THE OPERATIONAL DESIGN ENVELOPE FOR THE STAs

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Executive Summary

The *Everglades Protection Area Tributary Basins Long Term Plan for Achieving Water Quality Goals* recommends structural, vegetative and operational enhancements for each STA, and provides a predicted range of long-term average outflow phosphorus concentrations once the enhancements are completed. Refinement of the operational strategies for the STAs is required to optimize the phosphorus removal performance of the STAs and to ensure that the STAs are not subject to overload from inflow volume or nutrients. In addition, assessment of annual or long-term performance is aided by a comparison of actual loading to the loading that was anticipated during the design of the treatment areas, and the subsequent design of the STA enhancements. This paper develops the "operational design envelope" for inflow volume and phosphorus loads that were anticipated for each STA, and recommends a method for utilizing the resulting information to assist in tactical operational decisions.

Background

Part 2 of the *Everglades Protection Area Tributary Basins Long Term Plan for Achieving Water Quality Goals* (Long-Term Plan) describes specific structural, vegetation and operational enhancements for each STA needed to optimize phosphorus reduction performance (Burns and McDonnell 2003). Part 4 of the Long-Term Plan presents the predicted range of long-term average phosphorus concentrations for each STA based on simulation results using the DMSTA model (Walker and Kadlec 2003). As input, the DMSTA simulations utilized baseline data sets developed for each of the tributary basins. These data sets quantified site-specific assumptions regarding runoff quantity, water quality, Lake Okeechobee releases and other factors (Goforth and Piccone 2001). In order to improve the accuracy of these data sets, they will be updated at two-year intervals beginning in FY05; the initial update is underway.

The original conceptual design of the STAs was based on a first-order phosphorus removal model that used 10-year average annual values of inflow volumes, phosphorus concentrations, rainfall, ET, and an estimate of the removal characteristics of the treatment area (Walker 1995). The 10-year average annual flows and loads used for each STA in the 1994 Conceptual Design (Table 1) tend to mask the temporal characteristics of the inflows. For example, it is impossible to portray the seasonal characteristic of the inflows based on the 10-year average annual flow. Hence, there was little reference against which actual seasonal and annual flows/loads, and resulting STA performance, could be assessed. Similarly, there was limited ability to provide operational guidance for

30-day targets or discretionary water management measures, particularly the timing and magnitude of Lake Okeechobee releases.

Table 1. Initial Design Assumptions for the STAs (excludes BMP replacement water)

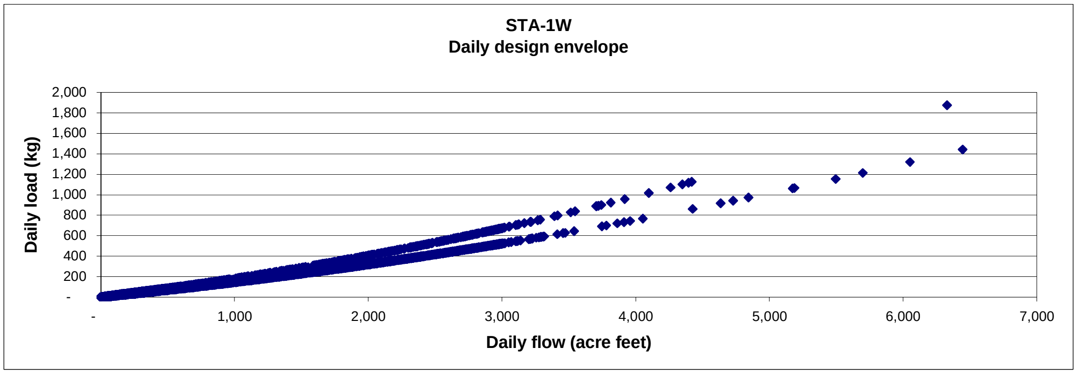
STA	**10-yr Average Annual Flow (acre feet/yr)**	**10-yr Average Annual Phosphorus Load (kg/yr)**
STA-1E	124,876	29,442
STA-1W	142,853	37,701
STA-2	174,641	33,764
STA-3/4	604,753	87,200
STA-5	87,000	28,000
STA-6 Section 1	18,034	4,388

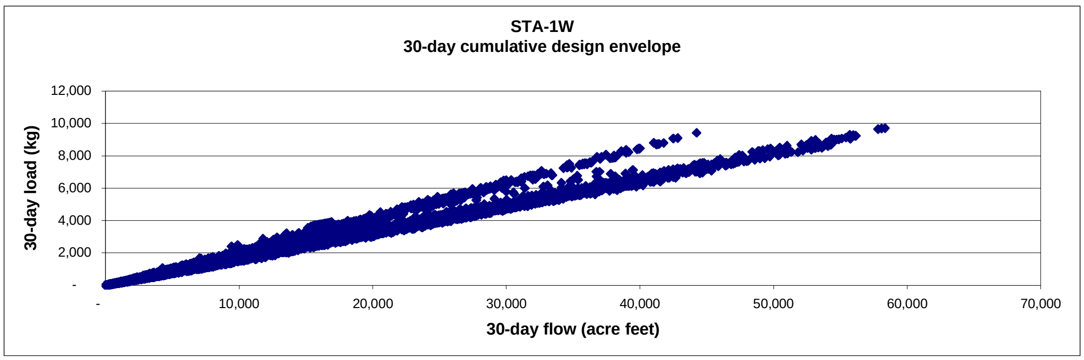
From Conceptual Design (Burns and McDonnell 1994)

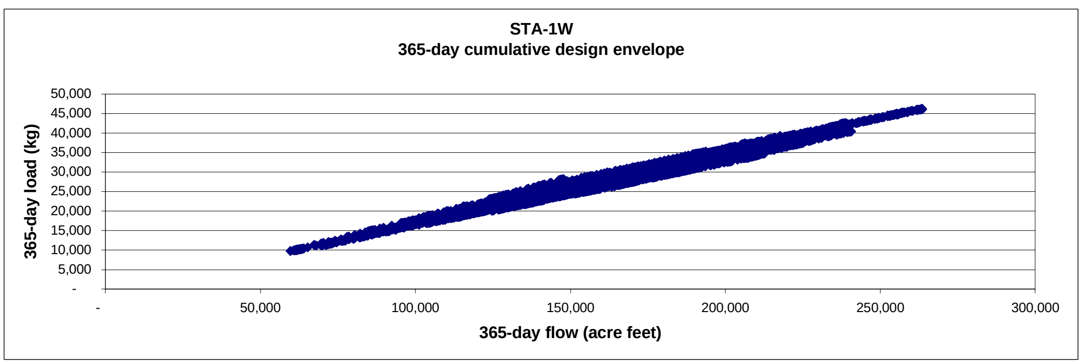
In contrast, the more recent design of the STA enhancements and projections of performance in the Long-Term Plan were based on a dynamic model utilizing a 31-year set of simulated daily flows and phosphorus loads, rainfall and ET. The range of daily, monthly, annual and total inflow flows and phosphorus loads varied considerably over this 31-year period, as demonstrated for STA-1W in Figure 1. Figure 1 displays the range of simulated phosphorus loads plotted as a function of the simulated inflow volumes, and demonstrates the different amount of operating information as a function of the temporal averaging scale. For example, as the averaging period decreases from 31 years to monthly, the maximum cumulative flow does not decrease linearly. In fact, the maximum monthly flow is more than twice the 31-year period average annual flow divided by 12. The top panel in Figure 1 demonstrates the assumed underlying relationship between inflow loads and inflow volumes, which was based on a daily regression relationship, where the upper curves reflects the relationship during the dry season and the lower curve reflects the relationship during the wet season (see Goforth and Piccone 2001 for details on the development of this regression relationship.)

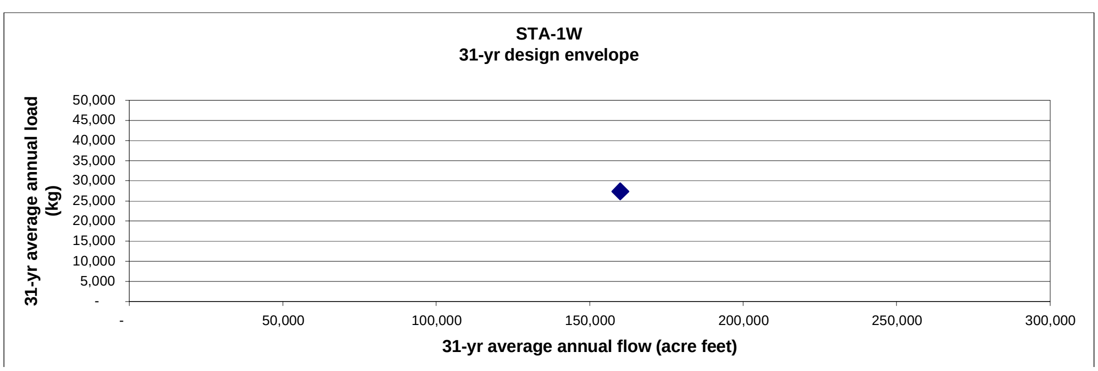
These findings reflect significant differences in the operating climate of the STAs that must be taken into account to ensure effective long-term operation of the STAs. This paper describes a method to provide tactical (e.g., monthly) operational guidance to ensure that the STAs are operated within their design envelope to the maximum extent practicable. The Long-Term Plan recognizes the need to develop STA operational support and related operating strategies in *Part 5 – Process Development and Engineering* under *Analysis and Interpretation* (see page 5-14), and in *Part 8 – Operation Maintenance* and *Monitoring* under *Program Management* (see page 8-12).

Figure 1. Design envelopes for STA-1W across different temporal scales (includes BMP replacement water)









Method

The basis for developing design envelopes for each STA was the inflow data sets used in the Basin-Specific Feasibility Studies (Burns and McDonnell 2002). These data sets consisted of 31 years of simulated daily flows and associated phosphorus loads for basins tributary to each STA. For most of the STAs, the flows were generated from a baseline South Florida Water Management Model (SFWMM) simulation, while for STA-5 and STA-6, a combination of actual and simulated inflows were used. In their baseline data report, Goforth and Piccone (2001) describe the method used to develop a corresponding daily phosphorus load.

The method used for developing graphical and tabular design envelopes for each STA is described below.

1. Using the daily input values, cumulative monthly and annual flows and loads were calculated.
2. For each month, the minimum, average, and maximum ***monthly*** value over the 31 years was determined.
3. Similarly, for each month, the minimum, average, and maximum ***annual*** value over the 31 years was determined.
4. Similarly, for each month, the minimum, average, and maximum ***3-year*** value over the 31 years was determined.
5. For each duration, 10% and 90% values were determined.
6. The results were plotted and presented in tabular form for each STA.

Results

A summary of the average annual inflows and loads to each STA is presented in Table 2. Detailed results for each STA are presented in Appendices 1-6.

Table 2. 31-Year Average Annual Flows and Loads to Each STA

	STA-1E	STA-1W	STA-2	STA-3/4	STA-5	STA-6
Area (acres)	5,350	6,670	6,430	16,543	4,118	2,370
Average Annual Inflow (acre feet)	132,288	159,985	232,759	657,168	129,083	37,442
Hydraulic Loading Rate (cm/day)	2.06	2.00	3.02	3.32	2.62	1.32
Average Annual Load (kg)	28,759	27,372	28,800	71,591	28,209	3,999
Nutrient Loading Rate (grams/sq m/year)	1.33	1.01	1.11	1.07	1.69	0.42

Application

The operational design envelopes presented in the appendices can be used to track the status of each STA relative to long-term cumulative inflow volumes and loads. This information will form a basis to assist with monthly operational decisions and keep the STAs solidly within their design envelopes.

