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TO: R. W. BENJAMIN

FROM: D. W. HAYES

D. W. Hayes

SEDIMENT TRANSPORT STUDIES IN TIMS BRANCH

SUMMARY

In 1984, the spillway of Steed Pond fed by Tims Branch collapsed and the pond slowly drained. Consideration was given to leaving the pond dry, but concern was expressed that the uranium accumulated in the sediments from the 300 Area discharges to Tims Branch might be eroded and transported to Upper Three Runs Creek. This study shows that the measured amount of sediment transported to Upper Three Runs Creek from Tims Branch #5, about two miles below Steed Pond, was about the same as in past years before the spillway collapsed. What little erosion that has occurred in the exposed sediments will be even less in the future with the revegetation of the exposed sediments. These results indicate that Steed Pond could be left in its present condition (dry) without affecting suspended solids concentrations and associated uranium concentrations in Upper Three Runs Creek.

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INTRODUCTION

During the weekend of September 2-3, 1984, a part of the wooden spillway for Steed Pond collapsed and the pond slowly drained (taking about 3 days). Consideration was given to leaving Steed Pond drained because of the difficulty of replacing the spillway and maintaining the dam in a safe operating condition. Steed Pond has accumulated some of the uranium discharged from 300 Area operations and past surveys have shown that the uranium concentration in the sediments ranges between 20 and 531 pCi/gm. An aerial survey of the exposed area of Steed's Pond showed that the uranium was widely spread in the sediments of Steed Pond. Until ground cover is established over these exposed pond sediments, they will be subject to erosion.

An initial estimate of the amount of sediment that might be eroded from Steed Pond was made in October, 1984. As much as 90 tons of sediment could be eroded from the exposed sediments in Steed Pond during the first year. About 36 tons of this eroded sediment could be delivered to Upper Three Runs Creek during the first year. Most of the eroded sediment is deposited on the lower part of the slope from which it was eroded and some sediment deposition occurs in Tims Branch below Steed Pond. Ground cover such as grass or weeds could further reduce the sediment delivered to Upper Three Runs Creek to about 10 tons. These sediment transport estimates were reported in a DPST (Uranium Studies in Tims Branch and Steed Pond System, DPST-84-847). A study was made to determine the amount of sediment that was transported to Upper Three Runs Creek at Tims Branch #5. These results were compared to historical data to determine if an increase in suspended solids had occurred due to the erosion of sediments from Steed Pond.

A second report will be prepared in the near future on the uranium concentrations in the Tims Branch system.

METHODS

An automatic water sampler was installed to collect water samples for suspended solids analyses at Tims Branch #5 (Figure 1), about 200 yards upstream of the Tims Branch confluence with Upper Three Runs Creek. The sampler (Manning Corporation, Scotts Valley, California Model S-4400) is EPA approved for collecting water samples for suspended solids. A water sample was collected every hour and the hourly samples were composited for a daily sample. Tims Branch #5 (shown in Figure 1) was chosen for the downstream sampling location, because it is a HP monitoring station where historical data on suspended sediment concentration could be used for comparison and was only 200 yards from Upper Three Runs Creek. Also, Tims Branch #5 is a USGS gauging station for measuring

stream flow. A recording rain gauge was also installed in the dry area of Steed Pond to determine the actual rainfall on the pond. Suspended solids concentrations were measured by the SRP 400 Area Certified Water Quality Laboratory. Turbidities were measured on a Hach Model 2000 turbidimeter.

RESULTS AND DISCUSSION

One hundred thirty-four samples were collected between September 10, 1984 and May 30, 1985 for suspended solids and turbidity analyses (Table 1 and Figure 2 & 3). Turbidity measurements were made on samples prior to submission for suspended solids analyses to provide backup information if samples were lost during the suspended solids analyses.

Suspended solids concentrations that were measured from September 10, 1984 to May 31, 1985 were similar to those measured in past years (Table 2). Based on suspended solids concentration data from previous years, the average suspended solids concentration did not increase during the September 10, 1984 to May 30, 1985 measurement period. These data indicate that Steed Pond erosion contributed very little to the suspended solids concentration at Tims Branch #5.

