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MEMORANDUM

DATE: September 10, 2002

TO: Doug Sedgwick

FROM: Peter Healey

RE: Grum Dump Seepage

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1. Background

Flow and water chemistry has been recorded adjacent to the Grum waste rock Dumps since 1988. The primary sampling location has historically been V2, which is located on the main stem of Grum Creek just upstream from its confluence with Vangorda Creek as shown in Figure 1. Sampling results from V2 are presented in Appendix A

According to the Vangorda Plateau Water License (IN89-002), additional sampling stations along the toe of the Grum Dump include the following:

V14 – Southwest Sump Grum main waste dump
V15 – Sulphide cell sump Grum main waste dump
V16 – South east sump Grum main waste dump

The location of the above are shown on Figure 1. V14 and V16 are described in the Water Licence as monitoring stations along the Grum Dump Seepage Collector Ditch which has not yet been constructed. Locations V14 and V16 are used currently to represent freshet or occasional monitoring of surface seeps in the general areas indicated in the Water Licence. V15 is located on the southern tributary (A) of Grum Creek just below an existing sediment pond as shown on Figure 1 and as shown in Photo 1 in Appendix B. Water samples have been collected from this station since 1995. The sedimentation pond was constructed in 1995 to enable sampling of V15. Sampling from V15 was intended to monitor the seepage from the Sulphide cell located within the Grum Dump. Water quality records for this site are also provided in Appendix A

In 1995, the mine made provision for the diversion of drainage from the main stem of Grum Creek (Photo 2) to a temporary sedimentation holding area located just above Vangorda Creek called Moose Pond. The location of this pond is shown on Figure 1. The base of Moose Pond is highly permeable and any water that accumulates in the pond rapidly infiltrates into the ground. The mine also installed a siphon pipeline from the pond to the V2 sampling station, which was was intended to drain any water that may accumulated in the pond. The syphon pipe has never been used because there has never been an accumulation of water in the pond. Sampling from this drainage was established at V2A, which is located at the end of a plastic pipeline, which discharges into Moose Pond as shown in Figure 1.

During a recent site visit by SRK on July 11 and 12, 2002, two erosion gullies were identified on the slopes of the lowest bench of the Grum Dumps. It is our understanding that these gullies had formed several years ago and had contributed to the sediment that is visible in the bush below the dump (Memorandum GLL, June 25, 2002). We also understand that the soil that has been eroded from the dump face over the years may have contributed to the periodic elevated metal seen at V2 and V2A. Furthermore, additional soil loss was experienced during the spring runoff this year.

2. Water Quality

In the 14 years that water quality has been monitored at V2, dissolved Zn concentrations have generally been less than 0.5mg/L. However, extremely high TSS concentrations were recorded pre-1995 and were related to inadequate water diversion structures (namely the Grum Interceptor Ditch). Construction of the Sheep Pad Ponds and diversion of the Grum Interceptor Ditch into these ponds in 1995 provided mitigation of the extreme TSS concentrations and provided ongoing control of sediment entering Vangorda Creek. TSS levels at V2 over the last two years have been less than 15mg/L with the exception of one recording of 42mg/L recorded in December 2001.

At V15, which is located above V2, total Zn levels recorded from 1995 to 2002 were generally less than 0.5mg/L. TSS levels over the last three years have ranged from 2 to 60mg/L. One exception was a reading of just over 600mg/L recorded on March 5, 2001. The sediment pond just above V15 is currently at capacity and Deloitte & Touche plan to construct a new pond this year.

At V2A, dissolved Zn levels recorded from 1997 to 2001, were generally less than 0.5mg/L with TSS levels less than 10mg/L. During the spring runoff in 2002, Zn concentrations of up to 8mg/L were recorded at V2A. TSS levels have been less than 15mg/L. The increased metal

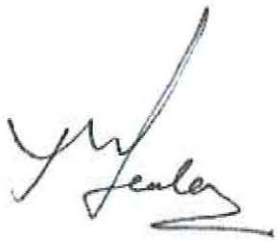
levels were traced back to a seep located at the toe of the Grum Dump (Seep#1) just north of the erosion gully #1 as shown on Figure 1. Flow has also increased in this seep and it is believed that the sulphide waste, which comprises several dump lifts located in the approximate centre of the dump, may be a source of the increased metal loading.