1. Actual monthly, annual and triennial cumulative flows and phosphorus loads are monitored for each STA. Presently, flow data are available approximately 4-6 weeks after field measurement. Efforts are underway to streamline data processing and reduce this lag time. Estimates of phosphorus loads depend on this flow data, so phosphorus loads are also approximately 4-6 weeks behind collection dates. Phosphorus concentration data are available from the District's laboratory within about one week of sampling.

2. Comparison of actual flows and loads to the monthly, annual and triennial ranges presented in the appendices will be made monthly. If deviations are observed, an immediate evaluation of the causes of the deviations should be conducted. Options for bringing the flows and loads back in the range depicted in the operational design envelopes should be identified, evaluated and implemented.

3. For discretionary operations, such as Lake Okeechobee releases and inter-basin transfer of water (when available), the monthly, annual and triennial cumulative values can be utilized to provide guidance.

   Lake Okeechobee release example:

   Flow-way 1 of STA-3/4 began flow-through operation in February 2004. This flow-way contains approximately 6,500 acres, or about 40% of the STA's total effective treatment area. A target for Lake releases during the month of March was obtained from the cumulative monthly design envelope. The 31-year average of simulated flow into STA-3/4 during March is 46,759 acre feet (see appendix 4). Assuming uniform distribution through the flow-ways, approximately 40%, or 18,420 acre feet was set as the target for flow-way 1. This equates to about 300 cfs. Since the STA was still in stabilization, the average value was selected, as opposed to the maximum value, which would have been 82,831 acre feet during the month. Had the STA been in operation for the previous 12 months, we could compare the cumulative actual flow/load with the simulated range and use the lower of the 12-month cumulative or monthly cumulative balance. For example, had the previous 11-month cumulative flow been 620,000 acre feet (assuming the entire STA was operational), the balance available to reach the average annual inflow volume would be (655,853 – 620,000 =) 35,853 acre feet. Since this is less than the March average of 46,759 acre feet, the target for discretionary releases would be 35,853 acre feet.

Another application of these operational design envelopes is in assessing each water year's performance for each STA relative to the design assumptions.

Future Refinements

The values presented in the appendices will be updated upon completion of the updated input data sets, which are presently underway and should be completed by September 2005 (see Long-Term Plan project *Update Baseline Data Sets* page 5-32). In addition, as regional storage reservoirs become operational, the operational design envelopes for effected STAs will be revised.

References

Burns and McDonnell 1994. Everglades Protection Project Conceptual Design.

Burns and McDonnell 2002. Basin-Specific Feasibility Studies Everglades Protection Area Tributary Basins Evaluation of Alternatives for the ECP Basins

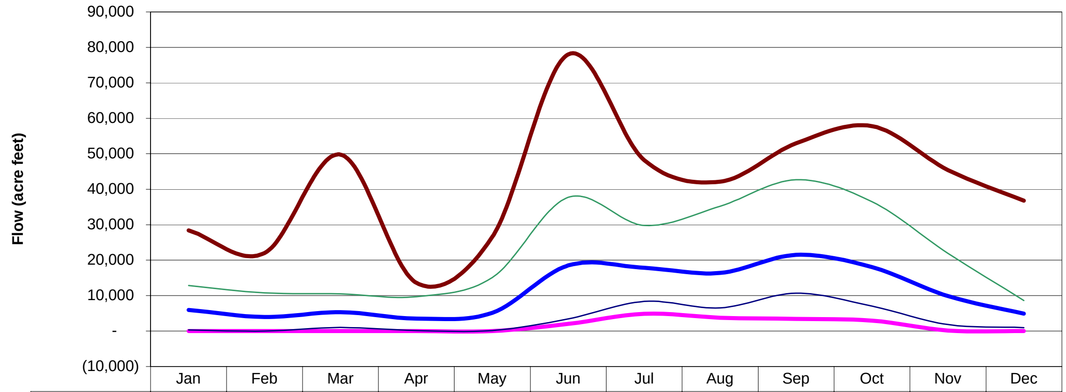
Burns and McDonnell 2003. Everglades Protection Area Tributary Basins Long Term Plan for Achieving Water Quality Goals

Goforth and Piccone 2001. Baseline Data for the Basin-Specific Feasibility Studies to Achieve the Long-term Water Quality Goals for the Everglades

Walker and Kadlec October 10, 2003. DMSTA Features and Potential CERP Applications

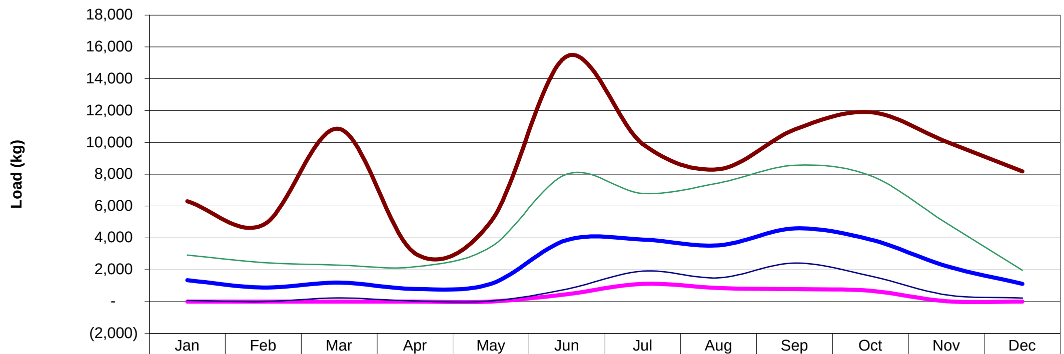
Appendix 1. Operating Design Envelope for STA-1E.

STA-1E 30-day Cumulative Flows

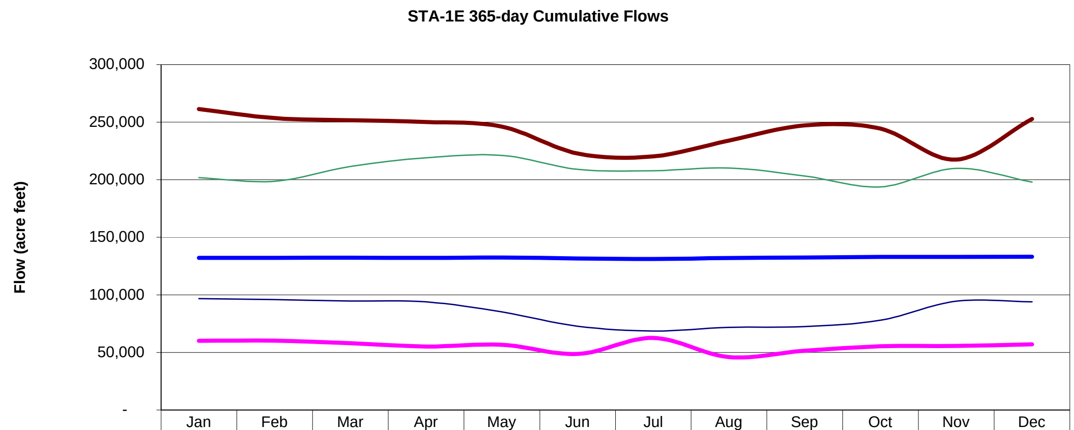


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
30-day min	-	-	-	-	-	2,012	4,868	3,730	3,426	2,943	117	3
10%	272	18	988	159	154	3,430	8,375	6,524	10,662	7,026	1,823	942
30-day ave	5,943	3,931	5,312	3,513	5,160	18,498	17,812	16,369	21,482	18,039	9,856	4,911
90%	12,812	10,742	10,462	9,698	15,065	37,697	29,780	35,233	42,681	36,449	21,889	8,612
30-day max	28,371	21,994	49,780	13,580	26,560	78,046	48,198	42,128	52,933	57,786	45,383	36,757

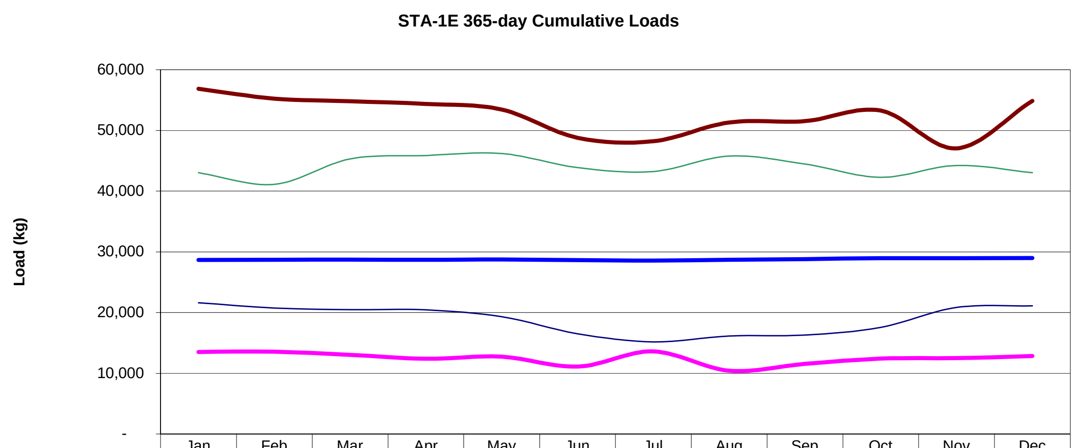
STA-1E 30-day Cumulative Loads



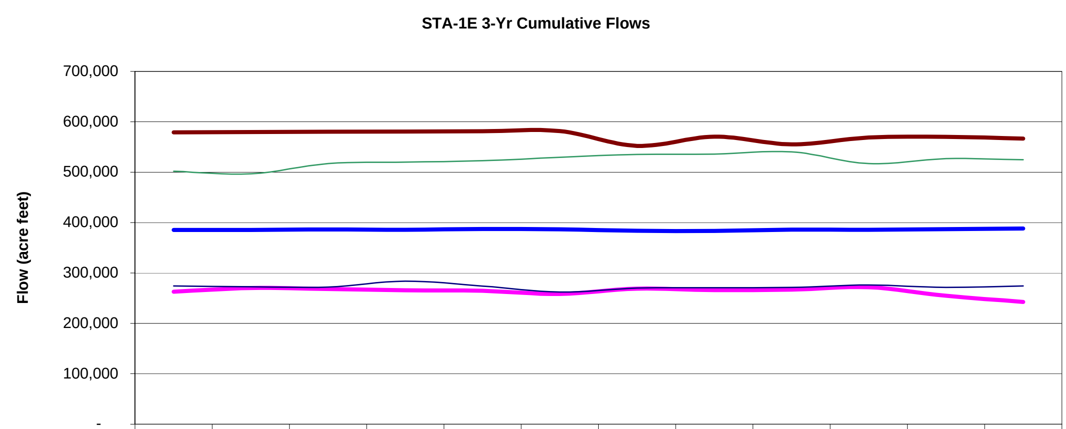
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
30-day min	-	-	-	-	-	459	1,111	851	782	672	27	1
10%	62	4	226	36	35	783	1,911	1,489	2,424	1,603	416	215
30-day ave	1,334	884	1,188	789	1,111	3,864	3,894	3,532	4,592	3,896	2,225	1,110
90%	2,924	2,452	2,291	2,187	3,438	8,007	6,796	7,446	8,565	7,904	4,922	1,965
30-day max	6,299	4,816	10,850	3,030	5,031	15,414	9,901	8,312	10,809	11,902	10,042	8,178



