
At or below 2413.5	Low
2413.5-2420.4	High
Above 2420.4	Gage Inundated

Notes:

1. "Low" reservoir levels correspond to elevations at or below the 80% chance pool elevation. Based on the Preliminary Design Report (1), that elevation is 2413.5.
2. "High" reservoir levels correspond to the elevations above the 80% chance pool elevation. Based on the Preliminary Design Report (1), that elevation is 2413.5.
3. When the "High" reservoir condition exceeds the elevation of the principal spillway invert, all inflows will automatically be passed through the uncontrolled principal and emergency spillways to control flooding, protect the structure from overtopping, and prolong flows.
4. "Gage Inundated" means that the reservoir level is too high for the upstream or inflow gage to operate properly. This high water level condition was documented in the Design Report and Operation, Inspection and Maintenance Plan for Pawnee Watershed Joint District No. 81 Horse Thief Reservoir Operation Plan V-Notch Weir Stream Gage. When this occurs inflow is assumed to be greater than 2 CFS.

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STEP 3: Using the downstream flow condition status from Step 1, the inflow into the structure and the reservoir level status from Table 2, determine the minimum required release from Table 3:

TABLE 3

MONTH	DOWNSTREAM FLOW CONDITION STATUS	INFLOW (cfs)	RESERVOIR LEVEL STATUS (Low/High/Gage Inundated)	MINIMUM REQUIRED RELEASE (cfs)
November December January February March	Dry	≤2.0	Low	Inflow up to 1.0
	Dry	≤2.0	High	Inflow
	Dry	>2.0	Low	1.0
	Dry	>2.0	High	2.0
	Dry	unknown	Gage Inundated	2.0
	Normal	≤2.0	Low	0
	Normal	≤2.0	High	0
	Normal	>2.0	Low	0
	Normal	>2.0	High	0
April May September October	Dry	≤2.0	Low	Inflow
	Dry	≤2.0	High	2.0
	Dry	>2.0	Low	2.0
	Dry	>2.0	High	2.0
	Dry	unknown	Gage Inundated	2.0
	Normal	≤2.0	Low	Inflow up to 1.0
	Normal	≤2.0	High	2.0
	Normal	>2.0	Low	2.0
	Normal	>2.0	High	2.0
June July August	Dry	≤2.0	Low	Inflow
	Dry	≤2.0	High	2.0
	Dry	>2.0	Low	2.0
	Dry	>2.0	High	3.0
	Dry	unknown	Gage Inundated	3.0
	Normal	≤2.0	Low	1.0
	Normal	≤2.0	High	2.0
	Normal	>2.0	Low	1.0
	Normal	>2.0	High	2.0
	Normal	unknown	Gage Inundated	2.0

Notes:

1. On this table "≤" means less than or equal to and ">" means greater than.
2. Release rates may not be reduced or increased more than 1.0 cfs from the previous valve setting. When the principal spillway is flowing 3.0 cfs or more the valve will be closed.
3. The inflow gage will not function when the reservoir level at the gage is above approximately 2420.4 feet above sea level. Whenever the reservoir elevation is above 2420.4, or the inflow gage is not functioning, inflows will be assumed to be >2.0 cfs. The minimum required release rates in TABLE 3 reflect this.

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STEP 4: During the month of July, increase the release rate by 1.0 cfs until the additional volume of release equals the volume of water diverted for recreational water use during the previous calendar year from Water Appropriation File No. 45,259. The release period for the increased release rate will be in increments of whole days. The release period equals the volume of water in Acre-Feet diverted for recreational water use from Water Appropriation File No. 45,259 during the previous calendar year times 0.5. See Table 4 to determine the release period for the increased release rate.

TABLE 4

RECREATIONAL WATER USE FROM PREVIOUS CLAENDAR YEAR (AC.FT.)	RELEASE PERIOD FOR 1 CFS INCREASED RELEASE RATE (DAYS)
0.0	0
0.1-2.0	1
2.1-4.0	2
4.1-6.0	3
6.1-8.0	4
8.1-10.0	5
10.1-12.0	6
12.1-14.0	7
14.1-16.0	8
16.1-18.0	9
18.1-20.0	10

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EXAMPLE OF RELEASE RULES

Refer to the following table for the system conditions for each example:

