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DETAILED ENGINEERING REPORT

SVZ-USA, Inc. Wastewater Treatment Lagoon

OTHELLO, WASHINGTON

February 2, 2023

Shannon & Wilson No: 109659-001

SHANNON & WILSON

Submitted To: SVZ-USA, Inc.
1700 N Broadway Ave
Othello, WA 99344
Attn: Mr. Mason Mackey

Subject: DETAILED ENGINEERING REPORT, SVZ-USA, INC. WASTEWATER TREATMENT LAGOON, OTHELLO, WASHINGTON

Shannon & Wilson prepared this report and participated in this project as a subconsultant to SVZ-USA, Inc. Our scope of services was specified in Agreement Number 109659-P with SVZ dated August 3, 2022. This report presents the results of our wastewater treatment lagoon flow rate and nutrient loading evaluation and our conclusions and recommendations and was prepared by the undersigned.

We appreciate the opportunity to be of service to you on this project. If you have questions concerning this report, or we may be of further service, please contact us.

Sincerely,

SHANNON & WILSON

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EXECUTIVE SUMMARY

Shannon & Wilson prepared this Detailed Engineering Report for the SVZ-USA, Inc. plant in Othello, Washington (Figure 1). This report presents the results of our wastewater treatment lagoon flow rate and nutrient loading evaluation, and our conclusions and recommendations regarding the feasibility of raising or eliminating the plant's current daily flow limit to the treatment lagoon.

The SVZ Othello facility is a fruit and vegetable processing plant located at 1700 N. Broadway Avenue in Othello, Washington. Wastewater from the plant is discharged to an 8.96 million gallon (MG) lined treatment lagoon and then to either land treatment application fields or the City of Othello's (City's) Publicly Owned Treatment Works (POTW).

Shannon & Wilson completed a water balance for SVZ's wastewater and analyzed the lagoon treatment efficiency, nutrient balances for the treatment fields, and flow volumes and constituent concentrations of wastewater discharged to the POTW. Our analyses showed that SVZ's current wastewater treatment and discharge practices prevent lagoon overflow, and the treatment system is capable of handling semi-regular daily flow exceedances. Additionally, exceedances of nitrogen, sodium, five-day biological oxygen demand (BOD_5), and fixed dissolved solids (FDS) are likely the result of more wastewater applied to the treatment fields than originally planned, rather than deficiencies in lagoon treatment. Finally, the underlying aquifer does not appear to have been negatively impacted by use of the treatment fields based on our review of provided data.

We recommend that the daily maximum flow limit to the treatment lagoon (175,000 gallons per day [gpd]) be removed, but that the monthly average limit of 150,000 gpd be retained. We also recommend that SVZ continue operation of the land treatment application fields, monthly wastewater and groundwater sampling, discharge of excess wastewater to the POTW, and annual Irrigation and Crop Management Plans (ICMPs); expand the wastewater analyte list to include additional constituents; and consider applying more freshwater to the treatment fields to offset high nutrient balances.

CONTENTS

Exhibits

Tables

Figures

CONTENTS

Appendices

ACRONYMS

bgs	below ground surface
BOD_5	five-day biological oxygen demand
BTEX	benzene, toluene, ethylbenzene, and xylenes
City	City of Othello
Ecology	Washington State Department of Ecology
FDS	fixed dissolved solids
gpd	gallons per day
ICMP	Irrigation and Crop Management Plan
in/hr	inches per hour
lb/acre/day	pounds per acre per day
lb/day	pounds per day
MG	million gallon
mg/L	milligrams per liter
PEC	Potholes East Canal
POTW	Publicly Owned Treatment Works
TDS	total dissolved solids
TPH	total petroleum hydrocarbons
TSS	total suspended solids

1 INTRODUCTION

Shannon & Wilson prepared this Detailed Engineering Report for the SVZ plant in Othello, Washington (Figure 1). We understand that SVZ is considering an amendment to their current Washington State Waste Discharge Permit (#ST0008077) by raising or removing their daily flow limit (175,000 gallons per day [gpd]) to the wastewater treatment lagoon. We also understand that SVZ has been consulting with the Washington State Department of Ecology (Ecology) on this amendment, and that Ecology requires an evaluation of SVZ's process wastewater flow, lagoon storage, and treatment capacity to update the permit. In this report, we present the results of our wastewater treatment system evaluation, and our conclusions and recommendations regarding the feasibility of raising or eliminating the current daily flow maximum limit.

To prepare this report, Shannon & Wilson:

- Discussed the wastewater evaluation with Mr. Mason Mackey of SVZ in preparation of our proposed scope of services;
- Reviewed Washington Administrative Code Section 173-240-130 for report content requirements;
- Completed a water balance for plant wastewater;
- Analyzed the treatment efficiency of the lagoon;
- Analyzed nutrient balances for the land treatment application fields; and
- Analyzed flow volumes and constituent concentrations of excess wastewater pumped to the City's POTW.

Shannon & Wilson prepared this report for the exclusive use of SVZ in the updating of their discharge permit. We conducted our work in accordance with our July 21, 2022, proposal and obtained authorization to proceed through a signed proposal dated August 3, 2022.

2 SITE DESCRIPTION

The SVZ Othello facility is a fruit and vegetable processing plant located at 1700 N. Broadway Avenue in Othello, Washington. The site is bordered to the north and east by agriculture fields, to the south by industrial food and/or agricultural facilities, and to the west by Broadway Avenue and undeveloped land. The site is primarily level with a slight downward slope towards the Potholes East Canal (PEC) west of Broadway Avenue (Figure 1).

2.1 Soil Types and Subsurface Review

The U.S. Department of Agriculture Soil Survey (U.S. Natural Resources Conservation Service, 2022) identified two primary soil types beneath the wastewater treatment lagoon and fields; Scootney loam and Burke silt loam. Scootney loam is described as a well-drained soil with a moderately high to high capacity to transmit water (0.57 to 1.98 inches per hour [in/hr]). Burke silt loams are also described as well-drained, but are considered to have a very low to moderately low capacity to transmit water (0 to 0.6 in/hr).

Resource Protection Well Reports for two site wells (obtained via Ecology's website [Ecology, 2022b]) indicate the lagoon and treatment fields are underlain by 2 to 3 feet of silt, then sand and gravel to 13 feet below ground surface (bgs). The report for well MW2R (Ecology Well ID number BHW 892) indicated silt was present to 22 feet bgs and clay to 25 feet bgs, while the report for well MW3R (Ecology Well ID number BHW 891) showed silt from 13 to 16 feet bgs, then sand and gravel to 29 feet bgs, and then silt down to 34 feet bgs.

2.2 Groundwater

The depth to groundwater at the plant, lagoon, and treatment fields is measured monthly from six monitoring wells (Figure 2). Based on measurements from 2019 to 2021 provided by SVZ, the depth to groundwater to the east of the lagoon is approximately 8 to 10 feet bgs year-round. The depth to groundwater around the plant itself is more variable, ranging from approximately 14 to 32 feet bgs. This data indicates that site groundwater flows to the south and southwest, likely from the agricultural fields to the east and towards the slope above the PEC.

3 FACILITY DESCRIPTION

The SVZ plant turns raw fruit and vegetable materials into concentrates and purees that are sold as ingredients to other food industries. According to the March 2022 Permit Renewal Application for ST0008077, the plant produces approximately 11,000 gallons of concentrates and purees each year (Ecology, 2022a).

Process water for the plant is provided by the City's public water system. SVZ uses an average of 105,000 gpd of potable water and has a maximum consumption limit of 250,000 gpd. The facility typically operates 5 days per week, 49 weeks per year, which results in an average annual consumption of 26.8 MG of potable water.

Based on flow data provided by SVZ, the plant produced approximately 32.5 MG of wastewater between 2018 and 2021. SVZ's wastewater is discharged to a lined lagoon located approximately 100 feet northeast of the plant (Figure 2). The lagoon is divided into two chambers; the smaller, southern chamber can hold 1.96 MG and the larger, northern chamber can hold 7.0 MG, for a total capacity of 8.96 MG. Wastewater in the northern chamber can be discharged to either a sprinkler system that applies the water to agricultural treatment fields, or to the City's POTW. Supplemental irrigation water for the treatment fields, if needed, is provided by the East Columbia Basin Irrigation District.

The land treatment application system is composed of two fields, Field 1 and Field 3 (Figure 2). Field 1 is east of the plant and covers 15.9 acres. Field 3 is east of the wastewater lagoon and north of Field 1 and covers 16.7 acres. The fields have historically been planted with various types of hay. A third field, Field 2 (2.5 acres), is not used for land treatment due to its small size and relatively shallow soil depth (approximately 1-foot thick). The system is monitored via flow meters and collection of monthly wastewater and groundwater samples.

SVZ entered into an agreement with the City in 2016 (City Agreement) to discharge a portion of their wastewater to the POTW (City of Othello, 2016). This allowed SVZ to remove water from the lagoon without stopping plant operations. The City Agreement limits the volume of wastewater that can be discharged to the POTW and the concentrations of certain constituents (e.g., nitrogen, BOD_5, and metals).

4 TREATMENT SYSTEM ANALYSES

SVZ provided the following data to aid in the wastewater treatment system evaluation:

- Daily water meter readings for 2018, 2019, 2020, and 2021. Meters captured flow for plant effluent going to the lagoon, lagoon water going to the treatment fields, and lagoon water going to the POTW.
- Manual measurements of the distance from the top of the lagoon dike to the water surface.
- Lagoon dimensions.
- Wastewater and groundwater analytical results from 2019, 2020, and 2021.

Because analytical results were not available for 2018, the average monthly values for 2019, 2020, and 2021 were calculated and used for nutrient loading analyses.

4.1 Water Balance

4.1.1 Calculations

The following calculations were performed to complete the water balance:

1. Volume of wastewater in the lagoon at the time of each manual measurement. These values were later used to calculate lagoon volume for days without a manual measurement (see Step 4).
2. Daily flow from the plant to the treatment fields and/or the POTW (subtract the previous day meter readings from the current day readings).
3. Daily change in lagoon volume (subtract gallons removed from the lagoon from gallons added).
4. Daily lagoon volume (add current day change in lagoon volume to the previous day lagoon volume, using volumes calculated in Step 1 as starting points).
5. Corrected daily lagoon volume (add gains from precipitation and subtract losses due to evapotranspiration).

Daily precipitation totals were obtained from the National Oceanic and Atmospheric Administration's Othello weather station (#US1WAAD0003). Evapotranspiration values were calculated using the equations shown in Exhibit 4-1.

Exhibit 4-1: Evapotranspiration Equations

Equations	Variable	Definition
$\mathrm{ET}_{mm/day} = 0.001224(T_{mean} + 20)([T_{max} - T_{min}]^{0.4})\mathrm{Ra}$ $\mathrm{ET}_{in/day} = ET_{mm/day} * 0.0394$	$\mathrm{ET}_{\mathrm{mm/day}}$	Evapotranspiration (mm/day)
	$\mathrm{T}_{\mathrm{mean}}$	Average monthly temperature (°C) [1]
	$\mathrm{T}_{\mathrm{max}}$	Maximum monthly temperature (°C) [1]
	$\mathrm{T}_{\mathrm{min}}$	Minimum monthly temperature (°C) [1]
	Ra	Extraterrestrial radiation ($\mathrm{MJm^{-2}day^{-1}}$) [2]
	$\mathrm{ET}_{\mathrm{in/day}}$	Evapotranspiration (in/day) [3]

NOTES:

1 Monthly average, maximum, and minimum temperatures are from the Moses Lake, Washington National Oceanic and Atmospheric Administration weather station (#USW00024110) because the Othello station does not collect temperature data. Moses Lake is approximately 25 miles north-northwest of Othello and is in a similar climate zone.

2 Monthly extraterrestrial radiation values are from Table 4 of *Validation of the Stead-State Hoffman Conceptual Model for Determination of Minimum Crop Leaching Requirements and Stakeholder Outreach using CSUID* (Quinn and others, 2017)

3 $\mathrm{ET}_{\mathrm{in/day}}$ used in the water balance.

°C = degrees Celsius; in/day = inches per day; $\mathrm{MJm^{-2}day^{-1}}$ = megajoules per square meter per day; mm/day = millimeters per day

A representative water balanced calculation table is provided in Appendix A.

4.1.2 Results and Discussion

Flow values were compared to the daily and monthly limits set forth in ST0008077 (Table 1) and the City Agreement (Table 2). The maximum flow for wastewater to the treatment lagoon (175,000 gpd) was exceeded 135 times between 2018 and 2021, with values ranging from approximately 175,300 to 445,400 gpd. However, the monthly average flow limit of 150,000 gpd was not exceeded and the treatment lagoon did not exceed its maximum capacity (8.96 MG) during this same period. Furthermore, discharge to the POTW exceeded the monthly average discharge limit (80,000 gpd) only once.

In our opinion, these results, taken together, demonstrate that SVZ's current wastewater treatment and discharge practices are sufficient to prevent lagoon overflow during typical plant operations. Additionally, the system is capable of handling semi-regular daily flow exceedances without risking overflow of the lagoon or requiring excessive discharge to the POTW.

4.2 Lagoon Treatment Efficiency

4.2.1 Calculations

The efficiency of the treatment lagoon was evaluated by analyzing nutrient loading to the treatment fields. Nutrient loads were calculated using flow volumes to the fields and constituent concentrations from periodic analytical samples, specifically BOD_5, FDS, and total Kjeldahl nitrogen. Daily nutrient loads were calculated by applying measured constituent concentrations to the day of the measurement plus all subsequent days before the next measurement. For example, if FDS was measured at 10 milligrams per liter (mg/L) on June 1 and 20 mg/L on July 1, daily FDS loads for June 2 to June 30 were assumed to be 10 mg/L.

Daily nutrient load calculations are presented in Appendix A.

4.2.2 Results and Discussion

Ninety (90) exceedances of the daily BOD_5 application limit (100 pounds per acre per day [lb/acre/day]) were identified between 2018 and 2021 and ranged from 103 to 508 lb/acre/day. However, because these exceedances represent only 9% of the plant typical operating time, we believe the lagoon does sufficient job of treating BOD_5.

The daily FDS limit (11 lb/acre/day) was exceeded 225 times between 2018 and 2021, with exceedances ranging from 22 to 514 lb/acre/day. However, the yearly average FDS limit (4,000 lb/acre/year) was not exceeded during this same time. In our opinion, this suggests that, in the longer term, the lagoon does a sufficient job of treating FDS.

Three exceedances of the yearly total nitrogen application limit (165 lb/acre/day) were identified between 2018 and 2021 and ranged from 267 to 590 lb/acre/year. Initially, this may suggest the lagoon does not treat nitrogen to an acceptable level. However, review of annual ICMPs suggests that the nitrogen loading limit was established under the assumption that a maximum of approximately 16 MG of wastewater would be applied to the treatment fields each year. The actual volumes applied to the fields were 4.8 MG for 2018, 25.5 MG for 2019, 17.3 MG for 2020, and 25.6 MG for 2021. Given the applied wastewater to the treatment fields exceeded the assumed maximum, we believe the nitrogen exceedances are not indicative of the lagoon treatment efficiency, but instead are the result of excessive wastewater application.

