



**Public Works Department**

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October 14, 2021

TO: Dan Huff, City Manager  
FROM: Andy Peters, Operations Supervisor

**RE: 2021 Sludge Judge Results**

Mr. Huff,

RESULTS

An independent Sludge Judge of Lagoon 1 was performed on August 27<sup>th</sup> 2021; followed by Lagoon 2 and the Aeration Basin on October 27<sup>th</sup> 2021. The total solids measured in all three lagoons combined is: **4899 dry tons**

DATA AND CALCULATIONS

Table 1 summarizes each sample taken, the % solids found, the geometry of the section, and the totals. The previous year's findings are also summarized for comparison.

METHODOLOGICAL CHANGES

In the past, the drafter of the annual sludge judge report generated the totals by averaging the total suspended solids (TSS) concentration of all samples, the average depth of all samples, and taking that total as a rectangle stretched over an area equal to the area of the lagoons as reported on As-built Drawings. This year, each subsection has been carefully measured, and the concentration and depths of the samples were extended only over the sections they occupy. This produces a more accurate estimate because the higher density solids are only assumed to occupy the space they actually occupy within the lagoon, while lower density solids occupy the rest. The specific geometry of each section is recorded in the "dimensions" column of Table 1.

Respectfully

**Andy Peters**

City of Molalla

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CC: Jake Ehredt, Lead Operator, City of Molalla

## NOTES

### Definitions (Def)

1. DRY TONS: equivalent *dry short tonnage* of sludge in a section
2. GALLONS SLUDGE: gallons of sludge in a section
3. SLUDGE DEPTH: average depth of sludge measured in a section (inches)
4. ACRES: surface area (in acres), of a section
5. DENSITY: The weight of a dry gallon of sludge

### Axioms (Ax):

1. There are 27,154 gallons in one acre-inch.
2. There are 2000 lbs in a short ton.
3. One acre is 43,560 square feet.
4. DENSITY is 18.48 lbs/gal (specific gravity 2.2, estimate)