3. Action taken to date

This year, Deloitte and Touche have taken positive action to manage the situation. This involved the construction of diversion ditches along the main haul road adjacent to the Grum Dump and on the dump itself. The ditches are intended to divert runoff away from the dump and reduce further erosion of the dump slopes. The second step involved upgrading the diversion of the main stem of Grum Creek into Moose Pond. At the time of our inspection, a flow of about 1 to 2 L/s was estimated to be discharging in the pond. No water was accumulating in the bottom of the pond.

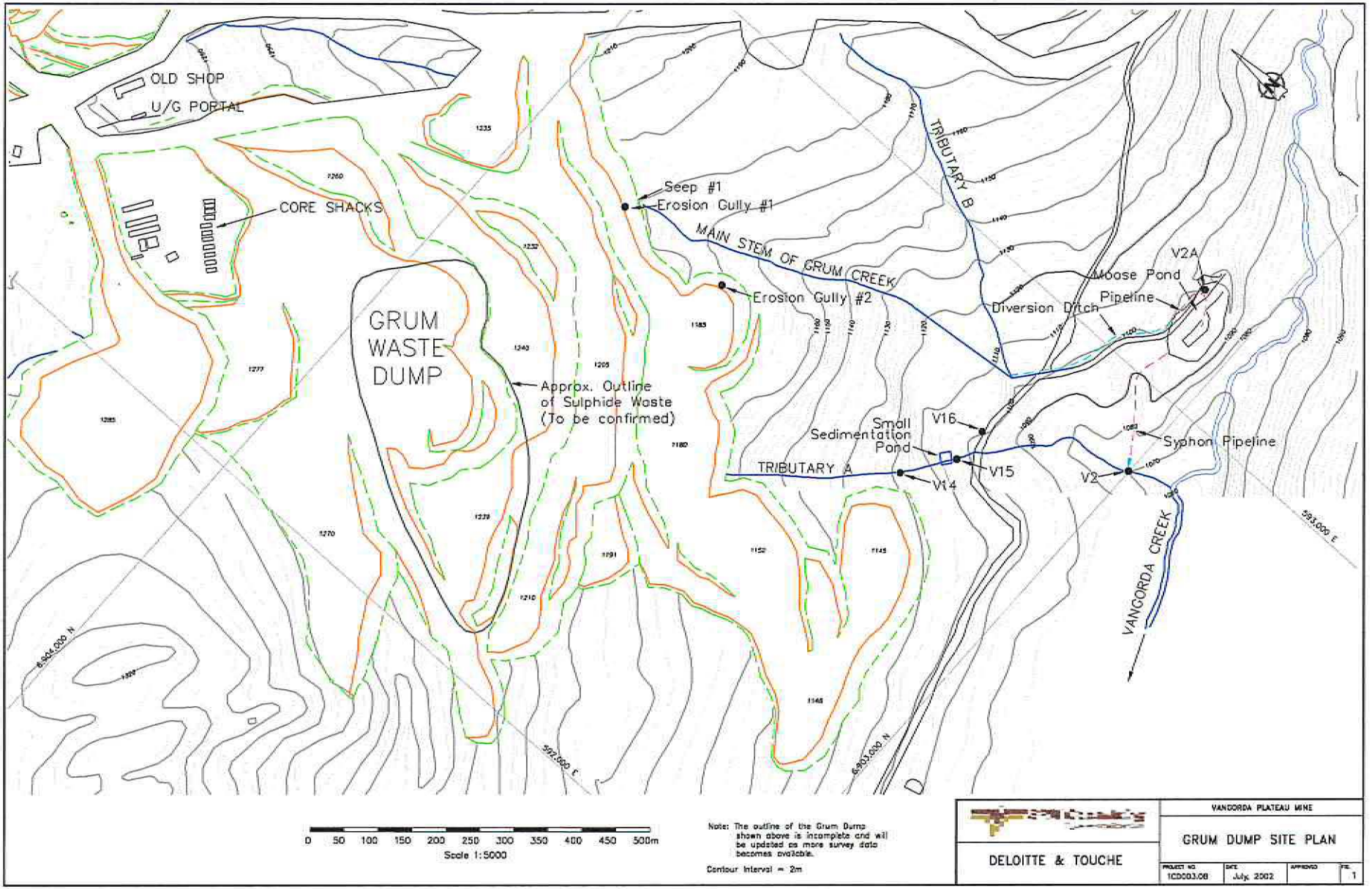
4. Conclusion

It is SRK's opinion that, the current practice of diverting the main stem of Grum Creek drainage to Moose pond is acceptable as a short term measure. We agree with GLL's suggestion that monitoring of flow and water chemistry at V2A and the seeps along the toe of the dump be continued over the next 12 months so that a better understanding of the nature and source of the contamination can be determined and used in the development of long term closure measures for the Grum Dump. It is also recommended that the physical stability of the downstream slope below the Moose Pond be investigated.