EXAMPLE NUMBER	DATE	RESERVOIR INFLOW (cfs)	RESERVOIR LEVEL STATUS (Low, High, Inundated)	JETMORE GAGE (cfs)	HANSTON GAGE (cfs)	BURDETT GAGE (cfs)	PLANNED DAM RELEASE RATE	
							PREVIOUS (cfs)	CURRENT (cfs)
1	7-Dec-08	1.5	Low	1.2	0.9	1.1	2.0	1.0
2	13-Jan-09	3.3	Low	0.8	1.1	1.3	3.0	2.0
3	1-Apr-09	1.6	Low	2.0	4.0	6.0	2.5	1.5
4	7-May-09	1.9	High	2.2	4.3	5.3	1.0	2.0
5	3-Jun-09	2.6	Low	1.3	1.0	2.0	1.0	2.0
6	4-July-09	4.7	High	2.3	2.0	3.1	2.0	2.0
7	17-Aug-09	1.1	Low	2.1	1.8	1.8	2.0	1.1
8	8-Oct-09	0.8	Low	2.3	4.0	5.6	2.0	1.0
9	20-Apr-09	unknown	Inundated	1.1	1.6	1.8	1.0	2.0

Refer to the following table for the additional dam release to offset the recreational water use from the previous year for each example:

EXAMPLE NUMBER	DATE	RECREATIONAL WATER USE DURING PREVIOUS REPORTING YEAR (Acre-Feet)	ADDITIONAL DAM RELEASE RATE (cfs)	INCREASED FLOW RATE (cfs)	NUMBER OF DAYS AT INCREASED FLOW RATE
1	7-Dec-08	16.5			
2	13-Jan-09	17.4			
3	1-Apr-09	17.4			
4	7-May-09	17.4			
5	3-Jun-09	17.4			
6	4-July-09	17.4	1.0	3.1	9
7	17-Aug-09	17.4			
8	8-Oct-09	17.4			
9	20-Apr-09	17.4			

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Example Descriptions:

- Example 1:** Comparing the flows at the three gages to Table 1, we conclude that downstream flow conditions are dry because the Hanston gage is reading below 1.0 cfs. From the Table 3 with dry downstream condition, inflow less than 2.0 cfs, reservoir level low, a minimum release of 1.0 cfs is required.
- Example 2:** Dry downstream conditions (Jetmore gage below 1.0 cfs). The reservoir remains low but the inflow has increased to more than 2.0 cfs. From Table 3 the minimum release is 1.0 cfs, but the current release can only be reduced by 1.0 cfs (per Note 2, Table 3), so the planned release can be reduced to 2.0 cfs.
- Example 3:** The downstream flow condition is normal because all three Buckner Creek gages are above the threshold values of Table 1. With the reservoir level status still low and inflow below 2.0 cfs, the release must be equal to inflow up to 1.0 cfs, but cannot reduce discharge by more than 1.0 cfs. Therefore, the planned release is 1.5 cfs.
- Example 4:** The downstream flow condition is normal, but the reservoir has filled to the high stage. Although the inflow is below 2.0 cfs, the planned release is 2.0 cfs.
- Example 5:** The downstream flow condition is dry as the flow at the upper two gages is below the level shown in Table 1 and the reservoir is low. From Table 3: dry; inflow greater than 2.0 cfs; reservoir level = Low; the planned release is 2.0 cfs.
- Example 6:** The downstream flow conditions are normal (all three gages above their threshold values) and the reservoir level is now high. With inflow greater than 2.0 cfs, Table 3 requires a planned release of 2.0 cfs. The water use reported for the recreation facilities at Horse Thief Reservoir for the previous calendar year was 17.4 acre-feet. During the month of July, the release rate will be increased by 1.0 cfs to a total release rate of 3.0 cfs for a period of 9 days. After 9 days the release rate will return to the planned release rate of 2.0 cfs.
- Example 7:** The downstream flow conditions are dry. The reservoir level is low and the inflows are less than 2.0 cfs. Therefore, all inflows must be released from the structure, so the planned release is 1.1 cfs.
- Example 8:** The downstream flow conditions are normal. With an inflow less than 2.0 cfs and a low reservoir level, all inflows up to 1.0 cfs must be released. So, in this case, the planned release is 1.0 cfs because we cannot reduce the discharge more than 1.0 cfs.
- Example 9:** The downstream flow conditions are dry. The reservoir level is at a point where the upstream gage is not working. In this case, Note 3, Table 3 governs and therefore the planned release is 2.0 cfs.