4.3 Nutrient Balances

The goal of the land treatment application system is to match application of constituents in wastewater (e.g., nitrogen) with consumption of those same constituents by treatment crops, microorganisms, and other natural processes. The ideal balance of constituents at the end of the year is zero. Soiltest Farm Consultants, Inc. conducted detailed nutrient balances for the treatment fields in 2019, 2020, 2021, and 2022 as part of the site annual ICMP. Shannon & Wilson reviewed the nutrient balance reports to evaluate the effectiveness of the land treatment application system. Copies of the ICMPs are included in Appendix B.

Soiltest identified nitrogen, sodium, BOD_5, and FDS as the wastewater constituents most likely to cause soil, environmental, and/or groundwater concerns. The yearly nutrient balances for these constituents are summarized in Exhibit 6-1 for 2018, 2019, 2020, and 2021. Positive balances indicate more of a constituent was added to the soil than removed (via crop uptake and other natural processes), while negative balances indicate more of a constituent was removed than added via wastewater application.

Exhibit 4-2: ICMP Net Nutrient Balances

	Constituent of Concern (lb/ac)[1]				
Year	Nitrogen	Sodium	BOD_5	FDS	Wastewater Applied to Fields (MG)
2018	-278	-16	0	242	4.8
2019	257	5,902	4,845	12,455	25.5
2020	148	1,887	5,179	6,191	17.3
2021	-202	8,443	9,162	28,141	25.6

NOTE:
1 Balance values are for the indicated calendar year only; they do not carry over between years.

Large positive balances for sodium, BOD_5 and FDS were observed in years where more than 20 MG of wastewater was applied to the fields. Such exceedances are not ideal for treatment crop growth and lower the overall effectiveness of the land treatment application system. SVZ has addressed excess sodium and FDS levels in the past by applying gypsum to the treatment fields. More frequent application of freshwater to the field may also reduce sodium, BOD_5 and FDS soil loads.

Nitrogen balances were smaller in magnitude and varied more between positive and negative values. This variation is likely due to soil nitrogen levels being influenced by both wastewater application rates, the presence or absence of a treatment crop, and the growth and uptake properties of the crop. Additionally, if the nitrogen balance is positive, but not too high, fertilizer may not need to be applied to the treatment fields the following year.

4.4 Groundwater Monitoring

Site groundwater is routinely sampled to evaluate whether land treatment application of wastewater has negatively impacted the underlying aquifer. Six groundwater wells are sampled each month, but only two, MW-6 and MW-7, are considered points of compliance for ST0008077. pH, nitrate, and total dissolved solids (TDS) levels from these wells are screened against naturally occurring background values specified in ST0008077 (Table 3), and two consecutive exceedances of a constituent in the same well constitutes a permit exceedance.

Based on our analysis, the following exceedances were identified:

- MW-7 (between July and August 2021) - one nitrate
- MW-7 (between July and November 2019) - four TDS

No permit exceedances were identified in MW-6.

In our opinion, the land treatment application system does not appear to have adversely impacted the aquifer. While 4 TDS exceedances were identified, they account for less than 10% of groundwater samples collected from 2019 to 2021. Additionally, only one nitrogen exceedance was identified in this same period and no TDS exceedances have occurred since November 2019.

4.5 Othello Publicly Owned Treatment Works Discharge

Per the City Agreement, daily wastewater discharge to the POTW is monitored using a flow meter, and wastewater composition is monitored via monthly samples. The wastewater analyte list varies during the year, as presented below:

- Monthly analytes - Ammonia as nitrogen, benzene, chloride, copper, dissolved sulfides, BOD_5, nickel, pH, sulfates, TDS, total suspended solids (TSS), total petroleum hydrocarbons (TPHs), and zinc.
- Yearly analytes - Arsenic; benzene, toluene, ethylbenzene, and xylene (BTEX); cadmium; chromium; lead; mercury; molybdenum; oil and grease; selenium; and silver.

Discharge volume and wastewater constituent limits are presented in Table 2.

Between 2018 and 2021, the following exceedances were identified.

- BOD_5 daily limit (1,000 pounds per day [lb/day]) - 2 exceedances, 2,202 and 5,166 lb/day.
- pH acceptable range (5.5 to 9.0) - 2 readings outside the acceptable range, 4.6 and 5.4.
- Sulfate limit (50 mg/L) - 2 exceedances, 120 and 220.4 mg/L.
- TSS limit (300 mg/L) - 22 exceedances ranging from 328 to 2,356 mg/L.
- Monthly average discharge limit (80,000 gpd) - 1 exceedance at 81,904 gpd.

Unfortunately, the available wastewater data did not contain results for the following constituents: arsenic, benzene, BTEX, cadmium, chromium, copper, dissolved sulfides, lead, mercury, oil and grease, selenium, silver, TPH, or zinc. Therefore, exceedances for these constituents could not be identified.

Overall, wastewater discharged from the lagoon to the POTW meets the limits set forth in the City Agreement. While 22 TSS exceedances were documented, they represent less than 2% of the plant operating time between 2018 and 2021, indicating SVZ strives to operate in conformance with the City Agreement. Additionally, constituent exceedances occurred less frequently over time (14 in 2019, 5 in 2020, and 3 in 2021), suggesting SVZ adjusts its treatment and/or discharge practices as needed to meet the City Agreement requirements.

5 CONCLUSIONS

Based on the analyses described in this report, we conclude:

- SVZ's current wastewater treatment and discharge practices prevent lagoon overflow and excessive discharge to the POTW during typical plant operations.
- The wastewater treatment system is capable of handling semi-regular daily flow exceedances without risking overflow of the lagoon or requiring excessive discharge to the POTW.
- The treatment lagoon sufficiently treats wastewater to the chemical limits set in ST0008077 and the City Agreement for the analyzed constituents.

- Fourteen (14) analytes included in the City Agreement were not analyzed between 2018 and 2021.
- Exceedances of the annual total nitrogen limit and large, positive nutrient balances for sodium, BOD_5, and FDS are likely the result of more wastewater being applied to the treatment fields than originally planned.
- The underlying aquifer does not appear to be negatively impacted by use of the land treatment application fields.

6 RECOMMENDATIONS

Based on the analyses described in this report, the requirements set forth in ST0008077 and the City Agreement, and SVZ's desire to raise or remove the daily flow limit to the wastewater treatment lagoon, we recommend:

- Remove the daily maximum flow limit to the treatment lagoon but keep the monthly average limit of 150,000 gpd;
- Continue operation of the land application treatment fields, monthly wastewater and groundwater sampling, discharge of excess wastewater to the POTW, and annual ICMPs;
- Expand the wastewater analyte list to include the missing constituents listed in Section 4.5; and
- Consider applying more freshwater to the treatment fields to offset high nutrient balances and increase the volume of wastewater discharged to the POTW to compensate for less being applied to the treatment fields.

Shannon & Wilson has prepared the document, "Important Information About Your Environmental Report," to assist you and others in understanding the use and limitations of our reports.

7 REFERENCES

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Table 1 - Washington State Discharge Permit Exceedances (2018 to 2021)

Parameter	Units	Compliance Period	Discharge Limit	Exceedances Number	Exceedances Range
Flow					
Plant to Lagoon	gal	Daily Max.	175,000	135	175,302 to 445,392
	gal/day	Monthly Ave.	150,000	0	N/A
Lagoon Volume	MG	Continuous	8.96	0	N/A
Total Wastewater to Fields[1]	MG	2021	15.9	1	33.9
		2020	14.2	1	19.5
		2019	10	1	35.5
		2018	0	1	34.2
Chemical Analytes					
BOD5 to Fields	lb/acre/day	Daily Max.	100	90	103 to 508
FDS	lb/acre/day	Daily Max.	11	225	22 to 514
	lb/acre/year	Yearly Ave.	4,000	0	N/A
Total Nitrogen	lb/acre	Yearly Total	165	3	267 to 590

NOTES:
1 Yearly totals vary based on the Irrigation and Crop Management Plan (ICMP)
— = no discharge limit; BOD5 = five-day biological oxygen demand; BTEX = benzene, toluene, ethlybenzene, and xylenes; FDS = fixed dissolved solids; gal = gallon(s); lb = pound(s); Max. = maximum; MG = million gallons; mg/L = milligramt per liter; N/A = not applicable; POTW = Publicly Operated Treatment Works; TPH = total petroleum hydrocarbons

Table 2 - Othello Discharge Agreement Exceedances (2018 to 2021)

Parameter	Units	Compliance Period	Othello Agreement	Exceedances Number	Exceedances Range
Flow	gal/day	Monthly Ave.	80,000	1	81,904
Arsenic	mg/L	Yearly	0.48	No records of analyses	
Benzene	mg/L	Monthly	0.05	No records of analyses	
BOD5	lb/day	Daily Max.	1,000	2	2,202 to 5,166
	mg/L	Daily Max.	3,000	0	N/A
BTEX	mg/L	Yearly	0.75	No records of analyses	
Cadmium	mg/L	Yearly	0.049	No records of analyses	
Chloride	mg/L	Monthly	1,000	0	N/A
Chromium	mg/L	Yearly	5.0	No records of analyses	
Copper	mg/L	Monthly	0.3	No records of analyses	
Dissolved Sulfides	mg/L	Monthly	0.5	No records of analyses	
Lead	mg/L	Yearly	0.19	No records of analyses	
Mercury	mg/L	Yearly	0.002	No records of analyses	
Molybdenum	mg/L	Yearly	1.14	No records of analyses	
Nickel	mg/L	Monthly	2.0	No records of analyses	
Oil and Grease	mg/L	Yearly	300	No records of analyses	
pH		Monthly	5.5 to 9.0	2	4.6 to 5.4
Selenium	mg/L	Yearly	0.419	No records of analyses	
Silver	mg/L	Yearly	0.06	No records of analyses	
Sulfates	mg/L	Monthly	50	2	120 to 220.4
Total Ammonia, as Nitrogen	mg/L	Daily Max.	60	0	N/A
Total Dissolved Solids	mg/L	Monthly	5,000	0	N/A
Total Suspended Solids	mg/L	Daily Max.	300	22	328 to 2,356
TPH	mg/L	Monthly	50	No records of analyses	
Zinc	mg/L	Monthly	4.18	No records of analyses	

NOTES:
— = no discharge limit; BOD5 = five-day biological oxygen demand; BTEX = benzene, toluene, ethlybenzene, and xylenes; FDS = fixed dissolved solids; gal = gallon(s); lb = pound(s); Max. = maximum; MG = million gallons; mg/L = milligramt per liter; N/A = not applicable; POTW = Publicly Operated Treatment Works; TPH = total petroleum hydrocarbons

Table 3 - Groundwater Exceedances[1], Wells MW-6 and MW-7[2] (2018 to 2021)

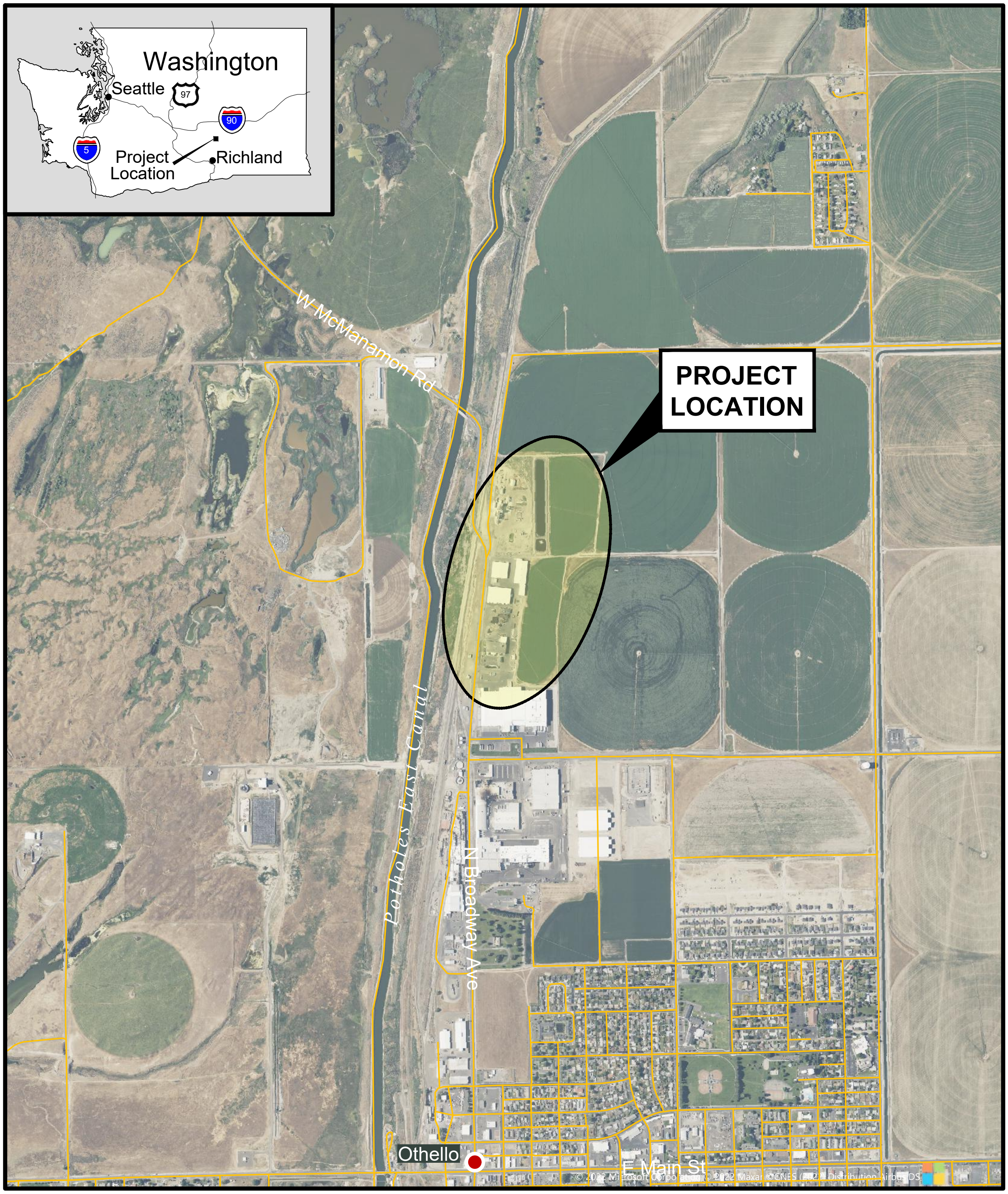
				MW-6			MW-7		
Parameter	Units	Compliance Period	Enforcement Limit	Exceedances	Exceedance Range	Permit Exceedances	Exceedances	Exceedance Range	Permit Exceedances
Ammonia (as nitrogen)	mg/L	Quarterly	—	—	—	—	—	—	—
Biocarbonate alkalinity	mg/L as $CaCO_3$	Quarterly	—	—	—	—	—	—	—
Calcium	mg/L	Quarterly	—	—	—	—	—	—	—
Chloride	mg/L	Quarterly	—	—	—	—	—	—	—
COD	mg/L	Quarterly	—	—	—	—	—	—	—
Depth to groundwater	ft	Monthly	—	—	—	—	—	—	—
Ferrous Iron	+ or -	Monthly	—	—	—	—	—	—	—
Magnesium	mg/L	Quarterly	—	—	—	—	—	—	—
Nitrate	mg/L	Monthly	18.1	0	N/A	0	2	18.3 to 19.9	1
pH		Monthly	6.5 to 8.5	0	N/A	0	0	N/A	0
Potassium	mg/L	Quarterly	—	—	—	—	—	—	—
Sodium	mg/L	Quarterly	—	—	—	—	—	—	—
Sulfate	mg/L	Quarterly	—	—	—	—	—	—	—
TDS	mg/L	Monthly	916	0	N/A	0	5	982 to 1014	4
TKN	mg/L	Quarterly	—	—	—	—	—		—