Higher concentrations of suspended solids were measured at Tims Branch #5 during spillway repair work and after rain (Table 1 and Figure 2). The highest concentration (73 mg/L) coincided with work that was being done to stabilize the Steed Pond spillway. During work on the spillway structure, sediment in the immediate vicinity was stirred up and was transported down stream to Tims Branch #5. The total amount of sediment transported to Upper Three Runs as a result of work on the spillway structure is equivalent to 2 cubic yards of sediment.

An increase in suspended solids after a rain is common to nearly all streams. In general, on the Tims Branch watershed, rainfall has to be greater than one half inch in 24 hours for the flow, suspended solids concentrations and turbidities to change at Tims Branch #5 (Table 1 and Figures 2 3 4 & 5). Rainfall less than one half inch in 24 hours does not produce enough runoff to effect changes in these variables. The major cause of the increase in suspended solids is the delivery of eroded soils to streams due to rainfall erosion. Probably, some of the suspended solids increase in Tims Branch after a rain is due to the erosion of soil in the

1. For purposes of comparison to historical data the sampling period September 10, 1984, to May 31, 1985, will be referred to as 1985 data.

3/700 area. In the 3/700 area considerable construction work is going on and the bare areas are susceptible to more erosion than grass and forested areas. Therefore, much of the increase in suspended solids during rain probably came from sources above Steed Pond in the 3/700 Areas. An additional source of suspended solids in a stream after a rain comes from the erosion of sediment that has accumulated in a stream channel during lower flows and with the increase in flow this loose sediment is resuspended and transported downstream.

The amount of sediment actually transported to Upper Three Runs Creek from Steed Pond erosion is less than initially calculated. The field measurements show that about 47 tons of sediment was actually transported to Upper Three Runs Creek the first year (Sept. 10, 1984 to May 31, 1985). This amount of transported sediment is about the same (50 tons) that was transported annually to Upper Three Run Creek in past years from Tims Branch (Table 2 and Figure 6). It was estimated earlier that about 36 tons of sediment could be eroded from the Steed Pond sediments (DPST-84-847) and this would add to normal sediment transport in Tims Branch. Therefore, the amount of sediment eroded from the Steed Pond system is not detectable using the historical data on sediment transport in Tims Branch. The condition of the sediments in Steed Pond have been observed regularly for erosion since the spillway gave way and the pond drained. Over this period no evidence other than for small scale erosion (very localized) was observed.

There are several reasons to support the fact that the Steed Pond sediments did not erode. The planting of ground cover, high porosity of the sediments and the low slope reduced the erosion. Ground cover (rye) was planted in October and November of 1984 by M Area operations to reduce erosion. The grass had established itself in the more moist lower regions of the pond bed by December, 1984. This grass stabilized the sediments and slowed the movement of water from the higher areas causing sediment deposition in the lower areas, thereby reducing the sediment yield to Tims Branch. The areas where rye could not grow were dry and very porous. Steed Pond was built in the 1930's and over the years a very thick mat of dead vegetation had accumulated on the bottom. When the thick mat dried out, a spongy and porous mat was left. The porous mat had a good capacity for absorbing the water that fell on it with little or no immediate runoff. The delayed runoff or downward movement of the water greatly reduced erosion/delivery of the sediments to Tims Branch. The change in elevation from one side of Steed to the middle is about 4 feet over a distance of 200 feet. This low slope assures that soil if eroded will not move far from the its original location.

Most of the erosion in Steed Pond probably occurred in the formation of the stream channel during the first few days after the pond was drained. The depth of the stream is now about 6 to 12 inches in the Steed Pond bed and the stream depth is controlled by the height of the remaining spillway structure. The top of the spillway structure is now about 4 feet above the actual stream bed immediately below Steed Pond dam. If the spillway structure was completely removed, the stream channel would cut through the sediments that have accumulated in the pond since 1930 (about 4 feet in the vicinity of the dam). The sediments that would be eroded if the remaining spillway structure was removed probably predate the 300 Area discharges and little uranium would be added to Tims Branch. The stream channel that has cut through the Steed Pond sediments has a stable bottom of sand and the rapid growth of aquatic vegetation in the channel will assure its stability.