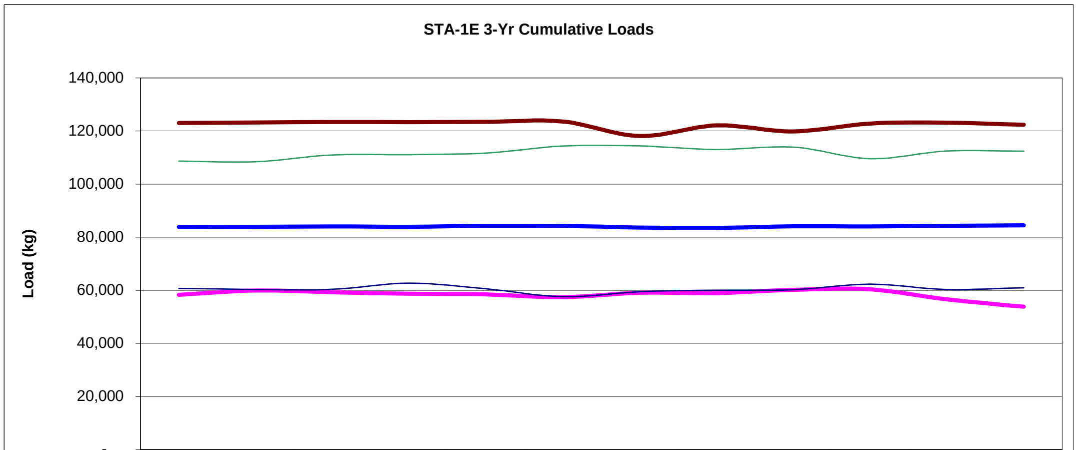
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
365-day min	60,058	60,219	57,999	55,189	56,640	48,623	62,527	46,004	51,432	55,260	55,650	57,141
10%	96,737	95,932	94,661	93,954	85,163	72,797	68,707	71,748	72,490	77,927	94,460	93,978
365-day ave	132,042	132,157	132,253	132,107	132,323	131,672	131,252	131,989	132,406	133,054	133,029	133,166
90%	201,774	198,710	211,493	219,129	221,106	209,018	207,837	210,152	203,294	193,714	209,911	197,861
365-day max	261,463	253,551	251,649	250,157	246,110	222,771	220,269	233,958	247,187	244,408	217,440	252,741



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
365-day min	13,520	13,557	13,050	12,409	12,740	11,097	13,602	10,430	11,551	12,425	12,514	12,854
10%	21,629	20,764	20,474	20,454	19,317	16,520	15,172	16,115	16,305	17,546	20,838	21,136
365-day ave	28,681	28,707	28,729	28,695	28,745	28,631	28,554	28,704	28,806	28,946	28,941	28,972
90%	43,034	41,114	45,302	45,849	46,210	43,872	43,230	45,781	44,455	42,270	44,228	43,041
365-day max	56,866	55,233	54,799	54,361	53,437	48,771	48,229	51,310	51,539	53,255	47,029	54,875

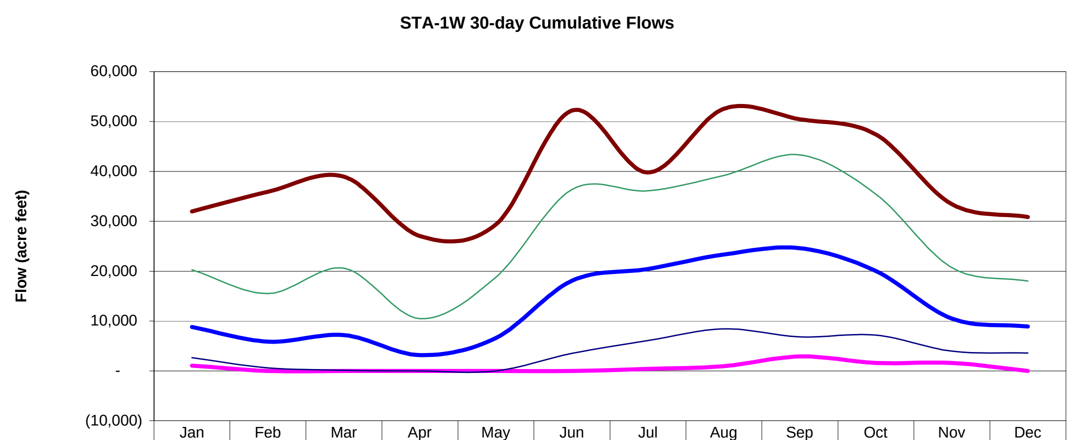


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3-yr min	263,043	269,963	268,133	265,546	264,469	258,428	268,833	265,854	266,933	271,729	254,899	242,587
10%	274,331	272,775	271,971	283,936	274,091	262,137	269,929	270,549	271,181	276,214	271,405	274,236
3-yr ave	385,235	385,413	386,252	385,661	387,395	386,836	383,827	383,431	386,161	385,854	387,047	388,032
90%	501,884	496,600	516,953	519,945	522,762	529,451	535,072	535,761	540,142	516,975	526,803	524,784
3-yr max	578,886	579,665	580,350	580,715	581,182	581,689	552,320	570,351	555,255	568,700	570,002	566,716

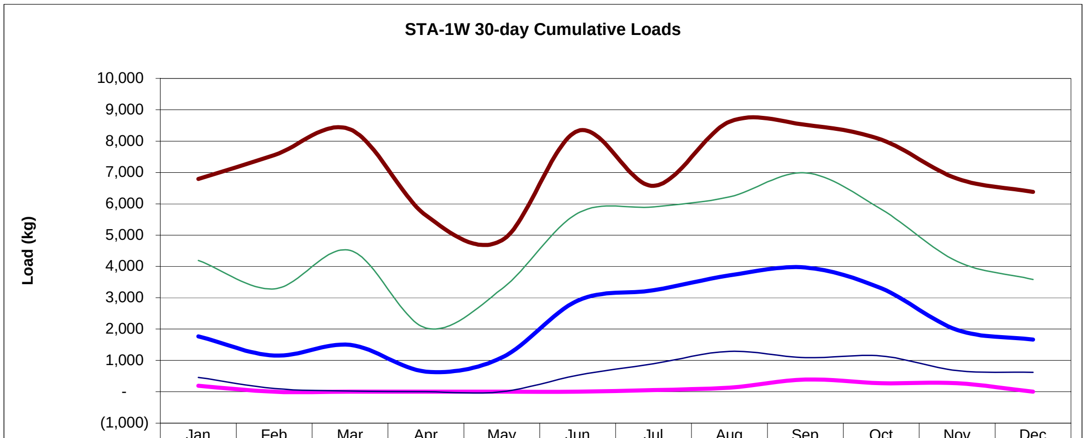


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3-yr min	58,337	59,916	59,284	58,694	58,448	57,443	59,129	58,960	60,166	60,392	56,619	53,809
10%	60,699	60,344	60,375	62,714	60,574	57,617	59,495	60,037	60,267	62,284	60,318	60,964
3-yr ave	83,865	83,899	84,083	83,950	84,302	84,236	83,638	83,541	84,099	84,040	84,300	84,517
90%	108,655	108,401	110,971	111,129	111,692	114,336	114,388	113,079	113,982	109,556	112,495	112,420
3-yr max	123,049	123,227	123,383	123,369	123,475	123,591	118,115	122,108	119,849	122,828	123,125	122,375

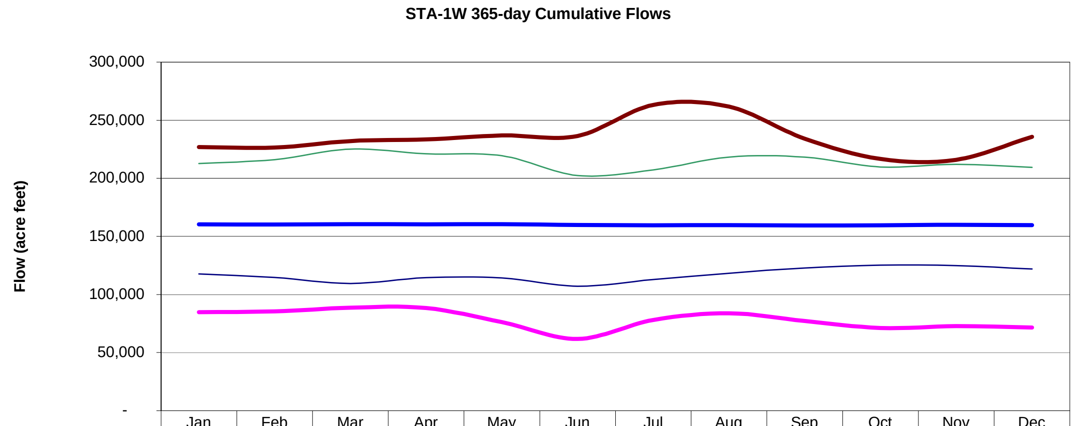
Appendix 2. Operating Design Envelope for STA-1W.



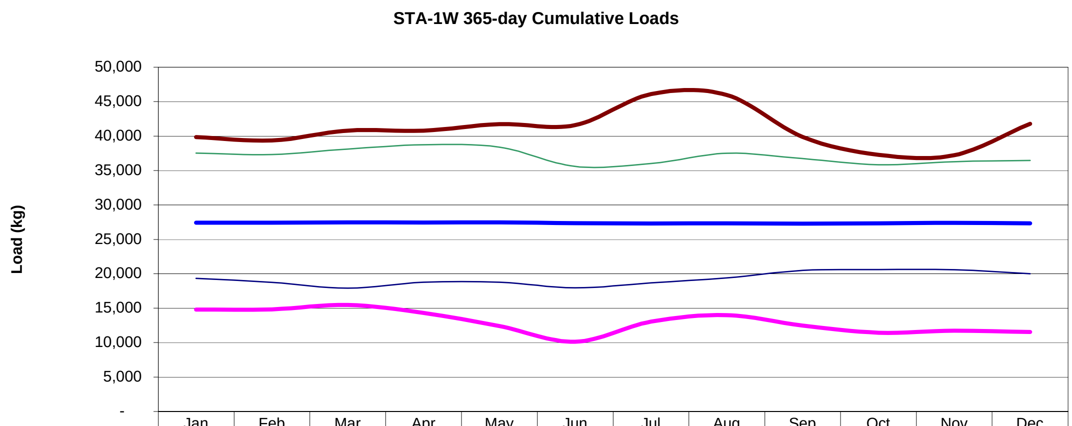
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
30-day min	1,055	-	-	-	-	-	382	942	2,877	1,584	1,604	-
10%	2,666	611	134	-	-	3,500	6,087	8,422	6,837	7,157	3,936	3,582
30-day ave	8,825	5,864	7,167	3,164	6,589	18,084	20,426	23,343	24,598	20,030	10,488	8,909
90%	20,249	15,494	20,569	10,471	18,791	36,379	36,104	39,224	43,328	35,437	20,697	17,995
30-day max	31,946	35,933	38,949	27,025	29,365	52,192	39,789	52,587	50,458	47,426	33,430	30,854