Peter Healey P.Eng
Principal Engineer

FIGURES


OLD SHOP
U/G PORTAL
CORE SHACKS
GRUM WASTE DUMP
Approx. Outline of Sulphide Waste (To be confirmed)
Seep #1
Erosion Gully #1
MAIN STEM OF GRUM CREEK
Erosion Gully #2
TRIBUTARY B
V2A
Moose Pond
Pipeline
Diversion Ditch
Small Sedimentation Pond
V16
V15
V14
TRIBUTARY A
Siphon Pipeline
V2
VANGORDA CREEK
592,000 E
593,000 E
6,904,000 N
6,903,000 N
0 50 100 150 200 250 300 350 400 450 500m
Scale 1:5000
Note: The outline of the Grum Dump shown above is incomplete and will be updated as more survey data becomes available.
Contour Interval = 2m
DELOITTE & TOUCHE
VANGORDA PLATEAU MINE
GRUM DUMP SITE PLAN
PROJECT NO. 1CD003.08
DATE July 2002
APPROVED
FIG. 1

APPENDIX A
Water Quality V2, V2A and V15

STATION: V2, Grum Creek, upstr. of Vangorda Ck									
	FLOW	TSS	ZN-T	ZN-D	PB-T	PB-D	FE-T	FE-D	SO4-T
Date	L/s	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
2/18/1988		<5	0.004		<0.02		0.049		24
5/29/1989		<5	0.015		<0.05		0.172		26
10/1/1990		<10	0.024		<0.05		0.091		50
4/16/1991		10	0.007		0.004				41
5/7/1991		640	0.142		0.08		32.6		46
6/11/1991		5	0.001		0.007		0.167		41
9/3/1991		5	0.009		0.004		0.064		
9/25/1991		<5	0.025		<0.06		0.099		103
9/25/1991		5	0.085		0.007		0.055		
10/8/1991		5	0.023		0.004		0.077		
11/14/1991		5	0.012		0.004		0.283		
12/18/1991		5	4.43		0.004		0.063		115
2/19/1992		5	0.025		0.012				
3/18/1992		5	0.008		0.004				
4/28/1992		460	0.257		0.37		32.8		142
4/28/1992		432	0.208	0.009	0.201				
5/21/1992		572	0.192		0.186				
6/10/1992		5	0.004		0.007				
7/15/1992		32	0.034		0.025				
8/12/1992		8	0.03		0.001				
9/9/1992		<10	0.018		<0.06		0.365		81
10/14/1992		21	0.023		0.011				
11/24/1992		1130	0.17		0.36		32.5		166
11/24/1992		1070	0.107		0.31				
4/26/1993		5330	0.91		2.92		207		54
8/2/1993		<10	0.036		<0.06		0.222		99
5/2/1994		24	0.014		<0.01		0.428		112
6/8/1994		16	0.005		<0.03				
7/19/1994		<4	0.02		<0.03				
8/9/1994		<5	<0.005		<0.01		0.041		58
10/11/1994		48	0.041		0.04		1.62		241
10/15/1994		7	0.04		<0.03				
1/31/1995	25	26	0.08		<0.03				328
2/22/1995		2810	0.46		0.64				
2/24/1995	25.2	2810	0.46		0.64		118		326
4/25/1995	50	558	0.1		0.3		21.9		128
5/9/1995		372	0.098		0.2		15.4		117
5/9/1995		395	0.09	0.053	0.21	0.15	15.65	5.21	112
6/7/1995		23	<0.002		<0.020		0.75		76
7/20/1995	88	7	<0.01		<0.020		0.19		87
8/23/1995	6	<1	0.01		<0.020		0.05		94
9/18/1995	7	<1	<0.01		<0.020		0.35		91
10/4/1995		6	0.005		<0.005		0.154		84
10/16/1995	14	18	0.01		<0.020		1.07		116
11/14/1995	10	27	<0.01		0.03		0.31		199
12/11/1995		7	<0.01		<0.020		0.33		78
12/12/1995		6	0.004		<0.005		0.233		74
1/25/1996	8	<5	0.03		<.02		1.06		45
2/14/1996		<5	0.02		<.02		0.24		55
3/13/1996		<5	<.01		<.02		0.13		52