CONCLUSIONS

Steed Pond sediments have eroded less than initial calculations predicted. With the reestablishment of vegetation in the bed of Steed Pond, the little erosion that has already occurred will be reduced even further. These results indicate that Steed Pond could be left in its present condition (dry) without affecting suspended solids concentrations and associated uranium concentrations in Upper Three Runs Creek.

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TABLE 1

ENVIRONMENTAL VARIABLES IN TIMS BRANCH

BEGIN DATE	END DATE	TURBIDITY	SUSPEN SOLIDS MG/L	RAIN IN.	FLOW CFS
10SEP84	11SEP84	4.7	15	0.00	8.3
11SEP84	12SEP84	4.5	4	0.00	7.0
12SEP84	13SEP84	3.7	2	0.00	5.6
13SEP84	14SEP84	3.0	6	0.00	4.8
14SEP84	15SEP84	3.5	7	0.00	4.1
15SEP84	16SEP84	4.7	5	0.00	3.7
16SEP84	17SEP84	3.5	10	0.00	3.4
17SEP84	18SEP84	3.0	11	0.00	3.4
18SEP84	19SEP84	3.0	14	0.00	3.6
19SEP84	20SEP84	3.4	7	0.00	3.6
20SEP84	21SEP84	3.9	10	0.00	3.9
21SEP84	22SEP84	2.9	6	0.00	3.7
22SEP84	23SEP84	2.9	9	0.00	3.5
23SEP84	24SEP84	3.5	7	0.00	3.5
24SEP84	25SEP84	3.3	6	0.00	3.9
25SEP84	26SEP84	4.0	4	0.00	4.1
26SEP84	27SEP84	3.8	6	0.00	3.9
27SEP84	28SEP84	3.7	4	0.00	4.1
28SEP84	29SEP84	4.4	11	0.00	4.8
29SEP84	30SEP84	3.8	9	0.00	5.2
30SEP84	01OCT84	5.7	10	0.00	8.9
01OCT84	02OCT84	3.5	2	0.00	6.5
02OCT84	03OCT84	3.1	1	0.00	5.3
03OCT84	04OCT84	2.7	1	0.00	4.5
04OCT84	05OCT84	2.5	2	0.00	4.4
05OCT84	06OCT84	2.1	3	0.00	5.0
06OCT84	07OCT84	5.0	4	0.00	5.7
08OCT84	09OCT84	4.5	4	0.00	5.8
09OCT84	10OCT84	3.3	4	0.00	4.1
10OCT84	11OCT84	2.2	2	0.00	3.8
11OCT84	12OCT84	2.6	-2	0.00	3.6
12OCT84	13OCT84	2.9	2	0.00	4.9
13OCT84	14OCT84	3.7	3	0.00	5.2
14OCT84	15OCT84	2.5	2	0.00	4.0
15OCT84	16OCT84	2.9	5	0.00	3.9
16OCT84	17OCT84	2.6	-2	0.00	3.9
17OCT84	18OCT84	2.9	4	0.00	3.6
18OCT84	19OCT84	3.2	3	0.00	3.4
19OCT84	20OCT84	2.3	2	0.00	3.4
20OCT84	21OCT84	4.3	7	0.00	3.4
22OCT84	23OCT84	3.5	22	0.00	3.5
23OCT84	24OCT84	5.0	14	0.00	4.4
30OCT84	31OCT84	.	.	0.25	4.0