NOTES:

1 Two consecutive exceedances for the same parameter at the same well is an exceedance.

2 Point of compliance for groundwater enforcement limits.

— = no enforcement limit; + or - = presence or absence; $CaCO_3$ = calcium carbonate; COD = chemical oxygen demand; ft =feet; mg/L = milligramt per liter; N/A = not applicable; TDS = total dissolved solids; TKN = Total Kjeldahl Nitrogen



0 2,000 4,000

Approximate Scale in Feet

Detailed Engineering Report
SVZ USA, Inc. Wastewater Treatment Lagoon
Othello, Washington

VICINITY MAP

February 2023 109659-001

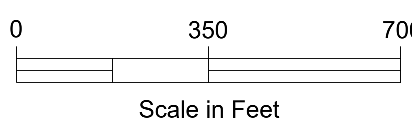
SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 1

Filename: C:\Users\jrs\CAD Group Dropbox\JDrive_PAS\109659\001\109659-001 Vicinity Map.dwg Date: 01-03-2023 Login: JRS

LEGEND

MW-2R ⊕ Groundwater Monitoring Well Designation and Approximate Location



Detailed Engineering Report
SVZ USA, Inc. Wastewater Treatment Lagoon
Othello, Washington

SERVICE AREA

February 2023 109659-001

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 2

FIG. 2

APPENDIX A: REPRESENTATIVE ANALYSIS TABLES

Appendix A

Representative Analysis Tables

CONTENTS

Table A-1: Representative Water Balance Calculation Table

	Meter Readings									Initial Lagoon Volume Calculation				
	Effluent to Lagoon		Lagoon to Irrigation					Lagoon to City		Change in Lagoon Volume		Top Dike to Water Surface		Lagoon Volume
Jan-18	Meter Reading	Gallons to Lagoon	Meter Reading	Gallons to Field 1	Meter Reading	Gallons to Field 3	Total Gallons to Fields	Reading	Gallons to City	Gallons	MG	Inches	Feet	MG
Limit(s)	—	Daily Max: 175,000 G/day Month Ave: 150,000 G/day	—	—	—	—	Year Total: 0 MG	—	Month Ave: 80,000 G/day	—	—	—	—	—
Date														
1	2,223,866	3,715	27,858,000	-	8,984,600	-	-	15,325,931	58,364	54649	0.055	—	—	—
2	2,227,581	4,036	27,858,000	-	8,984,600	-	-	15,384,295	58,923	54887	0.055	—	—	—
3	2,231,617	63,566	27,858,000	-	8,984,600	-	-	15,443,218	36,079	27487	0.027	247	20.6	3.39
4	2,295,183	124,344	27,858,000	-	8,984,600	-	-	15,479,297	39,888	84456	0.084	—	19.8	3.47
5	2,419,527	164,734	27,858,000	-	8,984,600	-	-	15,519,185	40,608	124126	0.124	—	19.3	3.60
6	2,584,261	24,941	27,858,000	-	8,984,600	-	-	15,559,793	41,184	16243	0.016	—	19.4	3.58
7	2,609,202	6,005	27,858,000	-	8,984,600	-	-	15,600,977	41,328	35323	0.035	—	19.5	3.54
8	2,615,207	43,596	27,858,000	-	8,984,600	-	-	15,642,305	53,201	9605	0.010	—	19.5	3.53
9	2,658,803	50,779	27,858,000	-	8,984,600	-	-	15,695,506	38,160	12619	0.013	—	19.5	3.55
10	2,709,582	54,752	27,858,000	-	8,984,600	-	-	15,733,666	43,488	11264	0.011	—	19.4	3.56
11	2,764,334	89,454	27,858,000	-	8,984,600	-	-	15,777,154	39,312	50142	0.050	—	19.2	3.61
12	2,853,788	57,299	27,858,000	-	8,984,600	-	-	15,816,466	39,168	18131	0.018	253	21.1	3.28
13	2,911,087	35,270	27,858,000	-	8,984,600	-	-	15,855,634	39,456	4186	0.004	—	20.7	3.27
14	2,946,357	15,034	27,858,000	-	8,984,600	-	-	15,895,090	40,555	25521	0.026	—	20.8	3.25
15	2,961,391	57,947	27,858,000	-	8,984,600	-	-	15,935,645	31,262	26685	0.027	—	20.7	3.27
16	3,019,338	56,418	27,858,000	-	8,984,600	-	-	15,966,907	29,791	26627	0.027	—	20.6	3.30
17	3,075,756	60,445	27,858,000	-	8,984,600	-	-	15,996,698	27,512	32933	0.033	—	20.4	3.33
18	3,136,201	58,927	27,858,000	-	8,984,600	-	-	16,024,210	28,800	30127	0.030	—	20.3	3.36
19	3,195,128	56,246	27,858,000	-	8,984,600	-	-	16,053,010	28,656	27590	0.028	268	22.3	3.01
20	3,251,374	36,900	27,858,000	-	8,984,600	-	-	16,081,666	28,944	7956	0.008	—	21.8	3.02
21	3,288,274	11,179	27,858,000	-	8,984,600	-	-	16,110,610	29,930	18751	0.019	—	21.9	3.00
22	3,299,453	64,842	27,858,000	-	8,984,600	-	-	16,140,540	28,423	36419	0.036	—	21.7	3.03
23	3,364,295	66,811	27,858,000	-	8,984,600	-	-	16,168,963	28,336	38475	0.038	—	21.6	3.07
24	3,431,106	81,396	27,858,000	-	8,984,600	-	-	16,197,299	26,435	54961	0.055	286	23.8	2.70
25	3,512,502	142,490	27,858,000	-	8,984,600	-	-	16,223,734	24,768	117722	0.118	—	22.7	2.81
26	3,654,992	45,084	27,858,000	-	8,984,600	-	-	16,248,502	23,214	21870	0.022	—	22.6	2.84
27	3,700,076	69,512	27,858,000	-	8,984,600	-	-	16,271,716	24,293	45219	0.045	—	22.4	2.88
28	3,769,588	63,431	27,858,000	-	8,984,600	-	-	16,296,009	22,375	41056	0.041	—	22.2	2.92
29	3,833,019	132,100	27,858,000	-	8,984,600	-	-	16,318,384	20,957	111143	0.111	—	21.7	3.03
30	3,965,119	177,028	27,858,000	-	8,984,600	-	-	16,339,341	22,569	154459	0.154	—	21.1	3.19
31	4,142,147	148,994	27,858,000	-	8,984,600	-	-	16,361,910	22,230	126764	0.127	—	20.5	3.31
1-Feb	4,264,011		27,858,000		8,984,600		-	16,384,140						
Total for Month		2,067,275		-		-	-		1,058,209					
Average for Month		66,686		-		-	-		34,136					

NOTES:

2223866	Value is a meter reading or was measured
—	No value or data for the cell
3715	Positive calculated value
-54649	Negative calculated value
0.015	Published data (e.g., NOAA precipitation totals)
177028	Exceedance of indicated criteria

ft^2 = square feet; g/day = gallons per day; MG = millions of gallons

Precipitation/Evaporation Lagoon Volume Correction							
Cross Section Area	Top Width	Surface Area	Precipitation		Evaporation		Corrected Lagoon Volume
ft^2	Feet	ft^2	Inches	Gallons	Inches	Gallons	MG
—	—	—	—	—	—	—	8.96
—	—	—	-	—	0.015	—	—
—	—	—	-	—	0.015	—	—
453	96.9	96863	-	0.000	0.015	906	3.39
464	98.3	98316	-	0.000	0.015	919	3.47
481	99.3	99324	-	0.000	0.015	929	3.59
478	99.2	99193	-	0.000	0.015	927	3.58
474	98.9	98907	-	0.000	0.015	925	3.54
472	98.8	98828	-	0.000	0.015	924	3.53
474	98.9	98931	-	0.000	0.015	925	3.55
476	99.0	99022	-	0.000	0.015	926	3.56
482	99.4	99428	-	0.000	0.015	930	3.61
438	95.9	95914	-	0.000	0.015	897	3.28
438	96.7	96683	-	0.000	0.015	904	3.27
434	96.5	96470	-	0.000	0.015	902	3.25
438	96.7	96692	-	0.000	0.015	904	3.27
441	96.9	96913	-	0.000	0.015	906	3.30
446	97.2	97186	-	0.000	0.015	909	3.33
450	97.4	97434	-	0.000	0.015	911	3.36
402	93.5	93541	-	0.000	0.015	875	3.01
403	94.5	94527	-	0.000	0.015	884	3.02
401	94.4	94367	-	0.000	0.015	882	3.00
406	94.7	94677	-	0.000	0.015	885	3.03
411	95.0	95002	-	0.000	0.015	888	3.07
360	90.7	90694	-	0.000	0.015	848	2.69
376	92.8	92788	-	0.000	0.015	868	2.81
379	93.0	92977	-	0.000	0.015	869	2.83
385	93.4	93367	-	0.000	0.015	873	2.88
391	93.7	93719	-	0.000	0.015	876	2.92
405	94.7	94667	-	0.000	0.015	885	3.03
426	96.0	95968	-	0.000	0.015	897	3.19
443	97.0	97023	-	0.000	0.015	907	3.31
				Total for Month	0.476		
				Average Daily	0.015		

Table A-2: Representative Nutrient Loading Calculation Table

	Meter Readings							BOD Loading					FDS Loading		
	Lagoon to Irrigation					Lagoon to City		BOD_5	Field 1	Field 2	Total	To City	FDS	Field 1	Field 2
Jan-18	Meter Reading	Gallons to Field 1	Meter Reading	Gallons to Field 3	Total Gallons to Fields	Reading	Gallons to City	mg/L	lb/acre	lb/acre	lb/acre/day	lb	mg/L	lb/acre	lb/acre
Limit(s)	—	—	—	—	Year Total: 0 MG	—	Month Ave: 80,000 G/day	3,000	—	—	100	1,000	—	—	—
Date															
1	27,858,000	-	8,984,600	-	-	15,325,931	58,364	349	—	—	—	170	1006	—	—
2	27,858,000	-	8,984,600	-	-	15,384,295	58,923	349	—	—	—	171	1006	—	—
3	27,858,000	-	8,984,600	-	-	15,443,218	36,079	349	—	—	—	105	1006	—	—
4	27,858,000	-	8,984,600	-	-	15,479,297	39,888	349	—	—	—	116	1006	—	—
5	27,858,000	-	8,984,600	-	-	15,519,185	40,608	349	—	—	—	118	1006	—	—
6	27,858,000	-	8,984,600	-	-	15,559,793	41,184	349	—	—	—	120	1006	—	—
7	27,858,000	-	8,984,600	-	-	15,600,977	41,328	349	—	—	—	120	1006	—	—
8	27,858,000	-	8,984,600	-	-	15,642,305	53,201	349	—	—	—	155	1006	—	—
9	27,858,000	-	8,984,600	-	-	15,695,506	38,160	349	—	—	—	111	1006	—	—
10	27,858,000	-	8,984,600	-	-	15,733,666	43,488	349	—	—	—	126	1006	—	—
11	27,858,000	-	8,984,600	-	-	15,777,154	39,312	349	—	—	—	114	1006	—	—
12	27,858,000	-	8,984,600	-	-	15,816,466	39,168	349	—	—	—	114	1006	—	—
13	27,858,000	-	8,984,600	-	-	15,855,634	39,456	349	—	—	—	115	1006	—	—
14	27,858,000	-	8,984,600	-	-	15,895,090	40,555	349	—	—	—	118	1006	—	—
15	27,858,000	-	8,984,600	-	-	15,935,645	31,262	349	—	—	—	91	1006	—	—
16	27,858,000	-	8,984,600	-	-	15,966,907	29,791	349	—	—	—	87	1006	—	—
17	27,858,000	-	8,984,600	-	-	15,996,698	27,512	349	—	—	—	80	1006	—	—
18	27,858,000	-	8,984,600	-	-	16,024,210	28,800	349	—	—	—	84	1006	—	—
19	27,858,000	-	8,984,600	-	-	16,053,010	28,656	349	—	—	—	83	1006	—	—
20	27,858,000	-	8,984,600	-	-	16,081,666	28,944	349	—	—	—	84	1006	—	—
21	27,858,000	-	8,984,600	-	-	16,110,610	29,930	349	—	—	—	87	1006	—	—
22	27,858,000	-	8,984,600	-	-	16,140,540	28,423	349	—	—	—	83	1006	—	—
23	27,858,000	-	8,984,600	-	-	16,168,963	28,336	349	—	—	—	82	1006	—	—
24	27,858,000	-	8,984,600	-	-	16,197,299	26,435	349	—	—	—	77	1006	—	—
25	27,858,000	-	8,984,600	-	-	16,223,734	24,768	349	—	—	—	72	1006	—	—
26	27,858,000	-	8,984,600	-	-	16,248,502	23,214	349	—	—	—	67	1006	—	—
27	27,858,000	-	8,984,600	-	-	16,271,716	24,293	349	—	—	—	71	1006	—	—
28	27,858,000	-	8,984,600	-	-	16,296,009	22,375	349	—	—	—	65	1006	—	—
29	27,858,000	-	8,984,600	-	-	16,318,384	20,957	349	—	—	—	61	1006	—	—
30	27,858,000	-	8,984,600	-	-	16,339,341	22,569	349	—	—	—	66	1006	—	—
31	27,858,000	-	8,984,600	-	-	16,361,910	22,230	349	—	—	—	65	1006	—	—
1-Feb	27,858,000		8,984,600		-	16,384,140									
Total for Month		-		-	-		1,058,209								Total for Month
Average for Month		-		-	-		34,136								

NOTES:

2223866	Value is a meter reading or was measured
—	No value or data for the cell
3715	Positive calculated value
0.015	Published data (e.g., NOAA precipitation totals)

BOD = biological oxygen demand; FDS = fixed dissolved solids; g/day = gallons per day; lb/acre = pounds per acre; lb/acre/day = pounds per acre per day; MG = millions of gallons; mg/L = milligrams per liter; TKN = Total Kjeldahl Nitrogen

	TKN Loading			
Total	TKN	Field 1	Field 2	Total
lb/acre/day	mg/L	lb/acre	lb/acre	lb/acre
11 lb/acre/day Year Ave: 4,000 lb/acre	—	—	—	Year Total: 165 lb/acre
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
—	22	—	—	—
N/A (see DECEMBER 2018)				N/A (see DECEMBER 2018)

APPENDIX B: IRRIGATION AND CROP MANAGEMENT PLANS

Appendix B

Irrigation and Crop Management Plans

CONTENTS

SVZ-USA, INC.