STATION: V2, Grum Creek, upstr. of Vangorda Ck									
	FLOW	TSS	ZN-T	ZN-D	PB-T	PB-D	FE-T	FE-D	SO4-T
Date	L/s	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
5/29/1996		125	0.03		<.02				93
11/27/1996		<5	0.05		<.02		0.31		53
12/19/1996		<5	0.06		<.02		0.15		115
1/14/1997		<5	0.01		<.02		0.04		74
2/26/1997	<1	8	0.01		<.02		0.08		82
3/10/1997	<1	<5	<.01		<.02		0.02		57
4/14/1997	<1	7	<.01		<.02		0.77		119
5/8/1997	14								
5/12/1997	7	369	0.06		0.09		5.88		235
5/21/1997	7	42	0.02		<.02		0.86		233
5/26/1997		27							
6/30/1997	1.5	<5	0.11		<.02		1.72		238
7/22/1997	2	<5	0.08		<.02		0.91		242
8/6/1997	5								
8/11/1997	2	<5	0.07		0.02		0.54		252
9/30/1997	2	<5	0.03		<.02		0.86		110
10/20/1997	1.5	10	0.02		<.02		0.91		82
11/19/1997	1.5	17	0.05		<.02		0.54		89
12/29/1997		51	<.01		<.02		1.09		87
1/12/1998	1.5	9	0.02		<.02		0.21		82
3/17/1998	1.5	9	<.01		<.02		0.18		28
5/18/1998	4	1	0.1		<.02		0.19		234
6/29/1998	2	1	0.01		<.02		0.1		115
9/14/1998	2	2	0.03		<.02		0.23		125
12/31/1998		12	0.04		<.01		0.38		154
3/17/1999		11	0.07	<.01	<.01	<.01	0.5	<.01	202
6/18/1999	1	8	0.11	<.01	0.02	<.01	1.61	0.04	180
9/10/1999	1	5	0.24	0.07	<.01	<.01	0.03	<.01	169
10/12/1999	1.5	4	<.01	<.01	0.03	<.01	0.18	0.02	191
12/13/1999	0.5	6	0.05	<.01	0.02	<.01	0.06	<.01	146
3/22/2000	0.5	10	<.01	<.01	<.01	<.01	0.25	<.01	183
6/20/2000		1	0.25	<.01	<.01	0.01	0.29	0.21	571
9/12/2000		7	1.02	0.08	<.01	<.01	0.86	0.02	638
11/12/2000		7	0.54	0.26	0.02	0.02	0.16	0.01	543
3/5/2001		3	0.09	0.01	<.01	<.01	<.01	<.01	380
6/13/2001		5	3.35	0.47	<.01	<.01	0.09	<.01	849
12/22/2001		42	0.07	0.3	<.01	<.01	1.11	<0.01	472
1/15/2002		11	0.02	0.02	<0.01	<0.01	0.19	<0.01	564
2/12/2002		10	<0.01	<0.01	<0.01	<0.01	0.15	<0.01	527
3/21/2002		10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	609
4/15/2002		6	0.1	0.12	<0.01	<0.01	<0.01	<0.01	349
5/13/2002		11	0.22	0.17	0.01	<0.01	0.28	<0.01	482
6/25/2002		6	0.38	0.18	1006	1004	0.143	<.002	615

STATION: V2A, Grum Creek Diversion to Moose Pond									
	FLOW	TSS	ZN-T	ZN-D	PB-T	PB-D	FE-T	FE-D	SO4-T
Date	L/s	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
5/12/1997	4	10	<.01		<.02		0.41		77
6/30/1997	1	<5	0.11		<.02		<.01		326
7/22/1997	1.5	<5	0.09		<.02		0.28		76
8/6/1997	2.5								
8/11/1997	1.5	<5	0.1		<.02		0.11		88
9/30/1997	1	<5	0.03		<.02		0.15		195
6/29/1998	1	<1	0.01		<.02		<.01		124
9/14/1998	1	4	0.02		<.02		0.17		116
7/3/1999	2	7	0.05	<.01	<.01	<.01	0.81	0.48	379
9/10/1999	0.5		0.08	0.05	0.02	<.01	0.05	<.01	370
10/12/1999	0.5		0.02	<.01	<.01	<.01	0.15	0.03	269
12/13/1999	0								
6/13/2001		5	3.37	0.51	<.01	<.01	0.07	<.01	836
9/8/2001		58	1.41	0.41	0.03	<.01	2.15	<.01	643
11/12/2001		7	0.54	0.26	0.02	0.02	0.16	0.01	543
12/22/2001		7	0.32	0.13	<0.01	<0.01	0.1	<0.01	419
3/21/2002		5	0.12	0.13	0.03	<0.01	0.1	<0.01	488
6/25/2002		8	1.096	1.042	0.011	0.01	0.94	<.002	663
7/18/2002		9	0.852	0.905					696
JAN 1980 - AUG 2002									
Mean	1.4	5	0.35	0.14	0.02	0.01	0.2	0.13	260
Minimum Va	0	1	0.01	0.01	0.01	0.01	0.01	0.01	76
Maximum V	4	10	3.37	0.51	0.02	0.01	0.81	0.48	836
Num. Value	12	9	11	4	11	4	11	4	11