ENVIRONMENTAL VARIABLES IN TIMS BRANCH, Page 2

BEGIN DATE	END DATE	TURBIDITY	SUSPEN SOLIDS MG/L	RAIN IN.	FLOW CFS
04NOV84	05NOV84	.	.	0.12	4.2
05NOV84	06NOV84	.	.	0.04	4.8
09NOV84	10NOV84	4.0	2	0.00	4.2
10NOV84	11NOV84	4.3	3	0.00	4.4
11NOV84	12NOV84	4.9	5	0.00	4.0
12NOV84	13NOV84	3.5	4	0.20	3.9
16NOV84	17NOV84	3.6	3	0.00	4.4
17NOV84	18NOV84	3.4	2	0.00	4.6
19NOV84	20NOV84	4.0	1	0.00	4.5
26NOV84	27NOV84	4.5	2	0.00	3.9
27NOV84	28NOV84	6.3	1	0.00	3.9
28NOV84	29NOV84	9.0	4.0	0.48	4.3
02DEC84	03DEC84	.	.	0.40	.
04DEC84	05DEC84	9.4	17.0	0.78	6.7
05DEC84	06DEC84	7.3	12.0	0.00	6.4
17DEC84	18DEC84	.	.	0.24	4.2
18DEC84	19DEC84	9.0	11.0	0.00	4.7
19DEC84	20DEC84	12.0	19.0	0.00	6.4
20DEC84	21DEC84	10.4	73.0	0.00	6.3
21DEC84	22DEC84	7.4	14.0	0.00	4.9
22DEC84	23DEC84	7.0	9.0	0.00	4.2
23DEC84	24DEC84	7.2	11.0	0.00	3.8
24DEC84	25DEC84	6.6	7.0	0.00	3.8
25DEC84	26DEC84	8.0	9.0	0.00	3.6
26DEC84	27DEC84	11.5	17.0	0.00	5.4
27DEC84	28DEC84	9.4	9.0	0.08	4.8
28DEC84	29DEC84	8.3	10.0	0.00	4.1
29DEC84	30DEC84	7.5	10.0	0.00	3.8
30DEC84	31DEC84	7.0	6.0	0.20	3.8
31DEC84	01JAN85	8.5	8.0	0.08	4.0
01JAN85	02JAN85	7.4	13.0	0.92	4.0
02JAN85	03JAN85	31.0	39.0	1.12	15.0
03JAN85	04JAN85	20.0	17.0	0.12	13.0
04JAN85	05JAN85	14.0	13.0	0.00	9.0
05JAN85	06JAN85	7.9	10.0	0.00	6.1
06JAN85	07JAN85	6.8	13.0	0.00	5.6
07JAN85	08JAN85	9.8	16.0	0.00	7.1
08JAN85	09JAN85	6.1	6.0	0.00	5.9
09JAN85	10JAN85	7.7	5.0	0.00	5.4
10JAN85	11JAN85	6.1	3.0	0.00	5.0
11JAN85	12JAN85	7.4	5.0	0.00	5.0
12JAN85	13JAN85	7.0	6.0	0.00	4.7
13JAN85	14JAN85	5.6	10.0	0.00	4.0
14JAN85	15JAN85	5.9	8.0	0.00	3.9
15JAN85	16JAN85	6.3	6.0	0.00	4.5
16JAN85	17JAN85	8.5	10.0	0.24	5.7