OTHELLO, WASHINGTON

LAND TREATMENT REPORT FOR 2017
& CROP MANAGEMENT PLAN FOR 2018

Washington State DOE Discharge Permit No. ST8077

prepared by
Dan Nelson, PhD, CPSS
Kyle Bair, PhD, CPSS
Soiltest Farm Consultants, Inc.
2925 Driggs Drive
Moses Lake, WA 98837

4 April 2018

1. INTRODUCTION

The SVZ-USA Inc. processing plant in Othello, Washington, produces fruit and vegetable juice concentrates and purees from fresh and frozen produce. The wastewater produced from the process is treated by a combination of land application and discharge to the City of Othello wastewater treatment facility. This crop management plan was developed to meet Washington State D.O.E. permit ST-8077 requirements for that portion of the wastewater treated by land application. Specific information included was obtained through site visits by Soiltest staff, and by verbal and written information obtained from SVZ staff and the farm operator.

The goal of land application of wastewater is to match the output of the waste constituents to the uptake or consumption of the constituents by crops, soil micro-organisms and natural chemical precipitation or adsorption processes of the soil to which it is applied. Managing applications requires first, measuring the application to the land of wastewater and other constituents and, second, measuring the constituent removal rate for the crops which are grown. The net loading rates are calculated as the difference between additions and removals. Some estimation is involved in calculating applications and removals. The inactivation rate of constituents by internal soil processes is not precisely known for most conditions. Consequently, periodic soil testing is used to monitor concentrations of wastewater constituents in the soil through time to determine whether labile concentrations are increasing or decreasing. Estimates can then be made regarding the likelihood of deleterious effects on soil properties or potential negative impact on ground water due to the application of wastewater.

Typically, a few key constituents can be identified and used for the calculations. The constituents of concern with the effluent generated by the SVZ-USA plant in Othello are nitrogen (N), water, sodium (Na) and total salts (TDS). These constituents are the most likely to cause soil, environmental, or plant growth problems. SVZ has made an agreement with the City of Othello to treat a portion of the wastewater generated by SVZ to increase capacity and reduce field loading rates. A small portion of the waste stream was treated by Othello in 2016; a much greater portion was treated by the Othello POTW in 2017.

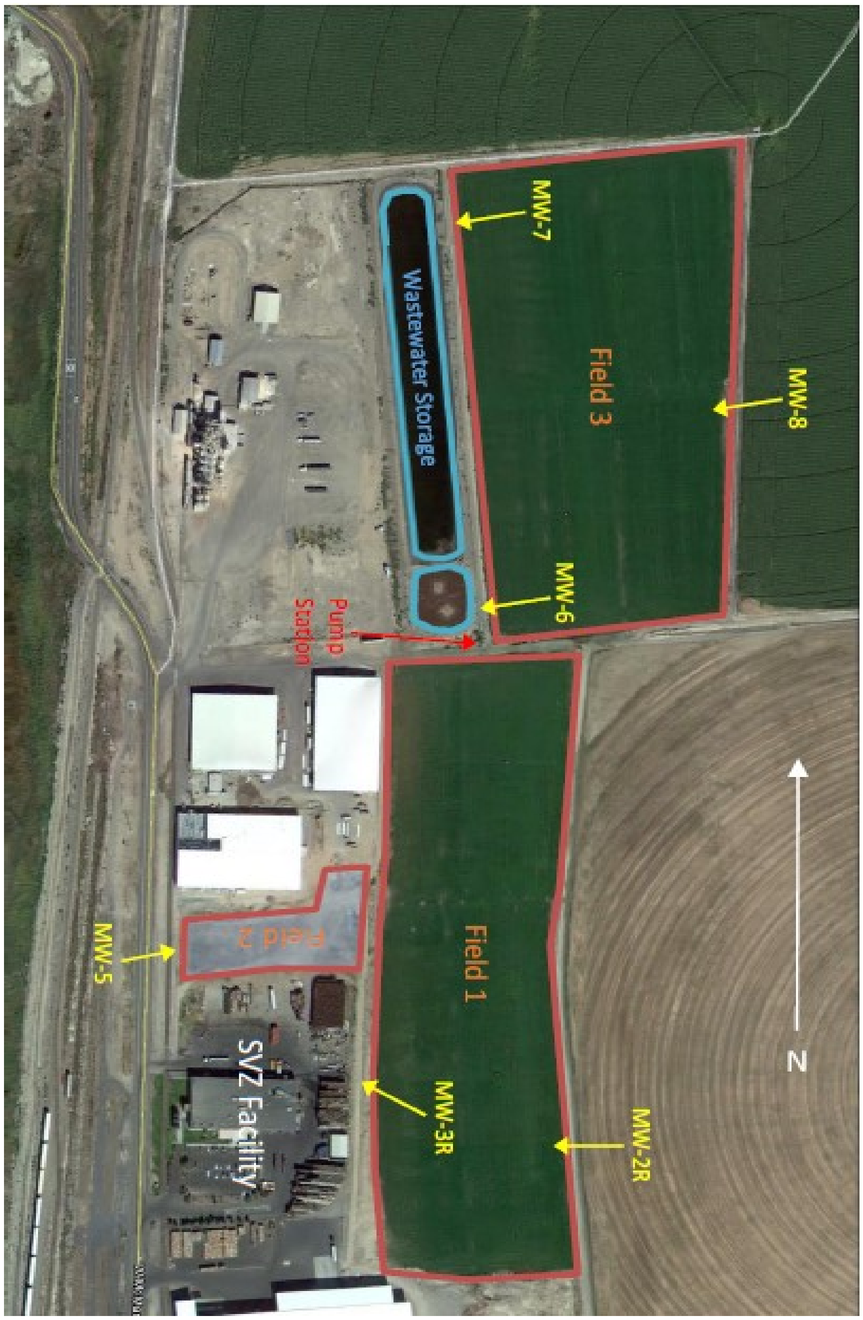
1.1 Treatment System

The water management system at SVZ Foods consists of a lined reservoir capable of holding approximately 7.7 million gallons (MG) of plant effluent in its two chambers. A large chamber on the north end holds 7.0 MG and a small chamber on the south end holds the balance. The effluent in the large chamber is connected by a control valve to a wet well where a pump is situated to pressurize the wheel-line sprinkler systems of the land application fields. Fresh water from the East Columbia Irrigation District can be admitted by means of a control valve into the wet well if supplemental water is needed for the crop. The supplemental water is not blended with the process water at the wet well as the valve controls are strictly manual.

Three fields make up the land treatment site (see Figure 1). Field 1 comprises

18.2 acres and is planted to grass hay. Field 2 comprises 2.5 acres and is left to native grasses and weeds. It can be watered with a solid set sprinkler system; however, the sprinkler system is in disrepair and has only been used for equipment storage. The soil at Field 2 is generally quite shallow, barely one foot in depth. Because of its small size and shallow soil, Field 2 has never been utilized for land treatment by SVZ. Field 3, also planted to grass hay, lies east of the lagoon and comprises 18.4 acres. Fields 1 and 3 are irrigated by means of wheel-line sprinkler systems.

FIGURE 1: MAP OF SVZ-USA LAND TREATMENT SITE



1.2 Irrigation Efficiency and Uniformity

The fraction of pumped irrigation water that enters and stays in the root zone of the growing crop is the application efficiency, sometimes called system uniformity. The typical application efficiency for sprinkler irrigation ranges from 60% to 95%[1] depending system type, design, maintenance, weather and run-off conditions. On average, wheel line systems operate at approximately 65%-70% overall efficiency. Because the land treatment site is nearly level and no runoff typically occurs, an efficiency factor of 70% is estimated to be appropriate for the wheel line systems in operation on Fields 1 and 3. A comparable factor is probably appropriate for the solid-set system in Field #2, if it was ever repaired and put into use.

1.3 Irrigation Timing

The application of irrigation water is based upon crop need and soil storage. Crop water use or evapotranspiration (ET) is a function of the crop, the growth stage and prevailing weather conditions. Soil moisture storage is dependent upon the texture, structure, organic matter content, coarse fragment content and depth of the soil. Specific crop water consumption is calculated in Table 1 for conditions in 2017.

The basic premise of irrigation frequency is to irrigate before the crop experiences water stress. When crop water use has depleted the available water to approximately 60% in the root zone, an irrigation should be initiated to minimize crop stress. To avoid excessive application, the amount of water applied in any irrigation should be limited to the amount of the available water holding capacity not already filled (i.e. 40% of water holding capacity).

In 2012, a consultant was hired to assist with irrigation timing. Irrigations were planned using dielectric soil moisture probes connected to data loggers in conjunction with ET data obtained from the WSU-Othello Experiment Station. In 2015, the loggers were updated to enable connection to a website where soil moisture and rain gage catches and temperatures can be viewed in real-time. Weekly reports are generated with suggested irrigation times and amounts (Figures 2A & 2B).

2. SOIL FACTORS

The physical and chemical characteristics of the soil determine the suitability of the site for land treatment purposes. Of primary concern is the suitability of the site for crop production. Specific soil properties determine the management strategies to be employed during the land treatment process.

Field 1 of the SVZ, Othello site is well suited for crop production and land treatment uses. The slope is nearly level. The nearest surface water is the Potholes Canal of the Columbia Basin Irrigation District. The shallow lakes of the Potholes area are located approximately one mile north and west of the site. Ground water is not

---

[1] Irrigation Requirements for Washington-Estimates and Methodology. EB 1513. WSU, Pullman. 1989.

FIGURE 2A: EXAMPLE IRRIGATION MANAGEMENT REPORT FOR FIELD 1

soiltest farm consultants, inc.
2925 Driggs Dr., Moses Lake, Wa 98837 - www.soiltestlab.com
Office: (509)765-1622 - Fax:(509)765-0314 - (800)764-1622

Irrigation Summary & Recommendation

SVZ
Grass Hay
Field 1 (S)
Rooting Depth 12 Inches
GPM: 114
18 Acres

Soil Type & Water Holding Capacity

Soil Depth, in.	4	8	12	24
AWHC, in/ft:	0.77	0.77	1.92	1.92

9.24 inches/24 hrs @ 70% Efficiency
6.0 hour set applies 2.31

Weekly Reporting

DATE	WATER USE, INCHES Last Week	Next Week	APPLIED INCHES	SOIL MOISTURE 4"	8"	12	24"	MOISTURE % GOAL	RECOMMENDATION SYSTEM	INCHES	HRS.	Sets	HRS/SET	Rain Only
30-Oct-17	***0.38***	***0.52***	***0.90***	***50%***	***50%***	***59%***	***44%***	***80%***	***OFF***	***1.39***	***4***	***0***	***0***	***0.09***
CUMLATIVE:	**23.40**		**21.94**											
		Rainfall:	**5.87**											
		Irrigation:	**16.07**											

Winter monitoring

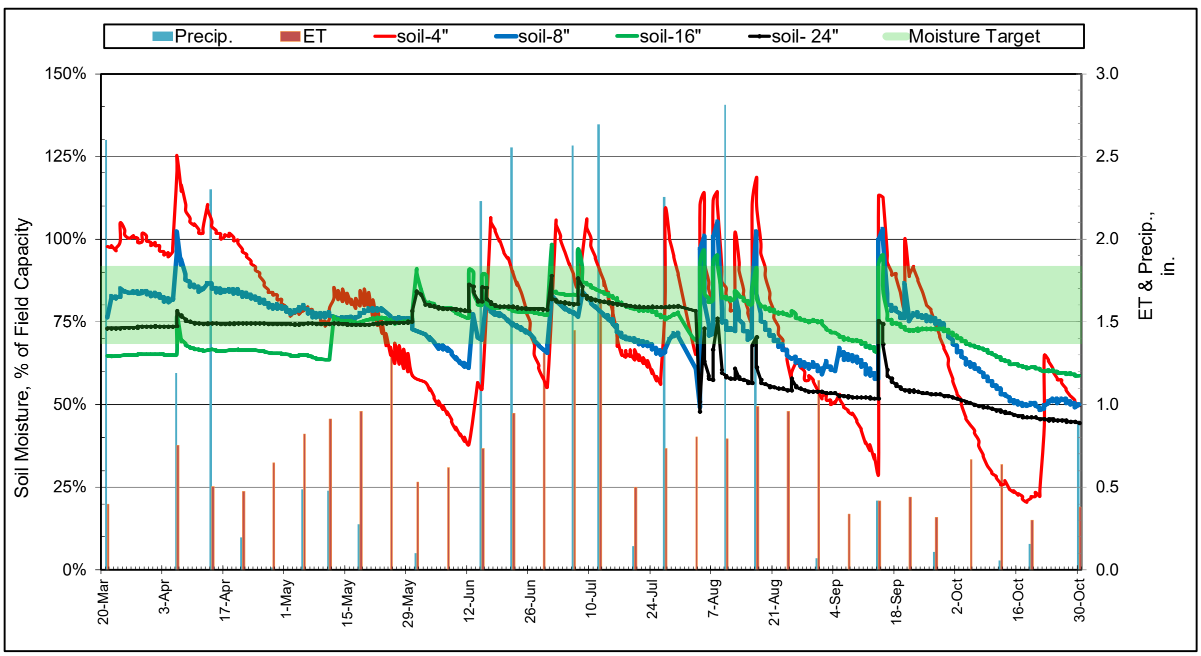


FIGURE 2B: EXAMPLE IRRIGATION MANAGEMENT REPORT FOR FIELD 3

soiltest
farm consultants, inc.
2925 Driggs Dr., Moses Lake, Wa 98837 - www.soiltestlab.com
Office: (509)765-1622 - Fax:(509)765-0314 - (800)764-1622