### Equations (Eq):

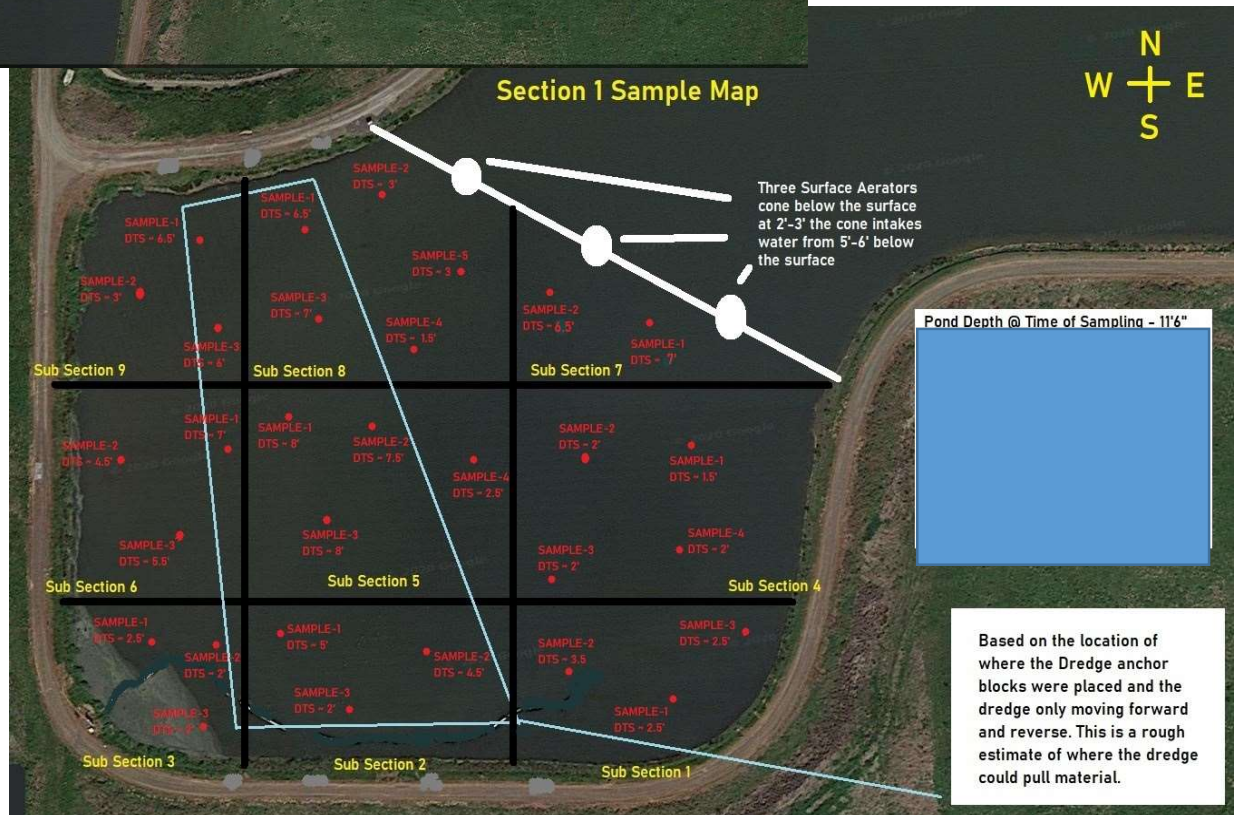
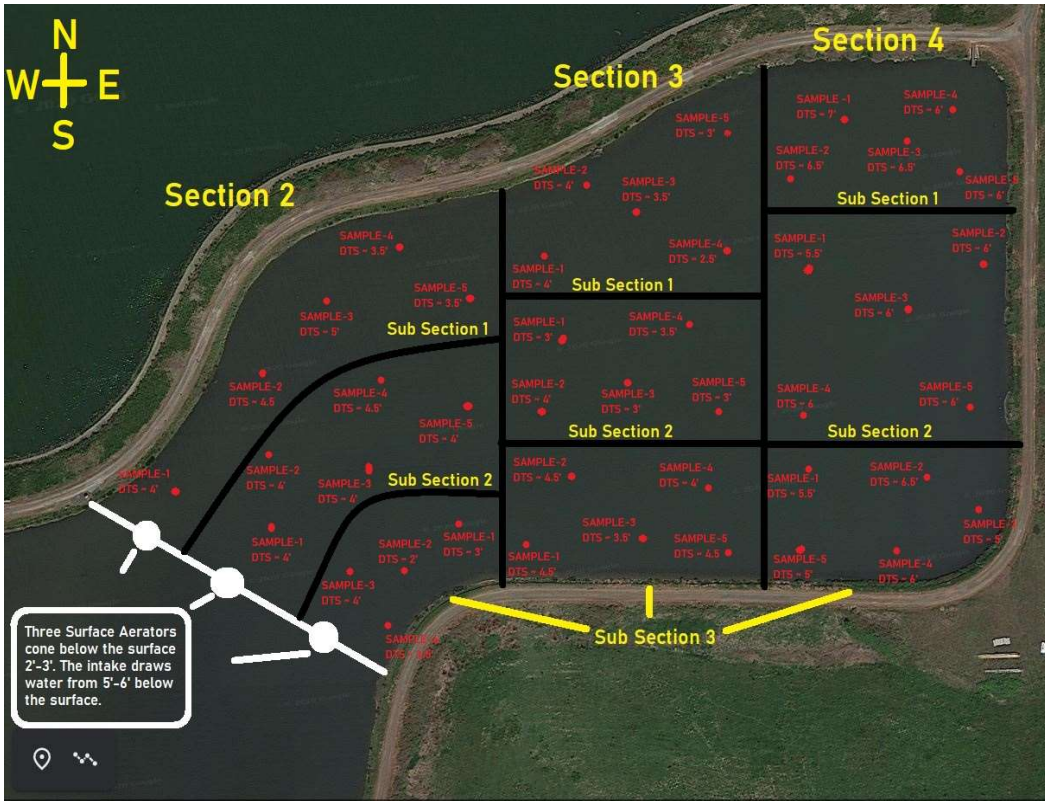
1.  $GALLONS\ SLUDGE = SLUDGE\ DEPTH * ACRES * 27,154$  (by Ax 1)
2.  $DRY\ TONS = (GALLONS\ SLUDGE * DENSITY) / 2000$  (by Ax 2)