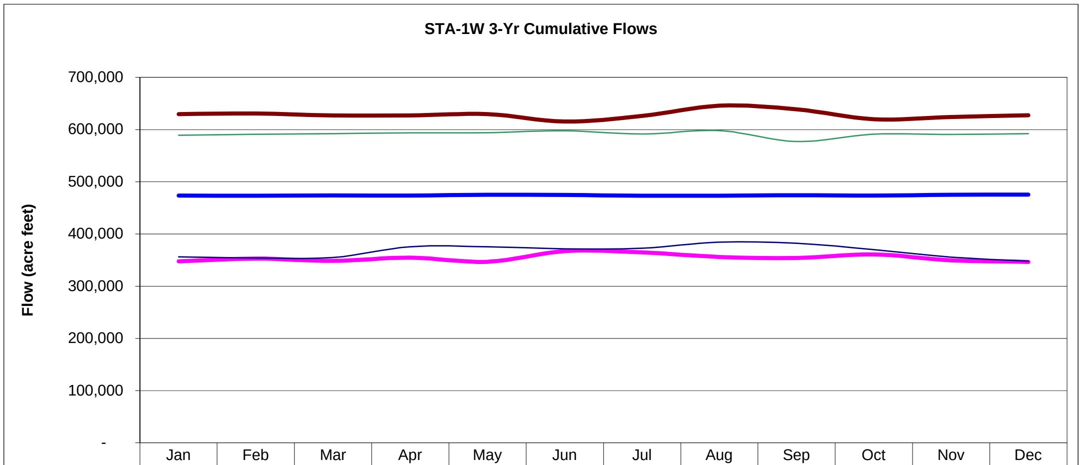
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
30-day min	192	-	-	-	-	-	52	129	391	274	275	-
10%	456	105	22	-	-	526	899	1,290	1,087	1,143	677	620
30-day ave	1,769	1,155	1,493	645	1,095	2,909	3,243	3,712	3,965	3,303	1,972	1,664
90%	4,192	3,286	4,514	2,035	3,285	5,697	5,898	6,222	6,987	5,824	4,162	3,586
30-day max	6,793	7,551	8,374	5,627	4,832	8,327	6,577	8,616	8,523	8,047	6,805	6,379



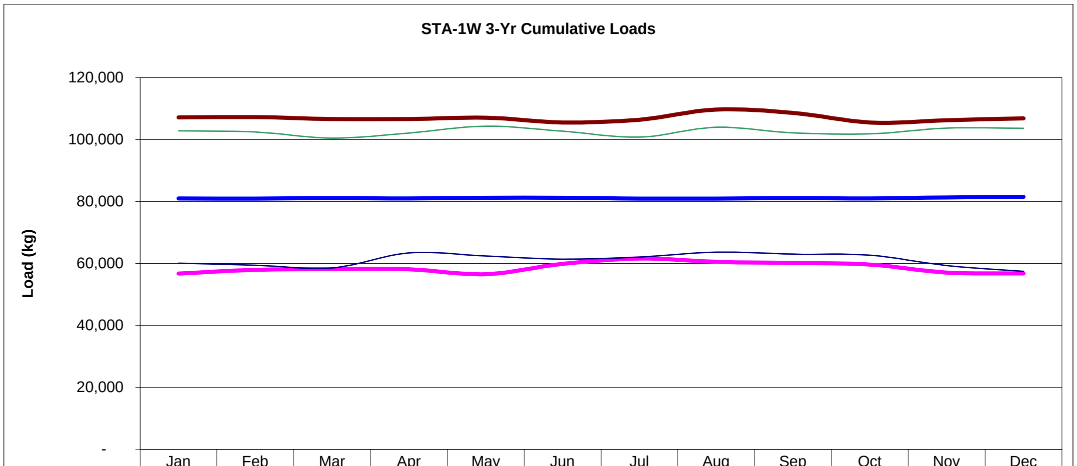
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
365-day min	84,896	85,476	88,593	88,323	76,187	61,831	78,067	83,815	77,235	71,152	72,771	71,627
10%	117,768	114,642	109,558	114,499	114,196	107,117	112,884	118,362	122,811	125,137	124,872	122,029
365-day ave	160,350	160,321	160,517	160,445	160,507	159,822	159,531	159,635	159,332	159,612	160,049	159,698
90%	212,665	216,112	225,074	221,098	219,434	202,459	207,307	218,305	218,320	209,683	212,019	209,421
365-day max	226,891	226,460	231,987	233,532	236,932	236,382	263,227	261,733	234,054	216,643	215,894	235,679



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
365-day min	14,807	14,829	15,487	14,325	12,404	10,117	13,044	13,999	12,478	11,452	11,737	11,534
10%	19,349	18,748	17,896	18,777	18,777	17,963	18,665	19,382	20,479	20,616	20,573	20,005
365-day ave	27,423	27,417	27,461	27,447	27,460	27,339	27,299	27,321	27,272	27,318	27,389	27,324
90%	37,520	37,311	38,117	38,742	38,394	35,581	36,015	37,492	36,729	35,842	36,289	36,441
365-day max	39,848	39,362	40,795	40,790	41,740	41,583	46,093	45,972	39,859	37,268	37,223	41,777

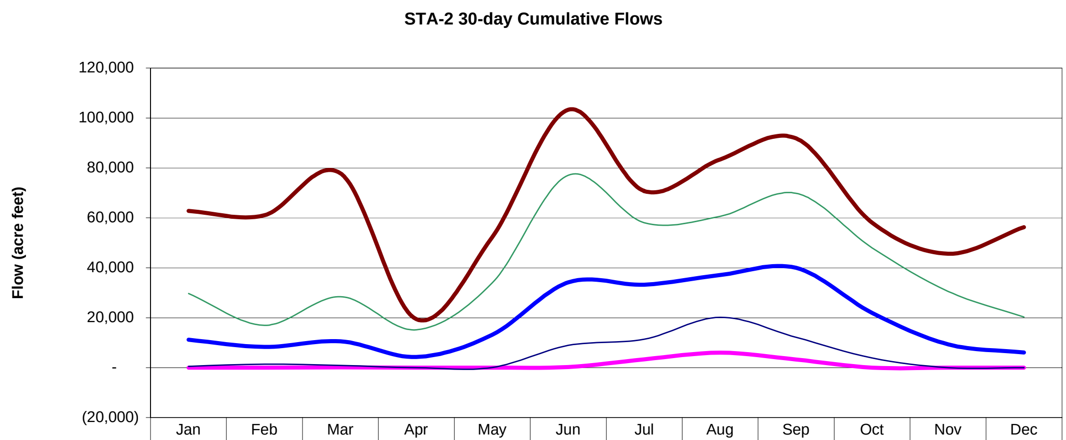


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3-yr min	347,543	352,824	348,413	354,700	346,846	367,283	364,974	356,167	354,165	361,095	349,624	346,465
10%	356,519	353,954	355,161	375,801	375,501	371,714	372,861	384,497	382,249	370,135	355,833	347,786
3-yr ave	473,638	473,351	474,046	473,643	475,218	474,822	473,405	473,157	474,321	473,472	475,120	475,672
90%	589,300	590,825	592,229	593,808	594,043	597,784	591,530	597,924	577,054	591,311	590,556	592,255
3-yr max	629,784	630,799	627,058	627,058	629,720	615,483	626,183	645,708	638,935	620,119	624,361	627,601

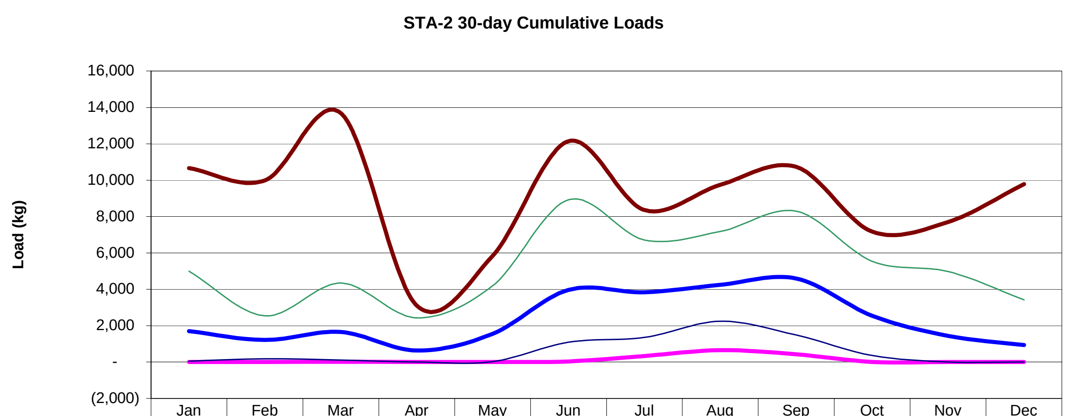


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3-yr min	56,753	57,972	58,186	58,109	56,543	59,863	61,611	60,553	60,143	59,657	57,112	56,793
10%	60,128	59,443	58,548	63,430	62,408	61,391	62,091	63,711	63,044	62,719	59,344	57,470
3-yr ave	81,003	80,934	81,094	81,000	81,253	81,205	80,980	80,946	81,141	81,024	81,350	81,501
90%	102,859	102,477	100,479	102,136	104,323	102,727	100,806	103,984	102,180	101,841	103,713	103,683
3-yr max	107,212	107,291	106,611	106,611	107,078	105,531	106,430	109,707	108,603	105,551	106,270	106,834

Appendix 3. Operating Design Envelope for STA-2.

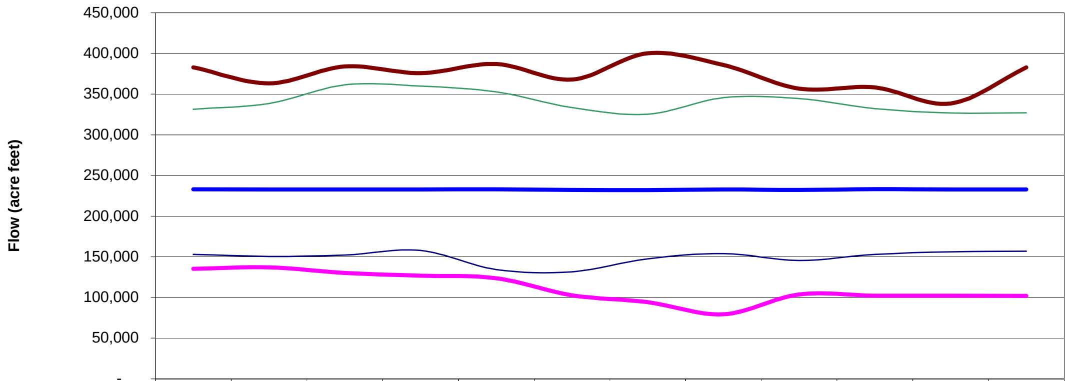


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
30-day min	-	-	105	-	-	264	3,331	5,995	3,276	15	-	-
10%	503	1,428	891	-	73	8,911	11,409	20,176	12,123	3,846	1	-
30-day ave	11,151	8,340	10,532	4,311	13,153	34,202	33,188	37,130	39,993	21,943	9,347	6,075
90%	29,678	16,986	28,456	15,142	33,998	77,098	58,036	60,627	69,821	48,033	30,526	20,266
30-day max	62,756	61,070	77,826	19,444	52,344	103,269	70,730	83,444	91,825	58,128	45,654	56,278