Irrigation Summary & Recommendation

SVZ
Grass Hay
Field 3 (N)
Rooting Depth 16 Inches
GPM: 114
20 Acres

Soil Type & Water Holding Capacity

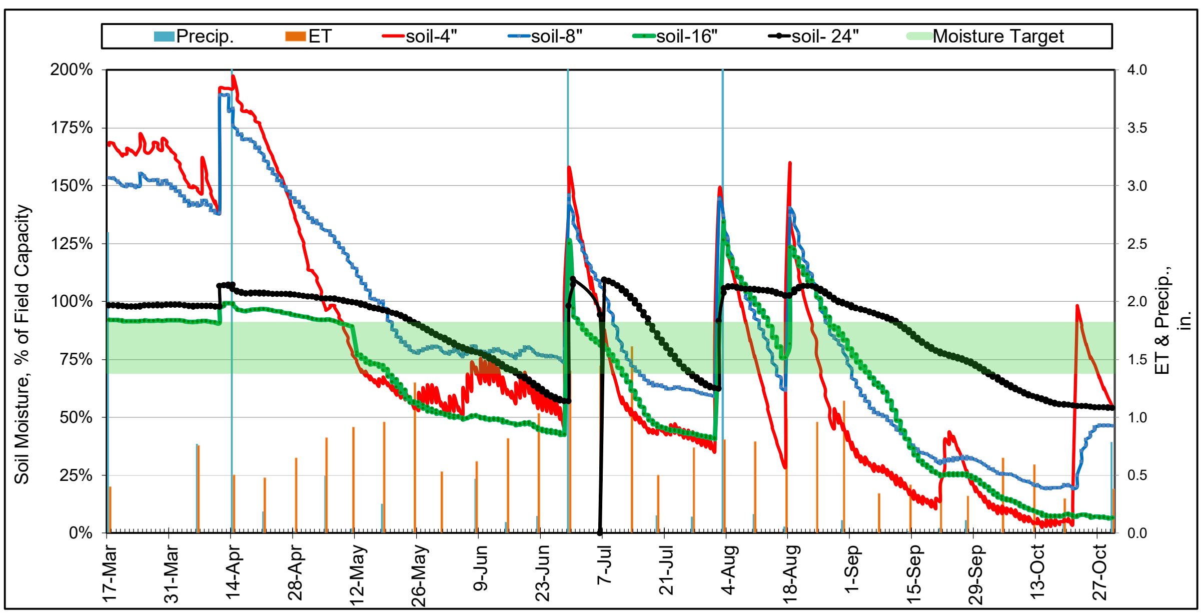
Soil Depth, in.	4	8	12	24
AWHC, in/depth	0.80	1.60	1.60	1.60

9.24 inches/24 hrs @ 70% Efficiency
6.0 hour set applies 2.31

Weekly Reporting

2017 DATE	WATER USE, INCHES Last Week	Next Week	APPLIED INCHES	SOIL MOISTURE 4 in, % F.C.	8 in, % F.C.	12 in, % F.C.	24in, % F.C.	MOISTURE % GOAL	RECOMMENDATION SYSTEM	INCHES	TOT HRS	SETS	HRS/SET	Rain Only
30-Oct	***0.38***	***0.52***	***0.79***	***55%***	***46%***	***7%***	***54%***	***80%***	***OFF***	***2.44***	***6***	***0***	***0***	***0.09***
CUMLATIVE:	**23.59**		**19.88**											
		Rainfall:	**5.87**											
		Irrigation:	**14.01**											

Winter monitoring.



found near enough to the surface to interfere with cropping activities. Soil drainage is good, neither excessive nor poor. No areas of salt accumulation or other undesirable chemical characteristics are naturally found. Soil depth to cobbly substratum is a bit shallow in places for root crops, but adequate for forage and grain crops. Yields of production crops at the site have been near Columbia Basin averages. Although Field 2 has never been used for water treatment, forage crops could be grown. The shallow soil at Field 2 will limit the productive capacity of the field and will also require careful water management to avoid excessive leaching or ponding at the site. The soil of Field 3 is like that of Field 1 only it grades to deeper soil as it progresses northward. Although still too rocky for root crop production, Field 3 has a higher yield potential than Field 1 due to greater soil depths (up to five feet).

2.1 Infiltration Rates and Water Holding Capacity

The soil at the land treatment site is predominantly Scooteney loam. The water infiltration rate ranges from 0.8 to 2.5 inches per hour. The available water holding capacity of the loam soils at the land treatment site are approximately 2.0 inches of water per foot of topsoil and approximately 1.0 inch per foot for the cobbly and gravelly subsoil.[2] Site investigations have revealed the depth to cobbly subsoil ranges from 12 to 60 inches, with the soil depth greatest at the northeast edge of the area.

2.2 Compaction and Puddling Potential

The soils at the land treatment site have loam and gravelly loam textures. In addition, the soils have low to moderate organic matter and low clay content. Consequently, the soils have a moderately strong soil structure and tend not to compact easily. Compaction can be ameliorated by minimizing traffic, eliminating traffic during wet periods, and by maintaining a perennial crop to develop a sod.

Generally, sodium becomes problematic when the exchangeable sodium percentage (ESP) reaches 15%. The soil at the land treatment site contains sufficient clay and has moderate enough slopes that 15% is the appropriate limit. This level of sodium should not be exceeded in the surface soils at the SVZ land application site to avoid possible infiltration problems. Elevated soil salinity can facilitate infiltration when the ESP is greater than 15%; however, excessively high salinity levels can impede crop production. Should sodium approach problematic levels in the surface soils, gypsum (calcium sulfate) can be applied to improve soil structure. Controlled leaching events can be planned to remove excess sodium from the surface horizon of the soil.

2.3 Soil Monitoring

The soils of the treatment fields have been monitored for many years. The permit guidelines require that the fields are sampled twice each year: once prior to the

[2] Soil Survey of Adams County Washington. USDA SCS. 1967.

initiation of crop growth in the spring and again in the fall after the last harvest is completed. Field 2 has not been sampled for several years because equipment has been stored on the site and precluded access to 3 of the 5 monitoring locations. The site has only been used for equipment storage and no plans exist to grow crops on the site or to apply process wastewater on Field 2; it was decided by the consultant to skip the site entirely. In 2007 soil monitoring was initiated on Field 3, which was added to the treatment system. The soil test reports from 2017 are included in the Appendix. Graphical summaries of selected constituents can be found in Figure 3.

Soil nitrate levels at the surface have been typically cyclical in nature. Field 2 monitoring ended in 2012 when 1-ft soil nitrate was at an all-time high for unknown reasons (this field is not cropped). Field 1 nitrate was unusually high in 2013; however, nitrate in both Fields 1 and 2 have been low and stable for the last 4 years. Oscillations in nitrate are common at the 2-foot depth as well. The oscillations in soil nitrate in Field 1 were increasing in magnitude through 2015 but have been stable the last two years. Field 1 has been replanted several times including 2014. The minimal crop growth during replanting cannot remove all the nitrogen mineralized from the organic matter. As a stable grass crop was established in Field 1, it was anticipated that fall nitrate levels would decline as they did in 2016 and 2017. Field 3 nitrate levels spiked in the 1-, 2- and 4-foot depths during 2008 when the alfalfa crop was plowed out and grass planted. This was likely the result of mineralization of the alfalfa root mass. Subsequent measurements of nitrate levels in Field 3 have remained stable and very low with only slight seasonal oscillations.

For optimum hay production, it is desirable to maintain soil salinity or soluble salts below 3.5 mmho/cm. Soluble salts have been within acceptable limits throughout the monitoring history. The trend in the two utilized fields appears to be either level or slightly decreasing in the top foot, and slightly increasing in the second foot.

Sodium is monitored by the exchangeable sodium percentage (ESP). ESP is of greatest concern at the surface layer of the soil where it can impact water infiltration. ESP in Fields 1 and 3 have historically exceeded the critical level of 15% at various times at both depths monitored (Fig. 3) and exhibited upward trends. In the most recent years, however, the ESP trend in fields 1 and 3 appear to be levelling off or declining. In March of 2015, 3.2 t/ac and 3.8 t/ac of gypsum were applied to Fields 1 and 3 respectively to ensure maintenance of good soil structure and water infiltration. Gypsum was applied again in March 2016 at the same rates as in 2015. The combination of gypsum applications and declining wastewater loading in 2016 and 2017 are the likely reasons for the improving ESP conditions.

First foot soil Total N trend lines of Field 1 and 2 both demonstrate increasing trends, whereas, the total N trend in Field 3 has remained flat. Total N in all fields appear to be trending slightly upward at the 2-foot depth. Total P in the first foot in Fields 1 and 2 are demonstrating a very slight upward trend while the trend in Field 3 is flat. Variations in measurements obscure any trends in the 2-foot total P of all fields. It is worth noting that total N and Total P are trending upwards in Field 2, which receives no inputs.

FIGURE 3: SUMMARY OF SOIL TEST MONITORING

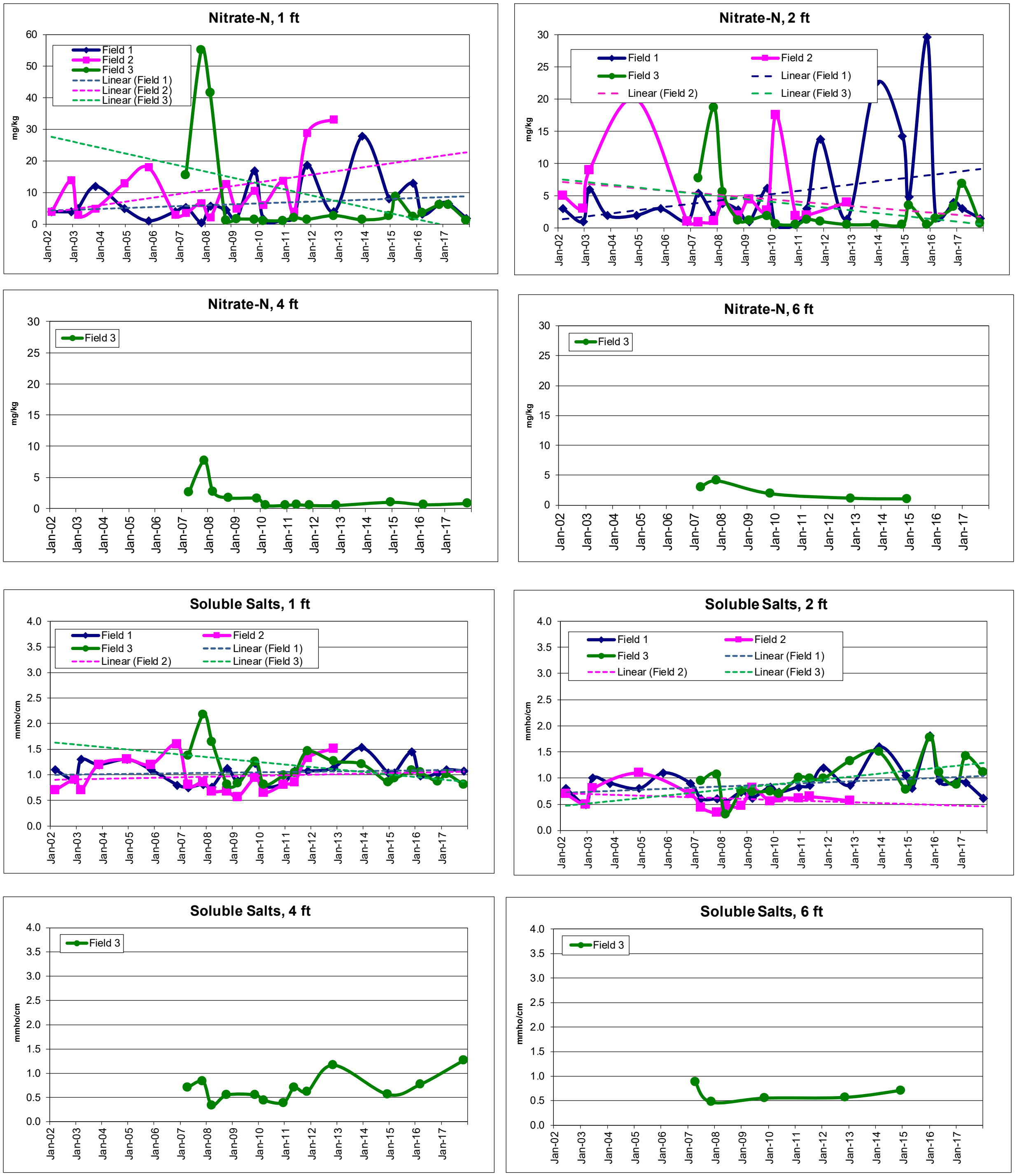
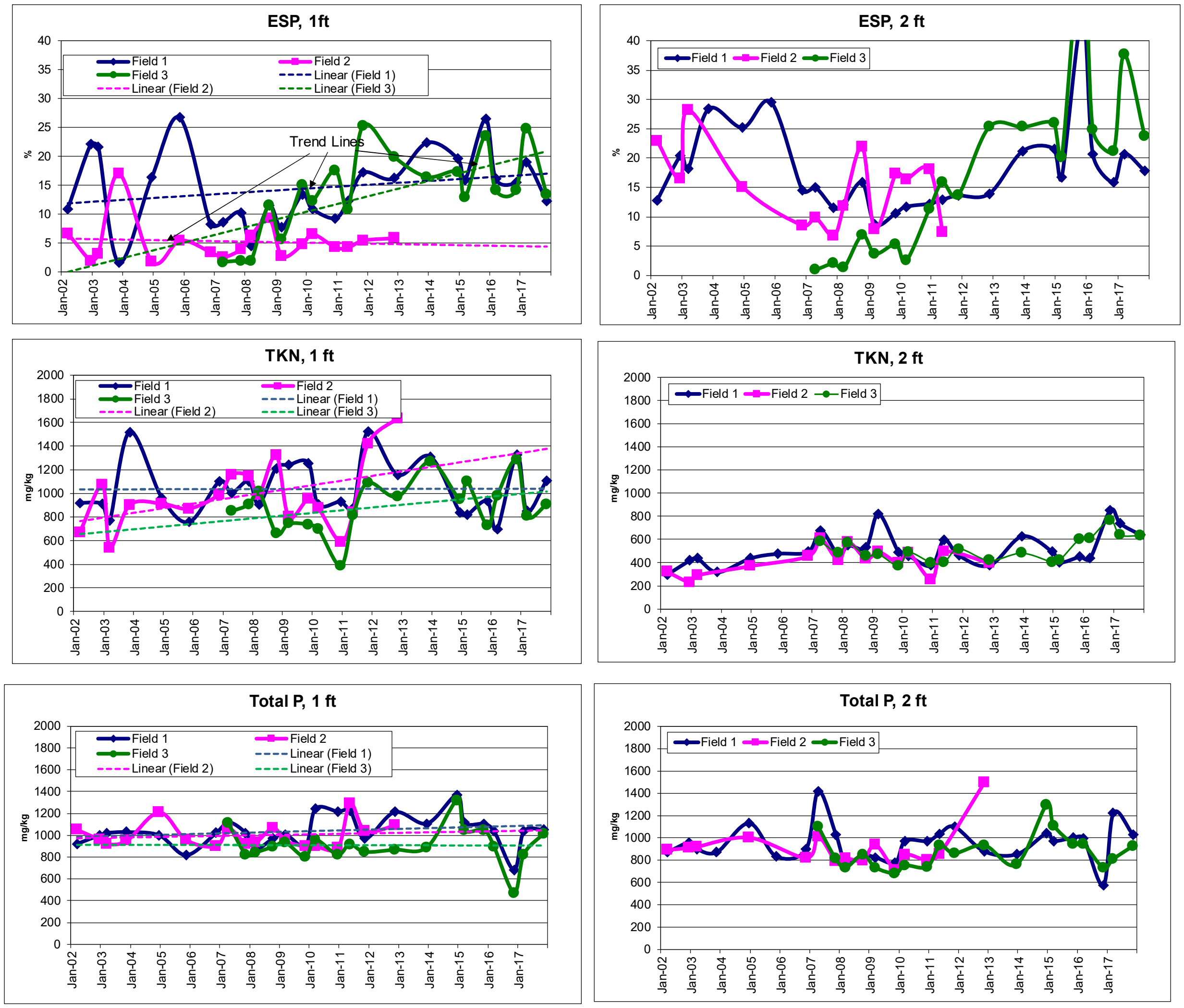


FIGURE 3: SUMMARY OF SOIL TEST MONITORING (CONTINUED)



3. CROP WATER MANAGEMENT

3.1 Crop Water Use and Irrigation Requirement

Grass hay was seeded into Fields 1 and 3 in the fall of 2007 and re-seeded in Field 1 in the fall of 2013. The 2017 monthly and annual water consumption for grass hay can be found in Table 1. Precipitation is subtracted from ET to calculate the Rainfall Balance. Excess precipitation is carried over into the subsequent month to reflect soil storage. The irrigation requirement is calculated from the rainfall balance using a net system application efficiency of 70%. This efficiency may adequately cover any needed leaching requirements; however, soil test data will be used to determine the need for additional planned leaching events. In a typical season, grass hay may utilize 35 inches of water and require 50 inches of irrigation water. The summer of 2017 followed a late, wet spring: total annual rainfall was 7.9 inches, consumptive water use was approximately 32.3 inches and the irrigation requirement was approximately 38.7 inches.