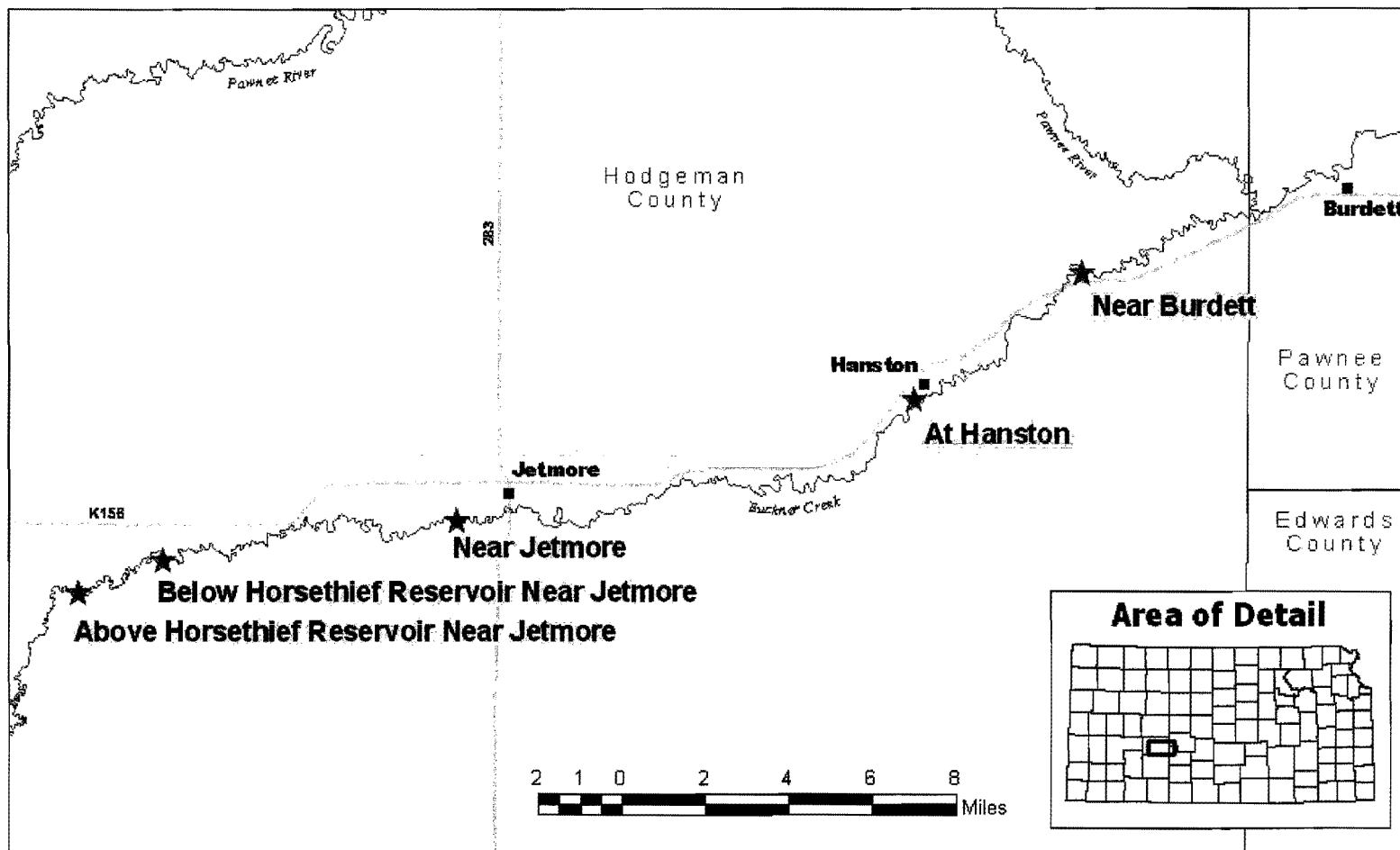
REFERENCES

1. Reh and Associates, Preliminary Design Report. Salina, KS: 909 East Wayne Avenue, August 1996
2. KLA Environmental Services, Inc., Design Report and Operation, Inspection and Maintenance Plan for Pawnee Watershed Joint District No. 81 Horse Thief Reservoir Operation Plan V-Notch Weir Stream Gage. Salina, KS: 1700 E. Iron Avenue, January, 2010

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USGS Gage Sites for Horsethief Reservoir Operations Plan



Kansas Department of Agriculture
Division of Water Resources
Stafford Field Office
E. K. Fitch



- ★ Buckner Creek USGS Gages
- Towns
- Streams
- - - KDOT Highways

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