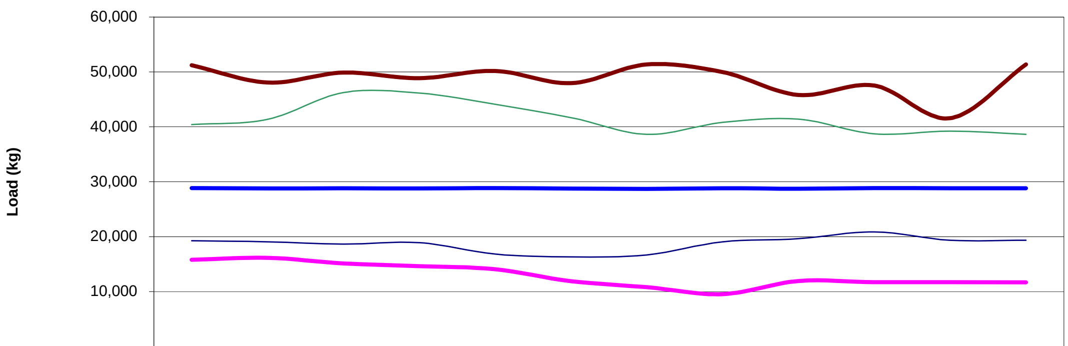
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
30-day min	-	-	18	-	-	36	327	651	423	1	-	-
10%	51	181	108	-	19	1,092	1,349	2,238	1,481	365	0	-
30-day ave	1,699	1,215	1,649	636	1,549	3,966	3,836	4,248	4,598	2,542	1,434	933
90%	5,000	2,540	4,342	2,426	4,194	8,923	6,709	7,180	8,290	5,539	4,974	3,424
30-day max	10,666	9,987	13,683	3,114	5,843	12,139	8,362	9,748	10,728	7,165	7,704	9,781

STA-2 365-day Cumulative Flows



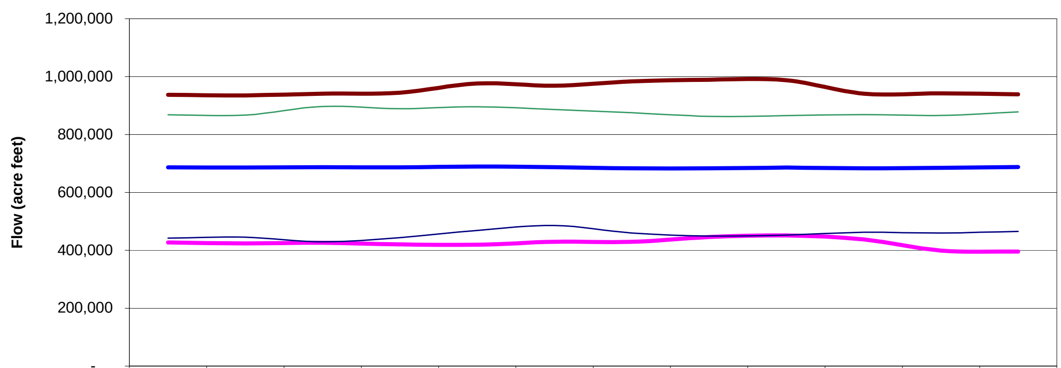
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
365-day min	135,280	137,127	130,072	126,773	123,761	102,774	94,247	79,493	103,843	102,351	102,351	102,113
10%	153,020	150,493	152,232	157,835	134,407	131,627	147,647	154,086	145,513	152,969	156,123	156,999
365-day ave	233,071	232,848	232,948	232,787	233,078	232,272	231,969	232,827	232,302	233,184	232,958	232,860
90%	331,345	338,504	361,282	359,946	352,687	333,468	325,334	345,608	344,480	332,244	326,756	327,003
365-day max	382,878	363,173	384,015	375,748	386,820	367,738	400,116	385,893	356,660	358,128	338,503	382,911

STA-2 365-day Cumulative Loads



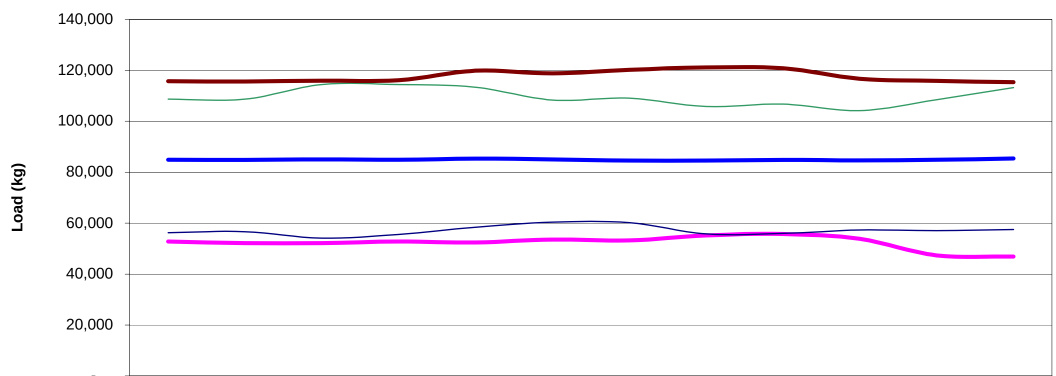
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
365-day min	15,767	16,144	15,126	14,615	14,058	11,903	10,804	9,543	11,941	11,711	11,711	11,672
10%	19,240	19,074	18,618	18,898	16,836	16,302	16,691	19,074	19,641	20,854	19,353	19,339
365-day ave	28,836	28,796	28,826	28,791	28,842	28,747	28,700	28,813	28,737	28,857	28,833	28,819
90%	40,406	41,377	46,229	46,144	44,103	41,690	38,630	40,821	41,408	38,737	39,221	38,649
365-day max	51,199	48,085	49,861	48,858	50,190	47,957	51,374	49,965	45,805	47,503	41,593	51,365

STA-2 3-Yr Cumulative Flows



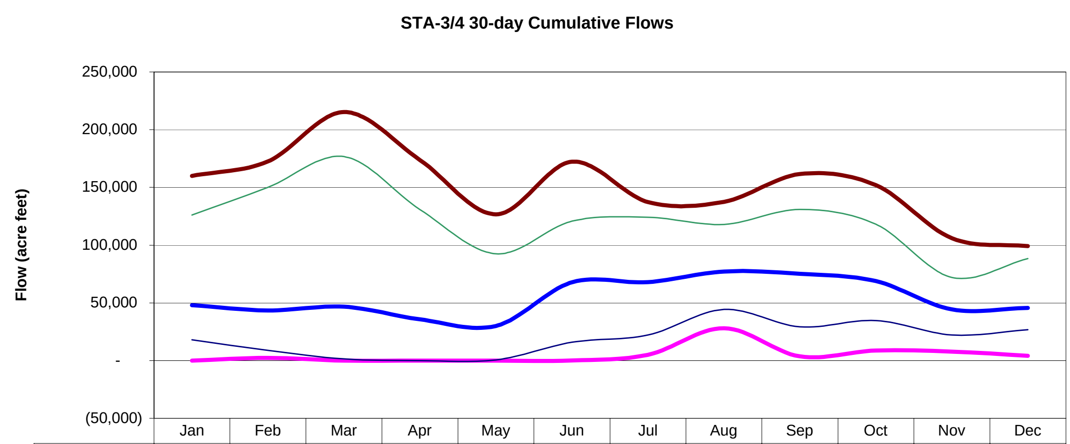
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3-yr min	427,151	424,082	426,224	420,612	419,250	429,307	429,558	445,817	451,703	437,444	399,298	396,074
10%	442,266	445,173	429,456	443,956	468,886	485,695	459,723	449,674	453,038	462,483	460,051	465,520
3-yr ave	686,303	685,926	686,918	686,445	689,509	687,235	683,480	683,260	685,916	683,638	685,149	687,639
90%	868,261	866,807	897,060	889,582	895,610	886,346	875,391	862,689	865,190	868,633	865,828	878,510
3-yr max	937,113	935,038	941,064	944,519	976,628	968,653	983,544	989,286	987,928	941,052	942,210	938,542

STA-2 3-Yr Cumulative Loads

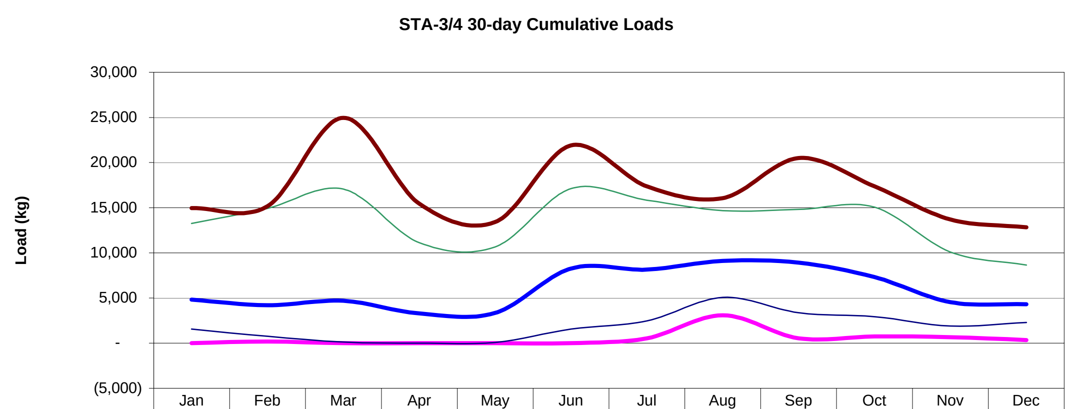


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3-yr min	52,727	52,167	52,187	52,753	52,430	53,591	53,237	55,183	55,678	53,810	47,314	46,860
10%	56,270	56,662	54,085	55,553	58,376	60,376	60,218	55,740	55,976	57,320	57,045	57,538
3-yr ave	84,922	84,840	85,017	84,915	85,281	85,015	84,555	84,578	84,863	84,621	84,905	85,352
90%	108,664	108,690	114,390	114,411	113,364	108,356	109,079	105,788	106,744	104,186	108,457	113,210
3-yr max	115,716	115,629	115,867	116,079	119,870	118,757	120,155	121,121	120,815	116,679	115,819	115,330

Appendix 4. Operating Design Envelope for STA-3/4.