3.2 Water Balance

In 2017, the total wastewater flow from the SVZ processing facility to the lagoon was 25.91 MG (Table 2A). The total water pumped from the lagoon and land applied was 3.5 MG. The additional pumped into the lagoon represents that sent to the City of Othello for treatment less any changes in storage and evaporation loss. Flow meter data show that 18.7 MG of fresh water was applied to the fields in 2017. Irrigation and process wastewater were applied approximately equally to the two fields.

It is estimated in Table 1 that for Field 1, 32.3 inches of water were transpired by the crop and that the irrigation requirement was 38.7 inches. Approximately 22.4 inches of water (16% wastewater, 62% fresh water and 12% rainfall) were applied to Field 1. The water balance indicates that the field was under-irrigated by 16.4 inches. The water balance was positive during the months of August and September. Process water was only applied in April. Deficit irrigation was practiced the remaining 5 months of the irrigation season. The hydraulic loading to Field 3 was nearly identical to Field 1.

The leaching requirement is estimated to be 1.8% as calculated from the gross irrigation water quality parameters in Tables 2A and 2B. The leaching requirement is the same for both fields as they receive water from the same sources at very nearly the same ratios; further, they are planted to the same crop and the soil is substantially consistent across both fields. The maximum desirable saturated paste EC for both fields was set at 3.5 mmho/cm for the calculation. As the EC of neither the supplemental water nor the wastewater is measured, it was estimated using a commonly used general relationship: EC=TDS/640. For the fresh/supplemental water the EC = 85/640 which yields 0.13 mmho/cm. Since we generally are concerned with FDS in vegetable wastewater, I used the same relationship except I used FDS rather than TDS. For 2017, the calculated EC was 893/640 = 1.27 mmho/cm. As indicated in Table 1, wastewater made up 16% of the water applied to each field. The weighted average EC for all the water applied to the field is then 0.31 mmho/cm. The Leaching Requirement is calculated by the following relationship.

$LR = EC_w / [(5 \times EC_w) - EC_e]$, where

LR is Leaching Requirement;

EC_w is the EC of the average water applied

EC_e is the maximum allowable EC of the soil solution

Inserting the values calculated above,

$LR = 0.31 / [(5 \times 3.5) - 0.31]$

results in a leaching requirement of 1.8%.

Note that 2017 leaching requirement is substantially less than 2016 because of the smaller percentage of wastewater use.

TABLE 1: 2017 HYDRAULIC LOADING SUMMARY

FIELD 1	Consump-tive Use	Precip-itation	Rainfall Balance	Irrigation Req't at 70% Efficiency	Irrigation Water Load Process	Fresh	Total	Balance
MONTH	ac-in/ac	ac-in/ac	ac-in/ac	ac-in/ac	ac-in/ac	ac-in/ac	ac-in/ac	ac-in/ac
JAN	0.10	0.61	-0.5	0.0	0.0	0.0	0.0	0.0
FEB	0.26	1.46	-1.2	0.0	0.0	0.0	0.0	0.0
MAR	0.90	1.19	-0.3	0.0	0.0	0.0	0.0	0.0
APR	3.83	0.90	2.9	4.2	3.6	0.0	3.6	-0.6
MAY	5.20	0.50	4.7	6.7	0.0	0.0	0.0	-6.7
JUN	4.85	0.22	4.6	6.6	0.0	0.0	0.0	-6.6
JUL	6.48	0.00	6.5	9.3	0.0	4.7	4.7	-4.6
AUG	5.22	0.13	5.1	7.3	0.0	9.3	9.3	2.0
SEP	2.41	0.37	2.0	2.9	0.0	3.9	3.9	1.0
OCT	2.32	1.06	1.3	1.8	0.0	0.9	0.9	-0.9
NOV	0.66	1.24	-0.6	0.0	0.0	0.0	0.0	0.0
DEC	0.07	0.24	-0.2	0.0	0.0	0.0	0.0	0.0
YEAR	**32.29**	**7.92**	**24.4**	**38.7**	**3.6**	**18.8**	**22.4**	**-16.4**

Total Hydraulic Load, in.	**22.4**	**2016 Load**	**25.9**		
Hydraulic Load Limit, in.	**30.0**	**% Change**	**-14%**	**Process, % of Total**	**16%**
% of Limit ac-ft/ac	**75%**			**Leaching Fraction as-applied**	**-42.3%**
(ET and Precip. data from AgWeatherNet Othello)				**Calculated Leaching Requirement**	**1.8%**

FIELD 3	Consump-tive Use	Precip-itation	Rainfall Balance	Irrigation Req't at 70% efficiency	Process	Fresh	Total	Balance
MONTH	ac-in/ac	ac-in/ac	ac-in/ac	ac-in/ac	ac-in/ac	ac-in/ac	ac-in/ac	ac-in/ac
JAN	0.10	0.61	-0.5	0.0	0.0	0.0	0.0	0.0
FEB	0.26	1.46	-1.2	0.0	0.0	0.0	0.0	0.0
MAR	0.90	1.19	-0.3	0.0	0.0	0.0	0.0	0.0
APR	3.83	0.90	2.9	4.2	3.6	0.0	3.6	-0.6
MAY	5.20	0.50	4.7	6.7	0.0	0.0	0.0	-6.7
JUN	4.85	0.22	4.6	6.6	0.0	0.0	0.0	-6.6
JUL	6.48	0.00	6.5	9.3	0.0	4.7	4.7	-4.6
AUG	5.22	0.13	5.1	7.3	0.0	9.3	9.3	2.0
SEP	2.41	0.37	2.0	2.9	0.0	3.9	3.9	1.0
OCT	2.32	1.06	1.3	1.8	0.0	0.9	0.9	-0.9
NOV	0.66	1.24	-0.6	0.0	0.0	0.0	0.0	0.0
DEC	0.07	0.24	-0.2	0.0	0.0	0.0	0.0	0.0
YEAR	**32.29**	**7.92**	**24.4**	**38.7**	**3.6**	**18.8**	**22.4**	**-16.4**

Total Hydraulic Load	**22.4**	**2016 Load**	**26.1**		
Hydraulic Load Limit	**30.0**	**% Change**	**-14%**	**Process, % of Total**	**16%**
% of Limit ac-ft/ac	**75%**			**Leaching Fraction as-applied**	**-42.2%**
(ET and Precip. data from AgWeatherNet Othello)				**Calculated Leaching Requirement**	**1.8%**

4. NUTRIENT MANAGEMENT

A balance sheet approach used for nutrient management analysis in this report, like the method used for water management. The inputs are identified and quantified. Losses and removals are also identified, quantified and compared to projections from last year. Finally, a balance is calculated and discussed in comparison to soil test results.

4.1 Nutrient Additions

The quantities of constituents in the wastewater applied to the land are calculated in Table 2A. The values were calculated each month by multiplying the volume of process water land-applied by the concentration of the constituent in the effluent analysis for that month. In 2017 493 lbs-N, 10,135 lbs-Na, 48,183 lbs-BOD and 24,446 lbs-salt were land applied in the wastewater. All loading rates were down significantly from previous highs (Figure 4).

To improve hay production, 100 lbs/acre of nitrogen fertilizer were applied to fields 1 and 3 in the early spring of 2017; an additional 50 lbs.-N/ac was applied to both fields in mid-summer. In addition, 85 lbs/ac of sulfur fertilizer were applied. Like the hydraulic loading, the nutrient loading was distributed uniformly across all treatment acres as best as could be practiced. Inputs from fresh irrigation water are calculated in Table 2B for those constituents for which test data were available.

Nitrogen loss from denitrification and volatilization can result in relatively low uptake efficiencies under fertigation with wastewater containing high BOD. No losses are deducted in Table 2A or 2B, but in calculating the total loading in Table 4 the sums were adjusted by the following nitrogen use efficiencies: 75% of the wastewater-N and 85% of the fresh water-N and fertilizer-N were carried into the total (Allison, F.E. 1965. *Evaluation of Incoming and Outgoing Processes That Affect Soil Nitrogen*, in Soil Nitrogen. Agronomy Monograph 10, Bartholomew, W.V. & Clark, Francis E. eds. American Society of Agronomy, Madison, WI).

4.2 Crop Nutrient Removals

Table 3 summarizes the removal of selected constituents in the harvested portion of the crop. The removal rates were calculated using 2017 yield values and constituent concentrations from the samples obtained from the harvests made in 2017. The ash content of the harvested portion of the plant material is used to calculate the total mineral salt removal.

The harvests in 2017 removed approximately 2.65 t/ac of hay (fresh weight). The yield was down from 2016. The grass hay crop removed a significant amount of most constituents. The hay removed 103 pounds of nitrogen per acre and approximately 284 pounds of total salts per acre. The hay harvests also removed approximately 137 pounds of potassium, 3 pounds of sodium and 15 pounds of chloride per acre.

TABLE 2A: WASTEWATER PRODUCTION AND LAND APPLICATION TOTALS

	PLANT PROCESS WATER PRODUCTION		IRRIGATION WASTEWATER								
			ANALYSES, mg/L							APPLIED	
MONTH	MG	Ac-Ft	TKN	BOD	COD	sBOD	FDS	Na	NH4-N	MG	Ac-Ft
JAN	1.580	4.849									
FEB	1.580	4.849									
MAR	2.960	9.084	14.6	1,198	2,163	1,116	797	288	1.50	0.000	0.00
APR	2.290	7.028	16.7	1,632	2,270	1,557	828	343	4.10	3.540	10.86
MAY	2.220	6.813	0.0	0	0	0	0	0	0.00	0.000	0.00
JUN	2.480	7.611	0.0	0	0	0	0	0	0.00	0.000	0.00
JUL	2.710	8.317	0.0	0	0	0	0	0	0.00	0.000	0.00
AUG	2.420	7.427	0.0	0	0	0	0	0	0.00	0.000	0.00
SEP	1.670	5.125	0.0	0	0	0	0	399	0.00	0.000	0.00
OCT	2.040	6.261	0.0	0	0	0	0	0	0.00	0.000	0.00
NOV	2.380	7.304									
DEC	1.580	4.849									
AVG	2.159	6.626	15.7	1,415	2,217	1,337	813	343	2.80	0.443	1.358
			TOTAL LAND APPLIED, LBS								
TOTAL	25.910	79.51	493	48,183	67,019	45,968	24,446	10,135	121	3.540	10.864
										Est. Evaporation Loss	
										22.370	68.651

Notes: Wastewater flow in January and February were estimated due to interference from snow and freezing conditions.
Irrigation wastewater was evenly split between Field 1 and Field 3 based on acreage.
In months with no quarterly analyses, average of adjacent months were utilized (green)

TABLE 2B: SUPPLEMENTAL WATER TOTALS

	units	result	MGal Applied		Total Pounds Applied
NITRATE-N	mg/L	**0.10**			
TKN	mg/L	**0.50**			
SUM OF NITROGEN	mg/L	**0.6**	**18.67**	**Nitrogen**	**93.4**
TOTAL DISSOLVED	mg/L	**85**		**Salts**	**13238**

Note: Green indicates that MDL was used in place of non-detect for calculation purposes.

FIGURE 4: SVZ PLANT PRODUCTION HISTORY

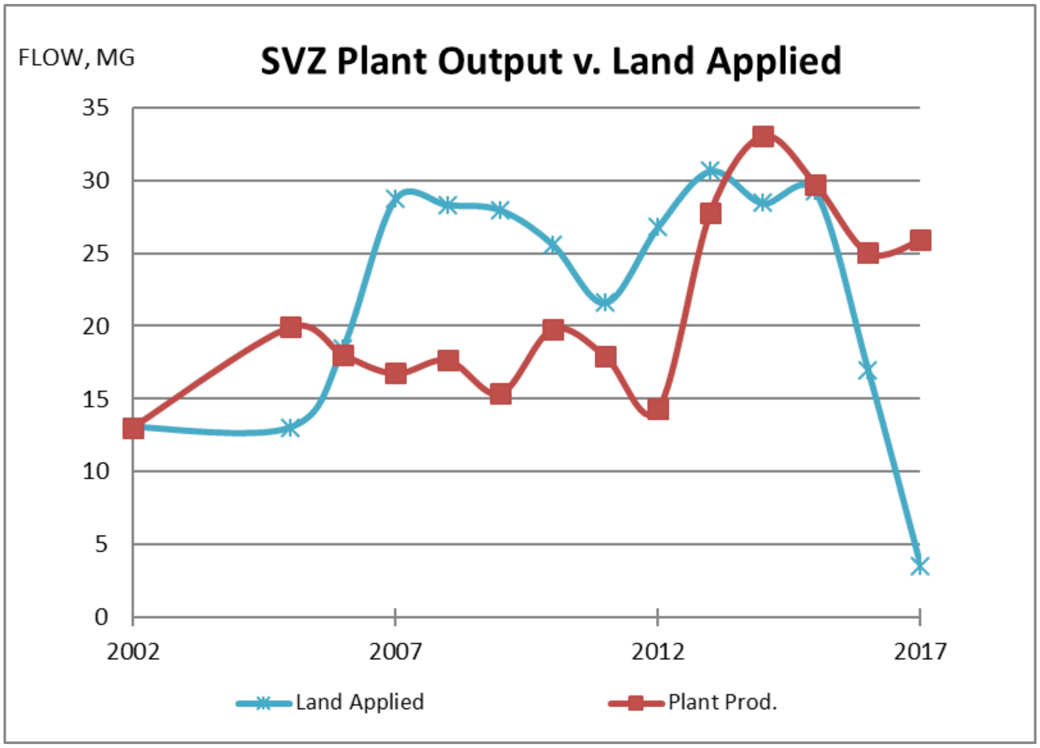


TABLE 3: HARVEST REMOVAL TOTALS

FIELD / DATE	CROP	YIELD, lbs	DM	N	P	Na	Ca	Mg	K	Cl	Ash
						%, TOTAL ANALYSIS					
FIELD 1	**18.2 acres**										
1st Cutting	Grass Mix Hay	45,749	93.4%	2.0%	0.20%	0.04%	0.27%	0.16%	2.20%	0.14%	6.8%
2nd Cutting	Grass Mix Hay	21,880	93.7%	2.1%	0.31%	0.07%	0.43%	0.24%	2.88%	0.33%	5.5%
3rd Cutting	Grass Mix Hay	28,842	94.0%	2.2%	0.42%	0.09%	0.58%	0.32%	3.55%	0.52%	4.2%
4th Cutting	Grass Mix Hay										
Total	lbs	96,470									
	t/ac	2.65									
Net Removal	**lbs/ac**		**4,964**	**103**	**14**	**3**	**20**	**11**	**137**	**15**	**284**
FIELD 3	**18.4 acres**										
1st Cutting	Grass Mix Hay	46,251	93.4%	2.0%	0.20%	0.04%	0.27%	0.16%	2.20%	0.14%	6.8%
2nd Cutting	Grass Mix Hay	22,120	93.7%	2.1%	0.31%	0.07%	0.43%	0.24%	2.88%	0.33%	5.5%
3rd Cutting	Grass Mix Hay	29,158	94.0%	2.2%	0.42%	0.09%	0.58%	0.32%	3.55%	0.52%	4.2%
4th Cutting	Grass Mix Hay										0.0%
Total	lbs	97,530									
	t/ac	2.65									
Net Removal	**lbs/ac**		**4,964**	**103**	**14**	**3**	**20**	**11**	**137**	**15**	**284**