Sludge Judge 2021, Table 1

	measured depth to sludge (ft, each sample)	average depth to sludge (in)	dimensions (ft)	area (sq feet)	area (acres)	sludge (gallons)	TSS Measured (each sample)	Average TSS	Dry gallons	Short Dry Tons, Year 2021			
<b>Lagoon 1</b>													
<b>Section 1</b>													
Subsection 1	2.6', 1.6', and 1.9'	24.4	189x102 rectangle minus a right triangle of base/height 77x102	15,351	0.35	233,492	4.99%, 2.76% and 5.11%	4.29%	10,009	92			
Subsection 2	3.0', 2.9', and 2.8'	34.8	176x102 rectangle	17,952	0.41	389,438	6.50%, 4.90% and 6.80%	6.07%	23,626	218			
Subsection 3	1.3', 2.4', 1.5'	20.8	112x102 rectangle minus right triangle of base/height 48x42	10,416	0.24	135,055	5.39%, 4.56%, 5.00%	4.98%	6,722	62			
Subsection 4	1.0', 2.3', 1.6', 1.0'	17.7	195x144 rectangle	28,080	0.64	309,825	4.11%, 5.63%, 3.10%, 5.38%	4.56%	14,113	130			
Subsection 5	6.4', 7.2', 7.1', 2.0'	68.1	176x144 rectangle	25,344	0.58	1,075,891	4.16%, 2.73%, 3.20%, 3.11%	3.30%	35,504	328			
Subsection 6	5.5', 3.0', 4.3'	51.2	109x144 rectangle	15,696	0.36	500,962	5.77%, 5.63%, 5.21%	5.54%	27,737	256			
Subsection 7	5.0', 5.3'	61.8	a right triangle with base/height 208x118	12,272	0.28	472,770	5.66%, 5.91%	5.79%	27,350	253			
Subsection 8	5.9', 3.2', 5.9', 2.3', and 2.6'	47.8	176x135 rectangle	23,760	0.55	707,386	6.90%, 5.83%, 5.63%, 4.19%, 3.79%	5.27%	37,265	344			
Subsection 9	6.8', 5.1', and 4.3'	64.8	109x125 rectangle	13,625	0.31	550,373	5.62%, 4.91%, and 3.77%	4.77%	26,253	243			
<b>Section 2</b>													
Subsection 1	3.0', 4.9', 3.7', 3.0', 3.0'	42.2	rectangles 168x88 and 197x147, plus an equilateral triangle 109' base	49,683	1.14	1,308,211	6.10%, 5.33%, 3.97%, 5.11%, 5.11%	5.12%	67,033	619			
Subsection 2	4.4', 3.8', 4.2', 4.9', 2.9'	48.5	rectangles 143x147 and 118x147 plus a right triangle of base/height 109x122	45,016	1.03	1,360,428	6.22%, 5.39%, 6.47%, 5.90%, 4.9%	5.78%	78,578	726			
Subsection 3	2.7', 2.5', 3', 3.7'	35.7	rectangles 88x134 and 97x50, a right triangle with base/height 50x88, and an isosceles triangle with equal sides (a)=84, and (h)=80	20,724	0.48	461,198	6.38%, 6.73%, 5.78%, 4.67%, 5.39%	5.79%	26,703	247			
<b>Section 3</b>													
Subsection 1	2.8', 2', 3.7', 2', 3.9'	2.9	a rectangle 109x260, and a right triangle with base/height 113x243	42,070	0.97	75,528	6.38%, 6.73%, 5.78%, 4.67%, 5.39%	5.79%	4,373	40			
Subsection 2	2.6', 3', 1.7', 2.4', 2'	28.1	a rectangle 260x147	38,220	0.88	669,012	5.90%, 4.76%, 6.54%, 3.98%, 5.87%	5.41%	36,194	334			
Subsection 3	6', 5.9', 5.4', 5.3', 4.8'	65.8	a rectangle 260x126	32,760	0.75	1,342,925	4.03%, 5.49%, 5.74%, 6.21%, 5.89%	5.47%	73,485	679			
<b>Section 4</b>													
Subsection 1	5.8', 6.7', 4.9', 5.0', 4.6'	64.8	a rectangle 239x137	32,743	0.75	1,322,633	5.10%, 6.23%, 5.97%, 4.20%, 3.98%	5.10%	67,454	623			
Subsection 2	5.1', 5.4', 4.2', 5.8', 6'	63.6	a rectangle 239x214	51,146	1.17	2,027,752	5.23%, 6.90%, 3.62%, 5.30%, 6.87%	5.58%	113,149	1,045			
Subsection 3	4.3', 5.6', 3.0', 5.3', 3.5'	52.1	a rectangle 239x126	30,114	0.69	977,654	3.11%, 4.35%, 6.87%, 4.89%, 5.30%	4.90%	47,905	443			
									<b>Lagoon 1 Total</b>	<b>2,111</b>	year 2020 3079	year 2019 3709	year 2018 6663
<b>Lagoon 2</b>													
<b>Section 1</b>													
	1.7', 1.8', 1.4', 2.3', 1.9', 2.3', 0.8', 0.9, 1.2', 1.4'	18.8	an ellipse where long radius=88' and short radius=47', a right triangle with base/height 302x428, and a rectangle 403x567	306,123	7.03	3,595,198	3.70%, 2.97%, 3.37%, 2.90%, 3.78%, 4.98%, 5.87%, 2.98%, 2.40%, 3.45%	3.64%	130,865	1,209			
<b>Section 2</b>													
	2.9', 2.7', 1.2', 2.4', 2.3', 2.9', 1.2', 0.6', 1.5', 2.3'	24.0	a rectangle 327x454 and a right triangle with base/height 327x81	161,702	3.71	2,419,197	3.89%, 4.36%, 3.89%, 4.14%, 4.33%, 2.46%, 4.53%, 3.87%, 3.01%, 2.11%	3.66%	88,543	818			
<b>Section 3</b>													
	2.1', 1.8', 3.0', 2.1', 1.8', 0.6', 0.9', 1.2', 1.0', 0.8'	18.4	a rectangle 435x259, and a right triangle with base/height 220x415	158,315	3.63	1,811,927	2.98%, 2.45%, 2.66%, 3.45%, 2.23%, 3.03%, 2.63%, 3.90%, 3.11%, 3.46%	2.99%	54,177	501			
									<b>Lagoon 2 Total</b>	<b>2,528</b>	year 2020 3256	year 2019 2628	year 2018 207
<b>Aeration Basin</b>													
	2.6', 2.9', 3.1', 2.4', 2.0', 1.9', 0.8', 0.6', 0.2'	22.0	a rectangle 60x90	5440	0.13	74,674	41.00%, 38.90%, 42.00%, 39.00%, 33.00%, 38.67%, 29.56%, 33.87%, 43.00%	37.67%	28,130	260			
									<b>Aeration Basin Total</b>	<b>260</b>	year 2020 2.06	year 2019 1.37	year 2018 167
									<b>Grand Total</b>	<b>4,899</b>	6337.06	6338.37	7037