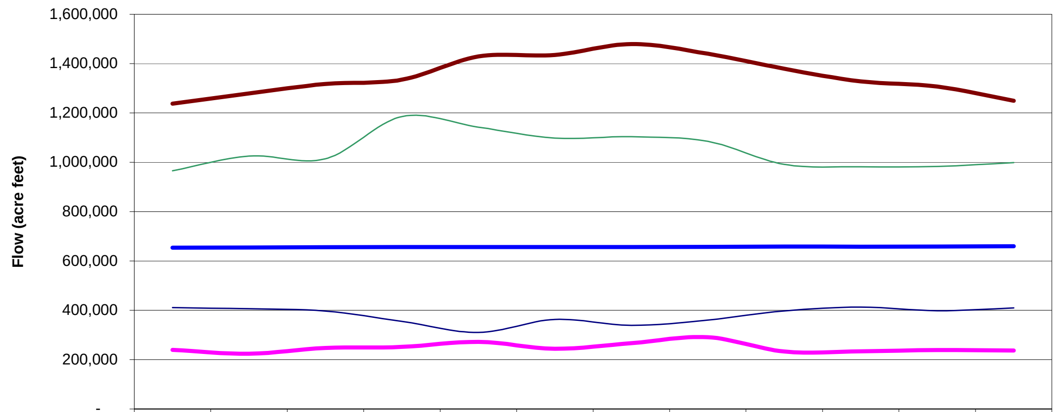


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
30-day min	-	2,368	-	-	-	79	4,989	28,142	3,732	8,751	7,880	4,148
10%	17,969	8,830	1,494	-	595	15,968	22,191	44,405	29,295	34,713	22,203	26,726
30-day ave	48,101	43,440	46,762	35,725	29,989	67,911	68,017	77,214	75,285	68,892	44,406	45,703
90%	126,050	149,991	176,648	130,786	92,603	120,756	124,104	117,942	130,987	118,160	71,940	88,356
30-day max	159,984	172,534	215,246	173,684	126,639	172,256	137,381	137,410	161,566	152,041	106,058	99,176



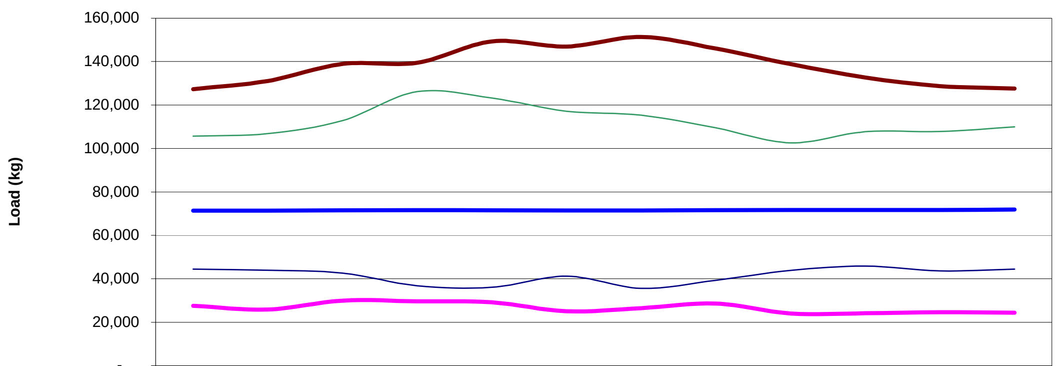
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
30-day min	-	179	-	-	-	13	529	3,091	540	741	667	348
10%	1,550	769	127	-	72	1,560	2,469	5,059	3,366	2,938	1,891	2,289
30-day ave	4,822	4,199	4,687	3,293	3,346	8,258	8,150	9,111	8,924	7,316	4,547	4,303
90%	13,262	14,924	17,068	11,132	10,651	17,112	15,828	14,680	14,815	15,050	10,091	8,660
30-day max	14,964	15,167	24,950	15,459	13,423	21,900	17,364	16,056	20,494	17,364	13,700	12,837

STA-3/4 365-day Cumulative Flows



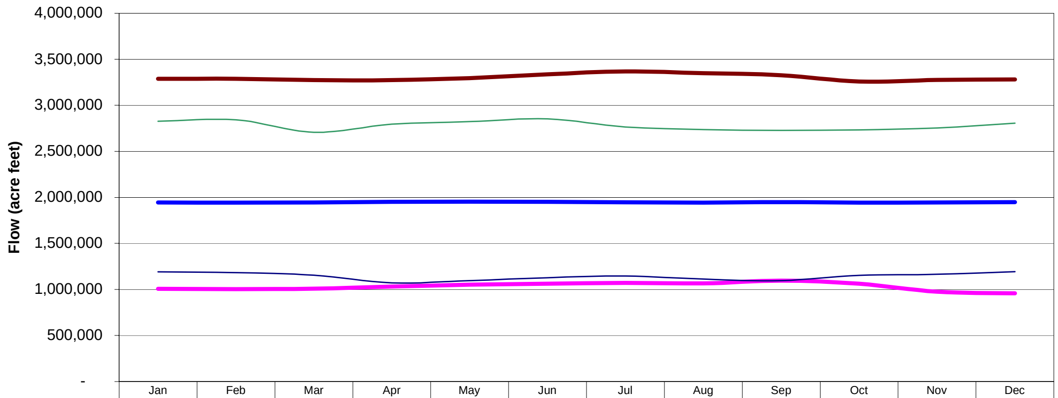
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
365-day min	240,130	224,140	247,577	252,242	272,996	244,612	266,842	291,484	233,327	234,086	239,709	237,269
10%	411,011	406,647	396,931	355,422	310,912	362,991	339,000	360,658	397,726	413,253	398,794	409,544
365-day ave	653,975	654,966	656,175	656,978	656,886	656,739	656,616	657,783	658,646	658,347	658,658	660,243
90%	965,971	1,025,283	1,014,781	1,185,642	1,142,310	1,098,170	1,103,653	1,085,202	991,737	981,829	983,121	998,843
365-day max	1,238,216	1,279,375	1,317,942	1,335,086	1,429,063	1,435,213	1,479,900	1,439,803	1,379,371	1,327,968	1,307,244	1,249,834

STA-3/4 365-day Cumulative Loads



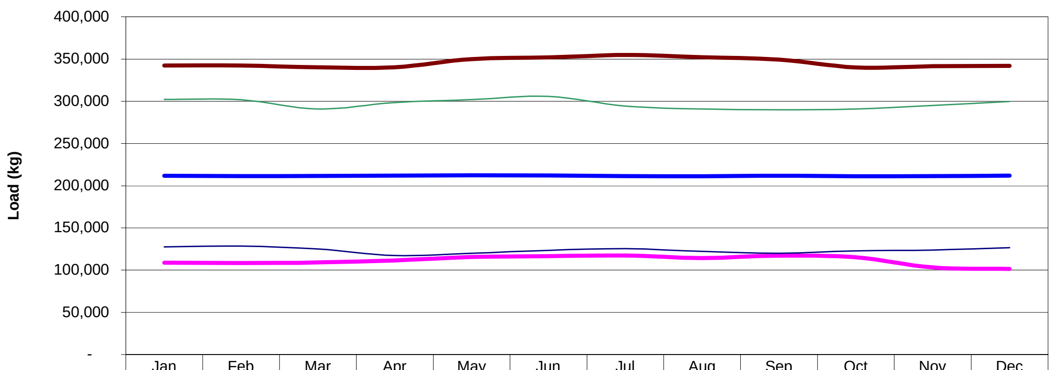
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
365-day min	27,571	25,891	29,960	29,651	29,173	25,049	26,496	28,585	24,024	24,126	24,602	24,380
10%	44,441	43,938	42,612	36,772	36,080	41,218	35,589	39,305	43,866	45,803	43,619	44,401
365-day ave	71,374	71,423	71,526	71,587	71,567	71,504	71,467	71,640	71,678	71,721	71,738	71,861
90%	105,642	106,811	112,801	126,163	123,232	117,113	115,339	109,540	102,599	107,720	107,821	109,999
365-day max	127,270	131,072	138,953	139,501	149,343	146,940	151,354	146,030	138,819	132,684	128,700	127,622

STA-3/4 3-Yr Cumulative Flows



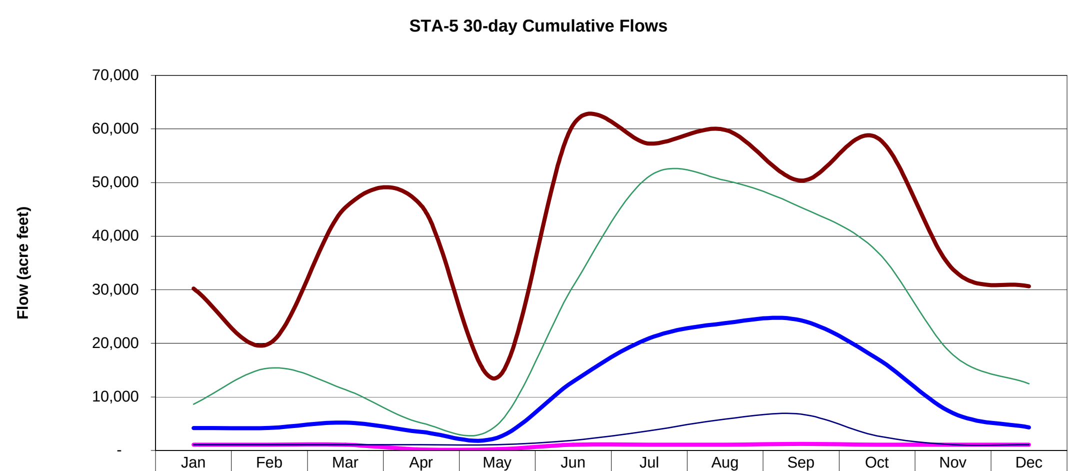
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3-yr min	1,007,304	1,002,606	1,009,583	1,031,848	1,052,053	1,063,315	1,071,534	1,065,831	1,095,280	1,063,115	975,644	958,435
10%	1,189,646	1,182,811	1,154,628	1,072,276	1,096,344	1,127,111	1,145,443	1,113,313	1,095,840	1,153,555	1,164,337	1,191,995
3-yr ave	1,945,755	1,943,155	1,945,214	1,950,343	1,952,417	1,951,768	1,946,358	1,943,605	1,949,148	1,943,989	1,944,762	1,949,807
90%	2,825,637	2,843,169	2,708,351	2,795,057	2,823,167	2,851,347	2,765,671	2,737,638	2,727,854	2,733,009	2,752,989	2,805,241
3-yr max	3,287,338	3,287,766	3,272,640	3,272,640	3,295,465	3,336,558	3,367,816	3,349,811	3,326,864	3,259,056	3,274,884	3,280,503

STA-3/4 3-Yr Cumulative Loads

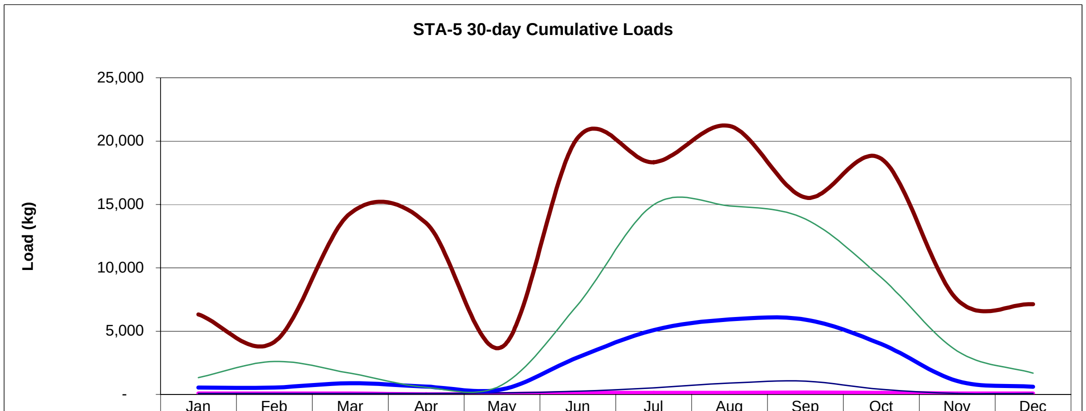


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3-yr min	108,932	108,436	109,127	111,611	115,635	116,683	117,369	114,472	117,126	115,145	103,340	101,425
10%	127,490	128,531	124,965	117,383	119,983	123,548	125,404	122,303	120,042	122,924	123,800	126,639
3-yr ave	211,719	211,445	211,649	212,046	212,391	212,251	211,497	211,153	211,817	211,207	211,434	212,094
90%	302,201	301,851	290,876	298,541	302,067	305,778	294,229	290,913	289,811	290,802	295,104	299,786
3-yr max	342,398	342,296	340,305	340,305	349,961	351,926	354,874	352,275	349,309	340,157	341,484	341,822