No analysis for 2nd harvest: green values are average of 1st and 3rd analyses

4.3 Nutrient Balances

The nutrient balances are calculated in Table 4. In these calculations, it was assumed that 100% of all constituents, except nitrogen as explained above, passed through the conveyance and application system and entered the soil. Positive values in the balance rows in Table 4 indicate an accumulation of constituent in the soil of the land treatment field.

TABLE 4: BALANCE OF CONSTITUENTS LAND APPLIED

FIELD 1	18.2 acres									
	N, lbs/ac		Sodium, lbs/ac		FDS or Salt, lbs/ac		BOD, lbs/ac		BOD, lbs/ac/day*	
Source	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**
Wastewater	13	76	277	860	668	3,886	1,316	1,227	5	5
Freshwater	2.6	1.20	0	0	0	0.0	0	0	0	0
Fertilizer	150	150	0	0	300	300	0	0	0	0
SUM^	**140**	185	**277**	860	**968**	4,186	**1,316**	1,227	**5**	5
% difference from last year		**-24.5%**		**-67.8%**		**-76.9%**		**7.3%**		
					3	lbs/ac/day*				
Permit Design	**165**	lbs/yr			**11**	lbs/ac/day				
% of Design	**85%**	112%			**24%**					
Harvest Removal, lbs/ac	**103**	252	**3**	73	**284**	880	**N/A**	**N/A**	**N/A**	**N/A**
Balance, lbs/ac	**37**	-67	**274**	787	**684**	3,306	**N/A**	**N/A**	**N/A**	**N/A**
FIELD 3	18.4 acres									
Wastewater	13	76	277	860	668	3,886	1,302	1,214	5	5
Freshwater	2.6	1.20	0	0	0	0.00	0	0	0	0
Fertilizer	150	150	0	0	300	300	0	0	0	0
SUM^	**140**	185	**277**	860	**968**	4,186	**1,302**	1,214	**5**	5
% difference from last year		**-24.5%**		**-67.8%**		**-76.9%**		**7.3%**		
					3	lbs/ac/day*				
Permit Design	**165**	lbs/yr			**11**	lbs/ac/day				
% of Design	**85%**	112%			**24%**					
Harvest Removal, lbs/ac	**103**	252	**3**	73	**284**	880	**N/A**	**N/A**	**N/A**	**N/A**
Balance, lbs/ac	**37**	-67	**274**	787	**684**	3,306	**N/A**	**N/A**	**N/A**	**N/A**

Notes: ^ Sum of N was calculated assuming 75% use efficiency of wastewater N and 85% use efficiency of commercial fertilizer N.

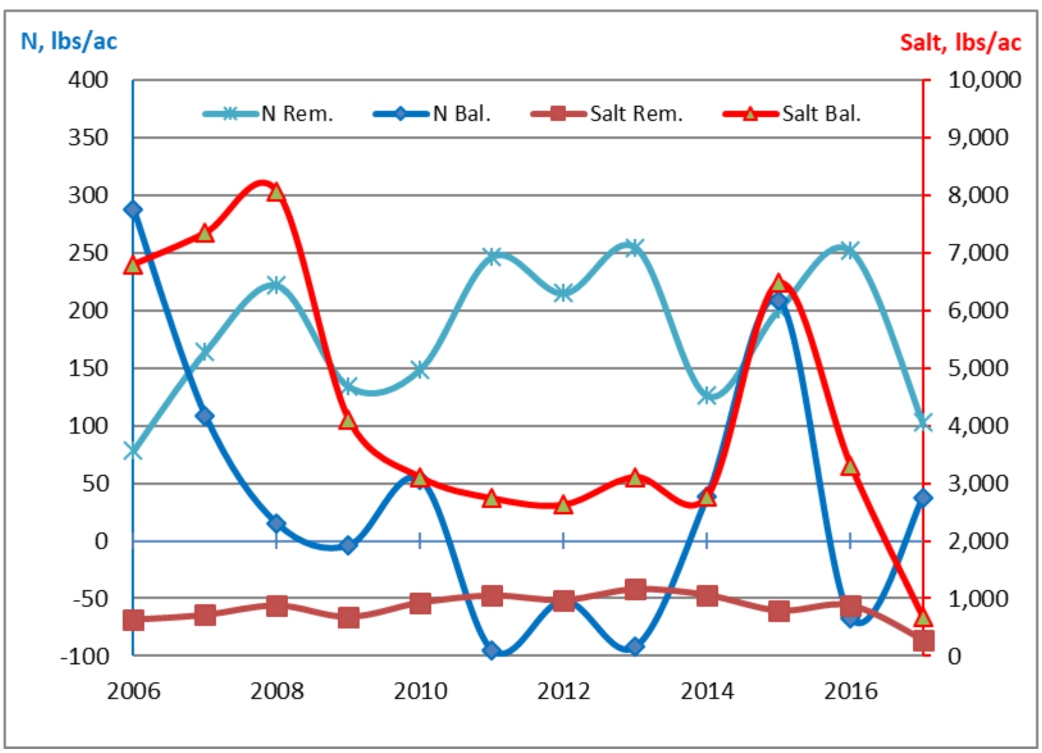
* FDS, pounds/acre/day was calculated over 365 days in a year; BOD pounds/ac/day was calculated using the 245 day irrigation season.

Balances in 2017 were much different than in 2016 due to the application of much less irrigation wastewater. Less nitrogen, 37 pounds per acre in Fields 1 and 3, was removed in harvests than was applied from all sources. Sodium and total salts were applied at rates greater than removed in harvest; however, the loading rates were much below 2016 rates, which, in turn, were much below the 2015 loading rates. Table 4 shows a net accumulation in the soil of approximately 274 lbs-sodium/ac and 684 lbs-salts/ac.

Wastewater nitrogen and sodium applications to the land in 2017 were not only less than in 2016 but were at all-time lows. Fertilizer nitrogen application was somewhat more than planned from 2016 data; however, because the wastewater nitrogen was so low, the fertilizer nitrogen would have been needed in 2017 if the hay yield had been nearer normal. Supplemental nitrogen applications are required if soil storage nitrogen and projected wastewater nitrogen are inadequate for proper production.

Salt applied in wastewater was also significantly lower than that anticipated from 2016 data. Salt removal in harvests in 2017 was much lower than 2016. The low loading rate resulted in a very low balance (Figure 5). Total salt application in 2017 was only 24% of the 11 lbs/day maximum listed in the permit.

FIGURE 5: SVZ HARVEST REMOVAL & NET APPLICATION HISTORY



5. GROUNDWATER MONITORING

Eight monitor wells have been installed at the land treatment site; the location of each is indicated in Figure 1. Monitor wells 1 through 5 were installed prior to the date SVZ assumed operations of the site. Wells 6 through 8 were installed in the spring of 2008 in preparation for adding Field 3 to the treatment site. Wells 1 and 2 were damaged during fall field work in 2013. These well were abandoned along with monitor wells 3 and 4 in 2014 when two new wells, 2R and 3R, were installed. The wells are monitored monthly for water level and various physical and chemical parameters as required by permit.

Historical data for nitrate and TDS are reported in Figure 5. The data for the new wells 2R and 3R are appended to that of the original wells 2 and 3 in Figure 5 as they are in approximately the same locations. In the 2012 Fact Sheet Update for State Waste Discharge Permit ST-8077, the background values for groundwater nitrate and TDS for well 2R were modified to 5.62 and 507 mg/L, respectively. The background values for well 8 were determined in the same Fact Sheet were 18.1 mg/l for nitrate-N and 916 mg/l for TDS. The background lines and data trend lines for these two parameters are included in Figure 5.

The Field 2 up-gradient well, MW2/2R demonstrates variations in TDS of approximately 200 mg/l during the last few years. The overall trend is downward from highs measured shortly after the well was installed; however recent years appear to be trending upward and are occasionally exceeding background levels. Up-gradient well MW8 in Field 3 demonstrated a steady increase of approximately 200 mg/l from its installation in 2008 until 2012, then decreasing to below original levels by the end of 2017. The overall trend is currently slightly downward and well below background.

The down-gradient wells are mixed in their responses over time. TDS in Well 3/3R demonstrates a downward trend but was still above background in 2017. Well 5 demonstrates a very slight upward trend above background with considerable short and long-term variations. Wells 6 and 7 both exhibit relatively consistently increasing TDS over the monitoring period and are both near background levels.

The nitrate levels in up-gradient well, MW2, is well above background and exhibits an increasing long-term trend with considerable variations in two to four-year time spans. Some very high values were recorded in 2016. The nitrate level in the Field 3 up-gradient well, MW8, has consistently trended downward and is well below background.

The nitrate levels in Field 3 down-gradient wells, MW6 and MW7, demonstrate an overall downward trend; however, in recent years, nitrate levels are increasing but still below background. The nitrate level in the Field 1 down-gradient wells, MW3/3R and MW5, demonstrate variably increasing trends with wide variations. Although there are many gyrations, the nitrate level in MW5 has risen from 5 to 20 mg/l. MW3/3R has varied from zero to nearly 30 mg/l at various times with a resultant increasing trend. Nitrate in both wells exceed background levels.

6. 2018 CROP PLAN

6.1 Soil Monitoring

The DOE land treatment permit requires that soil samples be collected in the spring and fall: this will be accomplished in 2018. The purpose of soil testing is to