ENVIRONMENTAL VARIABLES IN TIMS BRANCH, Page 3

BEGIN DATE	END DATE	TURBIDITY	SUSPEN SOLIDS MG/L	RAIN IN.	FLOW CFS
17JAN85	18JAN85	7.5	12.0	0.00	4.9
18JAN85	20JAN85	6.0	8.0	0.00	3.9
28JAN85	01FEB85	7.6	8.0	0.28	5.4
01FEB85	01FEB85	7.6	6.7	1.08	5.4
01FEB85	02FEB85	30.0	38.0	0.56	16.0
02FEB85	03FEB85	20.0	24.0	0.00	8.8
03FEB85	04FEB85	8.8	13.0	0.00	6.7
04FEB85	05FEB85	14.0	27.0	3.04	18.0
05FEB85	06FEB85	71.0	44.0	0.25	34.0
06FEB85	07FEB85	22.0	21.0	0.00	15.0
08FEB85	11FEB85	5.2	8.0	0.00	7.8
11FEB85	15FEB85	7.5	3.0	0.35	7.3
15FEB85	19FEB85	3.6	2.0	0.00	6.1
19FEB85	22FEB85	4.4	2.0	0.45	6.1
22FEB85	25FEB85	5.0	11.0	0.00	5.4
25FEB85	01MAR85	6.6	11.0	0.30	5.6
01MAR85	04MAR85	6.0	10.0	0.00	5.2
04MAR85	07MAR85	4.3	2.0	0.00	4.8
07MAR85	11MAR85	4.3	2.0	0.00	4.5
11MAR85	14MAR85	4.8	2	0.00	4.4
14MAR85	16MAR85	3.3	3	0.10	.
16MAR85	17MAR85	7.9	6	0.25	.
17MAR85	18MAR85	5.1	9	0.00	.
18MAR85	21MAR85	2.7	4	0.00	4.2
21MAR85	22MAR85	7.3	10	0.55	6.1
22MAR85	25MAR85	4.2	6	0.00	5.0
25MAR85	28MAR85	3.5	4	0.00	4.1
28MAR85	01APR85	4.0	3	0.00	3.8
01APR85	04APR85	6.1	6	0.00	4.2
04APR85	05APR85	3.2	4	0.00	.
05APR85	06APR85	8.0	12	0.50	.
06APR85	07APR85	5.5	12	0.00	4.7
07APR85	08APR85	8.0	5	0.00	4.1
08APR85	12APR85	5.5	7	0.00	4.7
12APR85	15APR85	5.9	8	0.00	5.2
15APR85	18APR85	5.4	4	0.20	4.0
18APR85	22APR85	4.1	5	0.00	3.6
22APR85	25APR85	3.9	6	0.00	3.4
25APR85	29APR85	4.7	6	0.15	3.3
29APR85	02MAY85	4.5	5	0.32	2.8
02MAY85	06MAY85	6.0	9	.	3.5
06MAY85	10MAY85	8.2	11	0.00	4.2
10MAY85	13MAY85	6.7	10	0.00	3.4
13MAY85	16MAY85	7.8	12	0.00	3.0
16MAY85	20MAY85	5.0	10	0.00	2.7
20MAY85	22MAY85	5.0	10	0.00	2.6

ENVIRONMENTAL VARIABLES IN TIMS BRANCH, Page 4

BEGIN DATE	END DATE	TURBIDITY	SUSPEN SOLIDS MG/L	RAIN IN.	FLOW CFS
22MAY85	22MAY85	7.8	15	0.00	.
22MAY85	23MAY85	9.0	16	0.00	3.7
23MAY85	27MAY85	6.5	10	0.45	2.7
27MAY85	29MAY85	4.7	10	0.00	2.7
29MAY85	30MAY85	19.0	15	0.00	4.2
30MAY85	30MAY85	8.0	11	0.00	.
30MAY85	31MAY85	6.8	35	0.00	4.2

SUSPENDED SOLIDS CONCENTRATIONS AND SEDIMENT TRANSPORT IN TIMS BRANCH #5

YEAR	NUMBER SAMPLES	MAXIMUM MG/L	MINVAL MG/L	AVGVAL MG/L	STDDEV MG/L	FLOW L/YR	TRANSPORT TONS/YR
1985	134	73	1	9.1	9.2	46.7 E 08	46.8
1984	12	10	2	5.8	3.1	52.0 E 08	33.2
1981	10	49	2	12.0	28.0	38.2 E 08	50.4
1980	12	15	2	6.4	8.1	64.1 E 08	45.1
1979	12	14	1	5.8	8.2	52.1 E 08	33.2
1978	12	68	2	11.1	36.3	53.2 E 08	65.0
1977	12	15	1	6.9	10.6	47.8 E 08	36.3
1976	12	13	2	4.8	6.1	40.2 E 08	21.2
1975	.	54	3	16.0	.	.	.
1974	.	29	1	10.0	.	.	.
1973	.	17	1	8.0	.	.	.

SUSPENDED SOLIDS VERSUS TIME AT TIMS BRANCH #5

FIGURE 2

TURBIDITY VERSUS TIME AT TIMS BRANCH #5

FIGURE 3

RAIN VERSUS TIME AT TIMS BRANCH #5

FIGURE 4

FLOW VERSUS TIME AT TIMS BRANCH #5

FIGURE 5

SEDIMENT IN TRANSPORT AT TIMS BRANCH #5

FIGURE 6

TONS PER YEAR

TRANSPORT OF SUSPENDED SOLIDS VERSUS TIME AT TIMS BRANCH #5

FIGURE 7