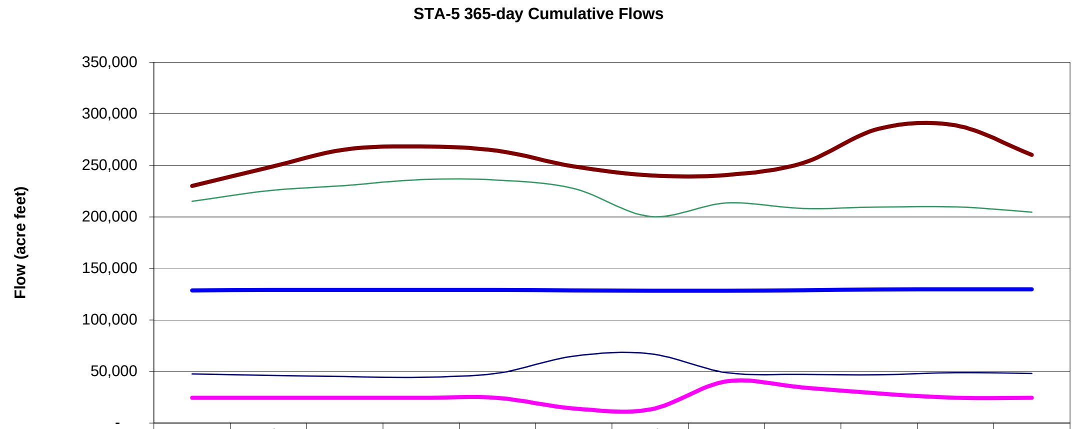
Appendix 5. Operating Design Envelope for STA-5.



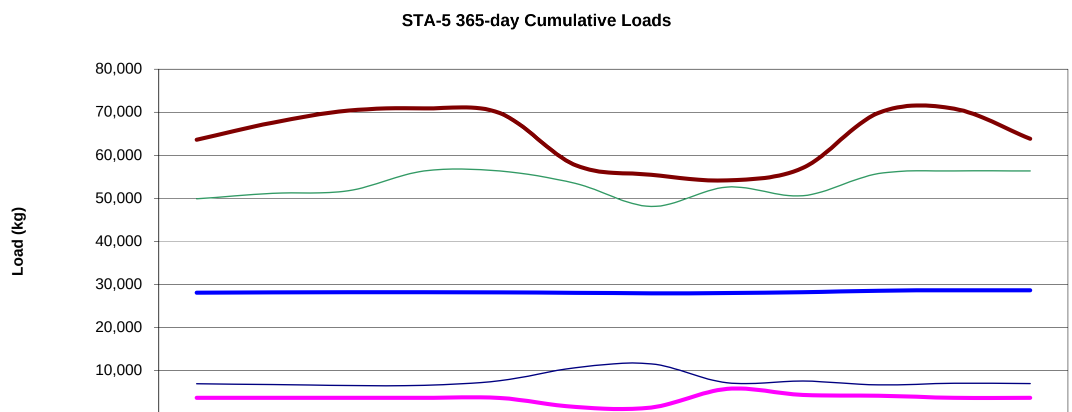
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
30-day min	1,071	1,071	1,071	206	242	1,071	1,071	1,071	1,226	1,071	1,071	1,071
10%	1,071	1,071	1,071	1,071	1,071	1,896	3,685	5,851	6,762	2,735	1,071	1,071
30-day ave	4,196	4,238	5,227	3,472	2,374	12,899	20,951	23,773	24,284	17,179	6,960	4,332
90%	8,664	15,410	11,373	5,167	4,794	30,716	51,150	50,416	45,378	37,148	17,863	12,458
30-day max	30,214	19,993	45,360	45,687	13,603	60,819	57,264	59,832	50,352	58,378	33,786	30,639



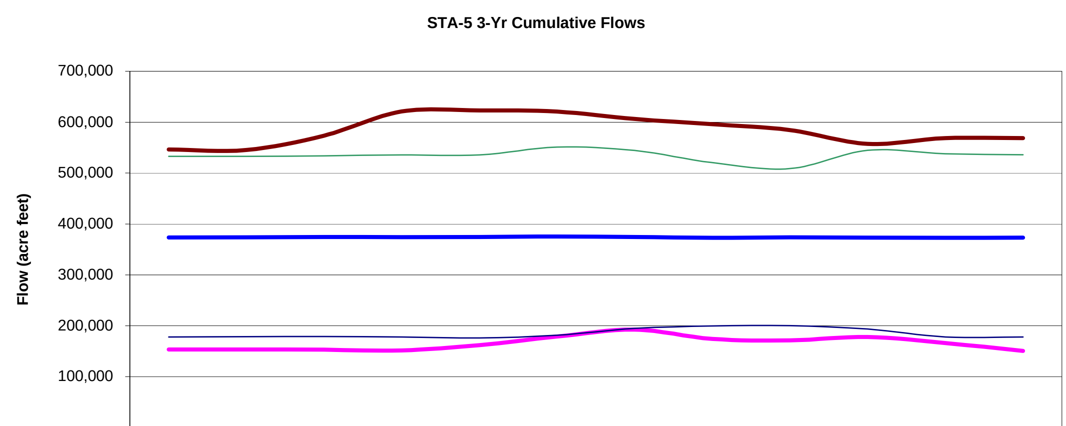
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
30-day min	83	83	83	16	31	140	140	140	161	140	83	83
10%	83	83	83	83	140	256	531	897	1,047	410	83	83
30-day ave	557	549	891	623	403	2,929	5,093	5,929	5,912	3,987	1,057	604
90%	1,328	2,611	1,688	569	748	7,090	14,978	14,895	13,857	9,223	3,437	1,685
30-day max	6,330	4,140	14,294	13,549	3,744	20,271	18,341	21,200	15,543	18,601	7,487	7,131



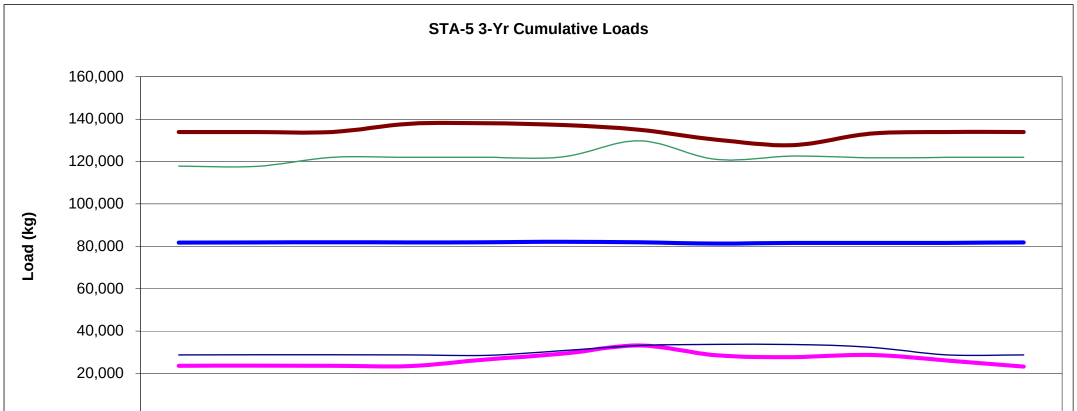
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
365-day min	24,617	24,617	24,617	24,617	24,538	14,158	13,186	40,491	34,524	28,738	24,617	24,617
10%	47,619	46,344	45,174	44,545	48,420	65,072	67,301	48,958	47,320	47,004	49,006	48,091
365-day ave	128,685	129,129	129,246	129,221	129,196	128,648	128,331	128,359	128,832	129,658	129,906	129,788
90%	215,131	225,493	230,442	236,267	235,727	227,666	200,410	213,566	208,256	209,589	209,659	204,575
365-day max	230,151	247,978	265,314	268,478	264,076	248,976	240,388	240,746	252,307	285,579	288,829	260,172



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
365-day min	3,631	3,631	3,631	3,631	3,620	1,513	1,379	5,707	4,326	4,122	3,631	3,631
10%	6,876	6,745	6,493	6,529	7,614	10,635	11,531	7,115	7,524	6,639	7,005	6,920
365-day ave	28,068	28,144	28,164	28,161	28,151	28,028	27,936	27,970	28,165	28,521	28,605	28,592
90%	49,900	51,173	51,735	56,354	56,352	53,433	48,099	52,622	50,610	55,736	56,354	56,355
365-day max	63,595	67,555	70,390	70,886	69,801	57,679	55,471	54,167	57,042	69,865	70,813	63,843

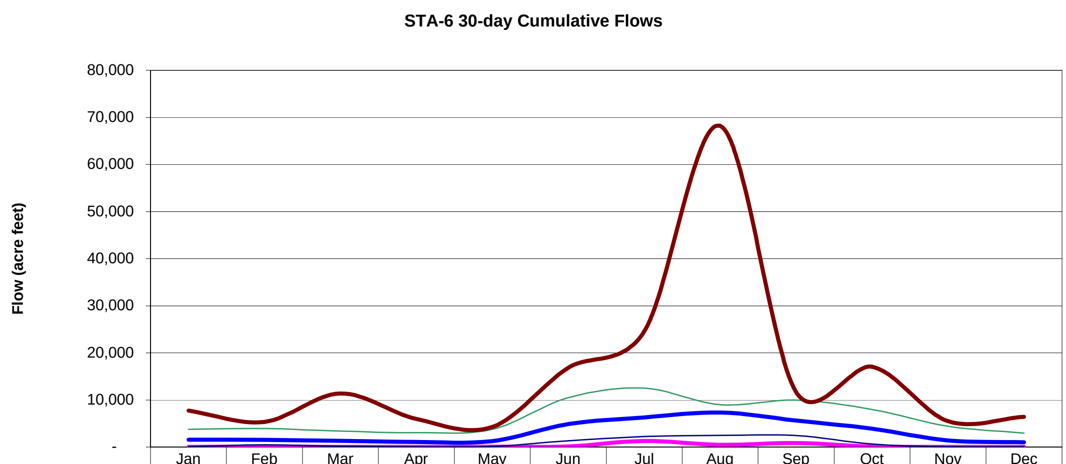


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3-yr min	153,410	153,554	152,943	151,601	161,946	178,812	192,488	174,127	171,564	178,235	166,231	150,641
10%	178,247	178,657	178,768	178,250	176,219	181,436	194,799	199,726	200,364	193,676	178,020	178,314
3-yr ave	373,558	373,919	374,346	374,101	374,452	375,435	374,495	372,935	373,684	373,006	372,746	373,207
90%	532,863	532,988	533,895	535,533	535,713	550,994	544,151	520,601	508,823	544,704	537,891	535,999
3-yr max	546,410	545,365	573,530	621,024	623,081	620,689	606,182	595,909	584,357	557,192	568,667	568,875