STATION: V15, Sulphide cell sump, Grum Dump									
	FLOW	TSS	ZN-T	ZN-D	PB-T	PB-D	FE-T	FE-D	SO4-T
Date	L/s	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
10/16/1995	1		<0.01	<.01	<0.020	<.02	0.06	0.23	44
11/14/1995			<0.01	<.01	<0.020	<.02	0.23	0.23	49
4/14/1997	<0.5	584	0.08		0.07		12.3		75
5/26/1997	0.4	8	<.01		<.02		0.52		30
6/30/1997	0.5	51	0.11	0.02	<.02	<.02	1.43	<.01	29
7/22/1997	0.33	41	0.08		0.03		2.38		94
8/11/1997	0.5	9	0.06		<.02		0.03		101
9/30/1997	0.3	<5	0.02		<.02		0.1		100
10/20/1997	0.3	6	0.02		<.02		0.19		85
11/19/1997	0.25	9	0.02		<.02		1.16		102
12/29/1997		203	0.04		<.02		4.24		123
1/12/1998	0.5	61	0.01		<.02		0.74		112
3/17/1998	0.5	271	0.09		0.16		7.9		39
5/18/1998	0.5	366	0.13		0.19		11.69		90
6/29/1998	0.5	<1	0.01		<.02		<.01		35
9/14/1998	0.5	5	0.03		0.03		0.08		189
12/31/1998	0.1	1213	0.05	<.01	<.01	<.01	5.06	0.07	192
3/17/1999		6	0.03	<.01	<.01	<.01	0.06	<.01	200
7/3/1999	1	8	0.02	<.01	0.02	<.01	0.91	0.49	215
9/10/1999	1	5	0.04	<.01	<.01	<.01	0.05	<.01	240
10/12/1999	0.5	3	<.01	<.01	<.01	<.01	0.13	0.05	320
12/13/1999	0.5	5	0.04	<.01	<.01	<.01	0.14	<.01	330
3/22/2000	0.25	63	0.03	<.01	<.01	<.01	4.26	<.01	340
6/20/2000		2	0.01	<.01	<.01	<.01	0.25	0.17	305
9/12/2000		5	0.03	<.01	<.01	<.01	0.13	<.01	560
11/12/2000		7	<0.01	<0.01	0.01	0.02	0.06	<0.01	1040
3/5/2001		607	2.94	1.05	0.09	<.01	44	<.01	124
6/13/2001		13	0.06	0.01	<.01	<.01	0.06	<.01	905
9/8/2001		31	0.1	0.04	<0.01	<0.01	0.84	<0.01	1044
11/12/2001		7	<0.01	<0.01	0.01	0.02	0.06	<0.01	1040
1/15/2002		13	0.01	0.03	<0.01	<0.01	0.09	<0.01	1052
2/12/2002		15	<0.01	0.01	<0.01	<0.01	0.1	<0.01	916
3/21/2002		17	0.01	0.02	<0.01	<0.01	0.16	<0.01	1067
4/15/2002		11	<0.01	<0.01	<0.01	<0.01	0.03	<0.01	921
5/13/2002		8	0.37	0.37	<0.01	<0.01	0.08	<0.01	717
JAN 1980 - AUG 2002									
Mean	0.5	111	0.13	0.08	0.028	0.01	2.84	0.06	366
Minimum Va	0.1	1	0.01	0.01	0.01	0.01	0.01	0.01	29
Maximum V	1	1213	2.94	1.05	0.19	0.02	44	0.49	1067
Num. Value	20	33	35	22	35	22	35	22	35

APPENDIX B
Photos

Photo 1: Sedimentation Pond upstream of V15

Photo 2: Diversion ditch from the main stem of Grum Creek to Moose Pond