Section area maps as defined in 2020, and used this year (2021) for geometric measurements in Table 1 (Dimensions column).

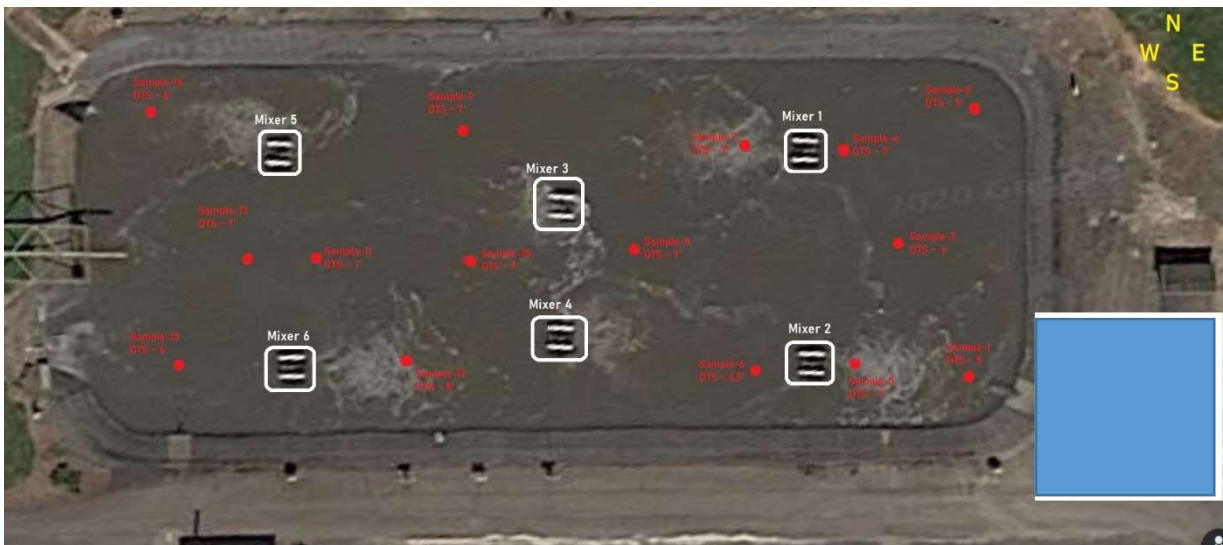
Lagoon 1



Lagoon 2



Aeration Basin



# Example subsection Geometries