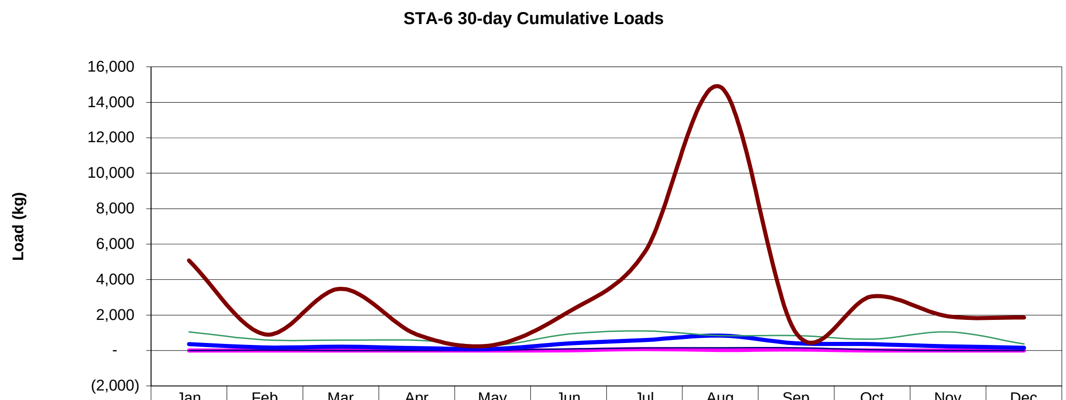


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3-yr min	23,620	23,635	23,572	23,440	26,579	29,271	33,167	28,574	27,664	28,760	26,087	23,176
10%	28,742	28,787	28,799	28,748	28,475	30,709	33,190	33,711	33,616	32,337	28,729	28,750
3-yr ave	81,674	81,731	81,865	81,760	81,848	82,110	81,817	81,298	81,629	81,573	81,584	81,753
90%	117,835	117,703	121,919	121,919	121,921	122,142	129,712	121,003	122,565	121,778	121,918	121,918
3-yr max	133,900	133,900	133,900	137,764	138,044	137,224	134,960	130,286	127,744	133,127	133,897	133,900

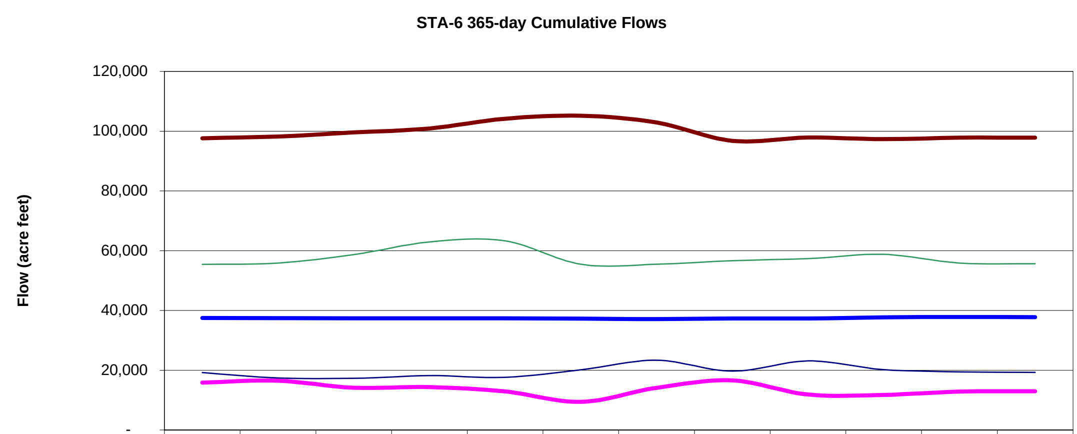
Appendix 6. Operating Design Envelope for STA-6.



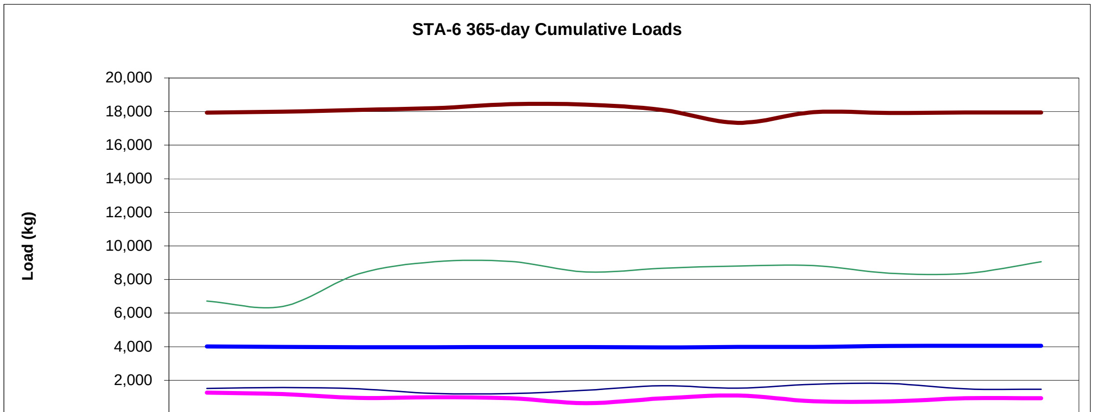
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
30-day min	54	108	54	45	89	161	1,299	461	857	107	54	54
10%	95	468	167	90	146	1,343	2,233	2,480	2,455	666	88	55
30-day ave	1,565	1,521	1,321	1,095	1,257	4,897	6,297	7,358	5,633	3,904	1,426	995
90%	3,751	3,949	3,397	3,075	3,779	10,503	12,504	9,018	9,995	7,995	4,418	2,956
30-day max	7,746	5,363	11,404	5,967	4,257	16,838	24,552	68,181	11,687	17,048	5,511	6,436



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
30-day min	2	3	2	1	5	10	80	29	52	6	2	2
10%	3	22	5	3	9	85	144	154	157	40	3	2
30-day ave	358	175	216	134	91	403	593	841	403	360	232	161
90%	1,049	604	588	585	283	926	1,105	844	841	643	1,051	370
30-day max	5,081	913	3,481	909	305	2,179	5,520	14,863	977	3,054	1,926	1,864

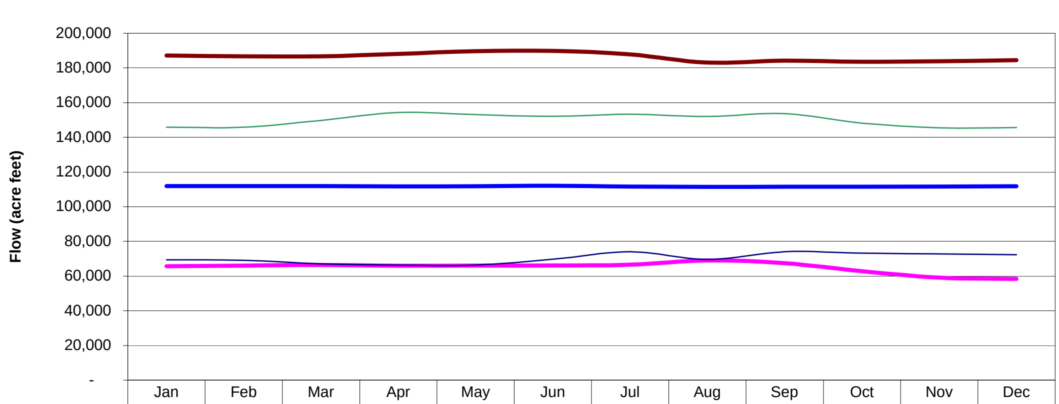


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
365-day min	15,847	16,497	14,141	14,391	12,880	9,430	14,090	16,589	11,856	11,742	12,828	12,955
10%	19,233	17,388	17,307	18,218	17,660	20,122	23,345	19,676	23,099	20,188	19,466	19,309
365-day ave	37,499	37,421	37,371	37,361	37,358	37,233	37,096	37,290	37,330	37,741	37,809	37,794
90%	55,429	55,837	58,645	62,939	63,299	55,436	55,464	56,665	57,351	58,753	55,869	55,610
365-day max	97,624	98,207	99,590	100,900	104,131	105,191	102,889	96,777	97,841	97,349	97,829	97,777



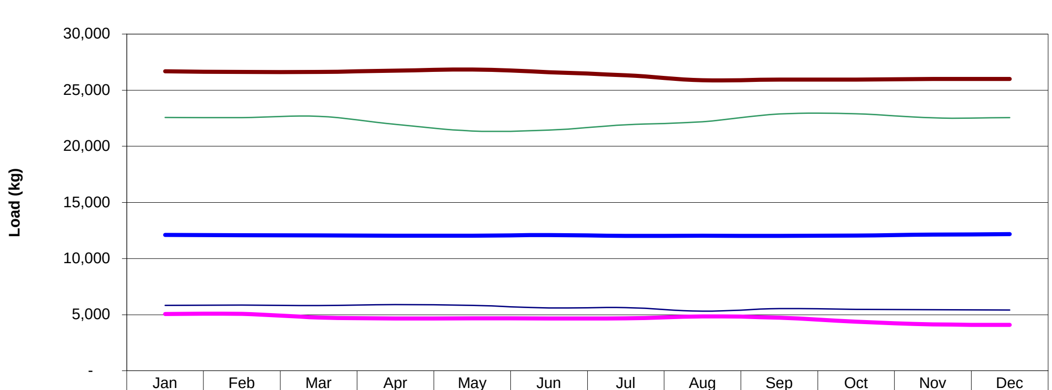
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
365-day min	1,264	1,179	954	991	932	640	921	1,091	754	745	929	934
10%	1,513	1,572	1,493	1,215	1,210	1,414	1,675	1,527	1,760	1,803	1,494	1,475
365-day ave	4,017	3,990	3,968	3,964	3,981	3,971	3,960	3,982	3,985	4,046	4,060	4,060
90%	6,717	6,397	8,339	9,056	9,080	8,450	8,667	8,808	8,835	8,372	8,358	9,054
365-day max	17,944	17,988	18,102	18,208	18,437	18,421	18,103	17,337	17,957	17,926	17,953	17,950

STA-6 3-Yr Cumulative Flows



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3-yr min	65,732	66,096	66,424	65,983	66,059	66,201	66,549	69,044	67,406	62,823	59,065	58,378
10%	69,393	69,109	67,074	66,383	66,353	69,700	74,069	69,629	74,066	73,269	72,792	72,369
3-yr ave	111,911	111,941	111,867	111,721	111,754	112,069	111,612	111,418	111,512	111,464	111,633	111,813
90%	145,795	145,784	149,721	154,377	153,101	152,118	153,338	152,057	153,708	148,168	145,525	145,634
3-yr max	187,176	186,763	186,763	188,075	189,631	189,845	187,834	183,114	184,235	183,608	183,856	184,475

STA-6 3-Yr Cumulative Loads



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3-yr min	5,060	5,070	4,749	4,665	4,670	4,662	4,680	4,847	4,733	4,367	4,125	4,102
10%	5,823	5,856	5,813	5,910	5,821	5,606	5,624	5,311	5,542	5,483	5,455	5,423
3-yr ave	12,109	12,072	12,067	12,039	12,040	12,087	12,026	12,035	12,019	12,047	12,133	12,168
90%	22,558	22,555	22,667	21,963	21,363	21,447	21,913	22,191	22,879	22,898	22,538	22,544
3-yr max	26,674	26,637	26,637	26,745	26,850	26,598	26,323	25,891	25,952	25,952	25,992	25,992