FIGURE 5: SUMMARY OF SVZ WELL MONITORING

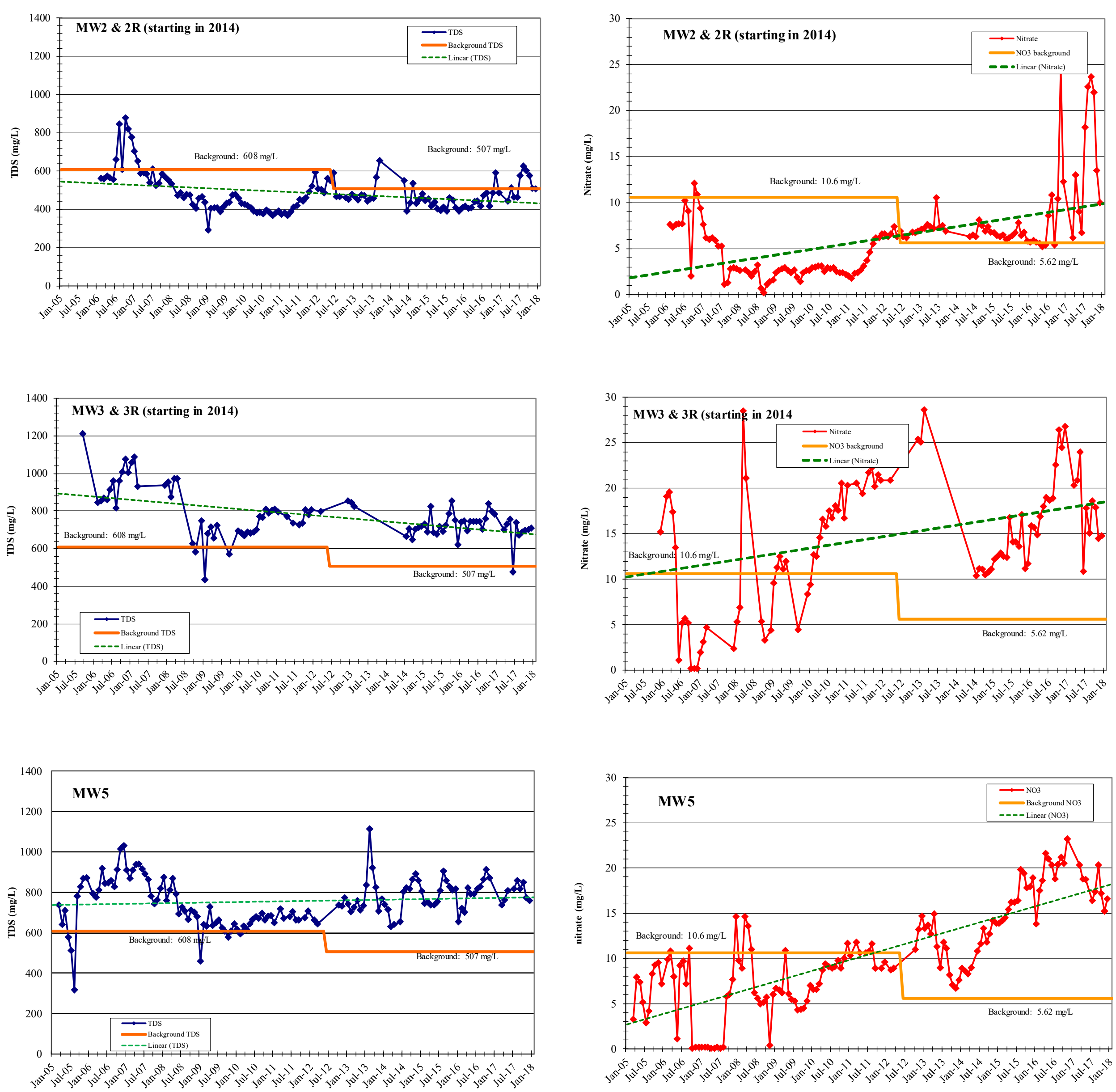
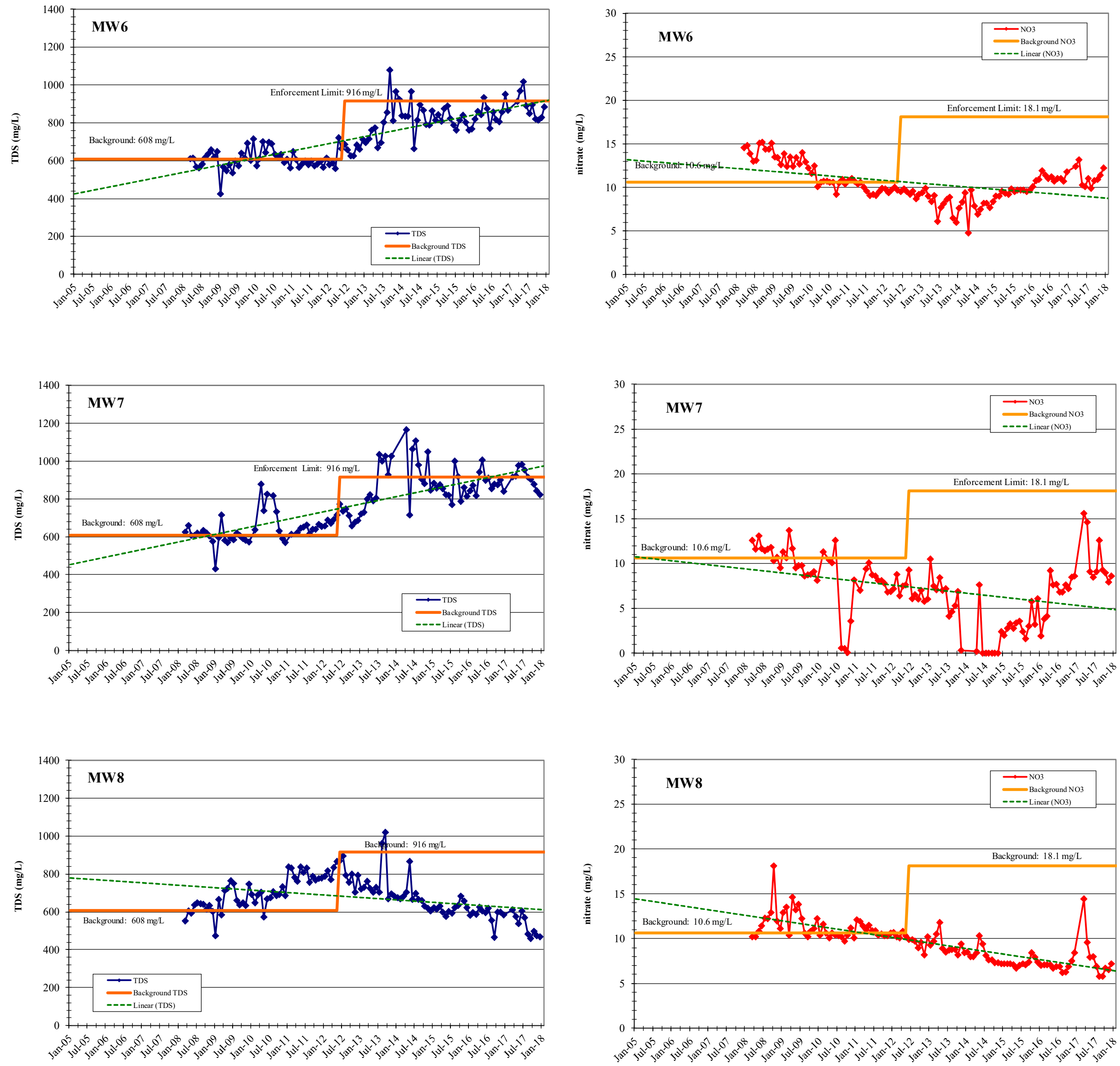


FIGURE 5: SUMMARY OF SVZ WELL MONITORING (CONTINUED)



monitor salt and nutrient concentrations over time and act as a back-up to the nutrient balance calculations. Modifications in management will be triggered by significant changes in soil test values. Soil samples will be collected and analyzed from Fields 1 and 3 to monitor chemical changes and salt conditions. Until SVZ moves the stored equipment, soil sample sites in Field 2 will continue to be inaccessible.

6.2 2018 Cropping Pattern and Wastewater Applications

Fields 1 and 3 will remain in grass hay for the 2018 season. Field 2 will remain idle (see Table 5). It is currently planned that no effluent from the lagoon will be applied to Fields 1 or 3 this year. All wastewater will be sent for treatment by the City of Othello. Soil moisture and ET monitoring will continue to be used to aid in the scheduling of supplemental water irrigations. As no wastewater is anticipated to be applied, the loadings for 2018 will be from supplemental water and fertilizer only. The projected fertilizer nitrogen requirement is also presented in Table 5.

TABLE 5: PROJECTED PLAN FOR 2018

Field I.D.	Total Acres	Treated Acres	Crop	Anticipated Water Use inches	Anticipated Water Use ac-ft	Irrigation Plan WW inches	Irrigation Plan Fresh W inches	Anticipated Wastewater Gross Loading N lbs/ac	Anticipated Wastewater Gross Loading Salts lbs/ac	Anticipated Wastewater Gross Loading BOD lbs/ac	Soil Resicual N* lbs/ac	Estimated Fertilizer Nitrogen lbs/ac
FIELD 1	18.2	18.2	Grass Hay	42.2	64.0	0.0	64.0	0	0	0	81	120
FIELD 2	2.5	0.0	N/A									
FIELD 3	18.4	18.4	Grass Hay	42.2	64.7	0.0	64.7	0	0	0	78	120
	39.1	**36.6**										

* Soil residual N is calculated from the sum of tested nitrogen from the previous fall soil test.

The nitrogen requirement in any given year depends on the crop, growing conditions/weather, water and nutrient management and disease/pest pressure. Most of these factors can only be estimated ahead of time from historical values or experience. The result is called the agronomic rate. The nitrogen requirement can be met by the addition of nitrogen into the system from four main sources, soil residual, wastewater, fresh water, fertilizer. Not all the nitrogen applied from any of these sources remains available for crop use. Volatilization and denitrification result in nitrogen loss from the system and each of these sources has an efficiency of use that needs to be included in the balance equation. If planning suggests that nitrogen availability from one of these sources is anticipated to be higher, then nitrogen from one or more of the other sources should be reduced.

The Projected Management Plan for 2018, as presented in Table 5 was developed with the following assumptions:

1) The weather, ET and precipitation, for 2018 will not vary substantially from 2016 to 2017 average.
2) All wastewater will be sent to the City of Othello for treatment.
3) Crop yields in 2018 will continue near those experienced in previous years.

6.3 Comments and Recommendations

The land application system operated well in 2017 and the grass hay crop produced fair. On a balance basis, approximately 37 lbs/ac of nitrogen remained in the fields relative to that applied. The fall nitrogen soil test indicated that 17 lbs/ac remained in Field 1 and 22 in Field 3. The modest positive balances of salts and sodium were much less than last year. The 2017 nitrogen balance demonstrates that the grass hay must be managed to produce well and help to maintain a favorable field N balance. Proper water management is the first and most important step. It was noted that SVZ upgraded the soil moisture monitoring equipment for the 2015 season to make real-time visualization of the field conditions possible. Adequate supplemental water should be applied to optimize crop growth.

Mineral salt loadings (N, Na, FDS) decreased significantly in 2017 compared to 2015 and 2016. The declining loading rates are reflected by the improving soil salinity and ESP values. Not all salts react the same when land applied. Magnesium has minimal effect on soil salinity compared to sodium. Potassium is a plant nutrient removed at significant rates by hay crops. The second year of deficit irrigation practices was instrumental in the decline in crop production in 2017. Application of adequate fresh water to achieve the desired leaching fraction of 1.8% will prevent salt accumulation at the surface. Adequate water will also increase hay yield, thus, improving the treatment capacity of the site.

Pesticides will be used only as needed. It is anticipated that some herbicide may be applied to the fields for weed control. Need for chemical and fertilizer applications will be determined by a certified crop advisor or similar professional. All pesticide applications will be made in accordance with label directions by licensed applicators.

The supplemental water flow meter appeared to have worked well in 2017 which allowed better evaluation of the hydraulic balances in the fields. It would be advisable to check the calibration of each flow meter at least annually and provide the dates of calibration for inclusion in this report.

APPENDIX

2017

DMR REPORTS FOR

Washington State DOE Discharge Permit No. ST8077

CAN BE VIEWED AT THE FOLLOWING LINK:

https://fortress.wa.gov/ecy/paris/ComplianceAndViolations/ViewDMRData.aspx

HARVEST REPORTS

soiltest farm consultants, inc.

2017 Certified NIRS by NFTA

SVZ-USA
MIKE GREENE
Othello , WA 99344
GROWER: SVZ

FIELD ID.: 98 3X4 1ST
NIR CALIBRATION: Grass Hay

DATE RECEIVED: 6/8/2017
DATE REPORTED: 6/9/2017
LAB NUMBER: F17-02262

GROWER ACCOUNT #:
GROWER SAMPLE ID:

NIR FEED ANALYSIS

	As Received Basis	100% Dry Matter
MOISTURE %	6.6	
DRY MATTER %	93.4	100
Protein		
CRUDE PROTEIN		12.3
DIGESTIBLE PROTEIN		8.2
Fiber		
ACID DET. FIBER %		33.2
NEUTRAL DET. FIBER %		57.5
LIGNIN %		4.5
RFV		102
FAT %		2.29
STARCH %		
ESC %		6.3
NSC %		7.8
ASH %		6.9
WSC %		7.8
Minerals		
CALCIUM (Ca) %		
PHOSPHORUS (P) %		
POTASSIUM (K) %		
MAGNESIUM (Mg) %		
Other Analysis:		
NITRATE NITROGEN mg/kg		12

		As Received Basis	100% Dry Matter Basis
TDN %	[ADF]		63.1
NEL, MCAL/KG	[ADF]		1.3
NEM, MCAL/KG	[ADF]		1.9
NEG, MCAL/KG	[ADF]		1.2
METABOLIZABLE ENERGY			2.36
DIGESTIBLE ENERGY			2.8
DIGESTIBLE DRY MATTER			63.0
DRY MATTER INTAKE			2.1
Wet Chemistry Minerals:			
Boron (B) mg/kg			0.90
Calcium (Ca) %			0.27
Copper (Cu) mg/kg			9.41
Iron (Fe) mg/kg			136
Magnesium (Mg) %			0.16
Manganese (Mn) mg/kg			105.24
Phosphorus (P) %			0.20
Potassium (K) %			2.20
Sodium (Na) %			0.04
Sulfur (S) %			0.24
Zinc (Zn) mg/kg			24.62
Chloride (Cl) mg/kg			1444

* TOTAL AFLATOXIN (AgraStrip 6.0 ppb)

Relative Feed value includes both ADF and NDF in accordance with AFGC Hay Market Task Force Equations

We make every effort to provide an accurate analysis of your sample. For reasonable cause we will repeat tests, but because of factors beyond our control in sampling procedures and the inherent variability of feeds, our liability is limited to the price of the tests.

This is your Invoice F17-02262 Account #: 288000 Reviewed by: KEB List Cost

soiltest
farm consultants, inc.

2017 Certified NIRS by NFTA

SVZ-USA
MIKE GREENE
Othello , WA 99344
GROWER:

DATE RECEIVED: 9/5/2017
DATE REPORTED: 9/6/2017
LAB NUMBER: F17-07502

FIELD ID.: 3RD 58 BALES
NIR CALIBRATION: Grass Hay

GROWER ACCOUNT #:
GROWER SAMPLE ID:

NIR FEED ANALYSIS

	As Received Basis	100% Dry Matter
MOISTURE %	6.0	
DRY MATTER %	94.0	100
Protein		
CRUDE PROTEIN		13.9
DIGESTIBLE PROTEIN		9.7
Fiber		
ACID DET. FIBER %		32.2
NEUTRAL DET. FIBER %		56.2
LIGNIN %		2.0
RFV		106
FAT %		2.62
STARCH %		1.68
ESC %		5.6
NSC %		7.5
ASH %		12.1
WSC %		5.8
Minerals		
CALCIUM (Ca) %		
PHOSPHORUS (P) %		
POTASSIUM (K) %		
MAGNESIUM (Mg) %		
Other Analysis:		
NITRATE NITROGEN mg/kg		227

		As Received Basis	100% Dry Matter Basis
TDN %	[ADF]		64.3
NEL, MCAL/KG	[ADF]		1.3
NEM, MCAL/KG	[ADF]		1.9
NEG, MCAL/KG	[ADF]		1.3
METABOLIZABLE ENERGY			2.41
DIGESTIBLE ENERGY			2.8
DIGESTIBLE DRY MATTER			63.8
DRY MATTER INTAKE			2.1
Wet Chemistry Minerals:			
Boron (B) mg/kg			6.73
Calcium (Ca) %			0.58
Copper (Cu) mg/kg			8.37
Iron (Fe) mg/kg			689
Magnesium (Mg) %			0.32
Manganese (Mn) mg/kg			55.03
Phosphorus (P) %			0.42
Potassium (K) %			3.55
Sodium (Na) %			0.09
Sulfur (S) %			0.33
Zinc (Zn) mg/kg			27.76
Chloride (Cl) mg/kg			5198

* TOTAL AFLATOXIN (B1, B2, G1, G2) (AgraStrip 8.0 ppb)
Relative Feed value includes both ADF and NDF in accordance with AFGC Hay Market Task Force Equations

We make every effort to provide an accurate analysis of your sample. For reasonable cause we will repeat tests, but because of factors beyond our control in sampling procedures and the inherent variability of feeds, our liability is limited to the price of the tests.

This is your Invoice F17-07502 Account #: 288000 Reviewed by: KEB List Cost

DOE SOIL TESTING RESULTS

soiltest
farm consultants, inc.

SVZ-USA
P.O. BOX 715
OTHELLO, WA 99344

DATE RECEIVED 3/24/2017
DATE REPORTED 4/17/2017
INVOICE # 4437

1

SAMPLE I.D.	LAB NO	NO3-N mg/Kg	NH4-N mg/Kg	TKN mg/Kg	TOTAL P mg/Kg	OLSEN P mg/Kg	NH4OAC K mg/Kg	NH4OAC Ca meq/100g	NH4OAC Mg meq/100g	NH4OAC Na meq/100g
1FT	4437	6.5	1.9	850	1036	29	784	8.4	4.3	1.86
2FT	4438	3.0	1.3	741	1222		780	5.3	3.4	2.11
3FT	4439	1.8	3.1	521	1333		774	6.0	3.0	2.48

SAMPLE I.D.	LAB NO	DTPA EXT SULFUR mg/Kg	DTPA EXT B mg/Kg	DTPA EXT Zn mg/Kg	CEC meq/100g	ESP %	Est Sat Paste SOL SALTS mmhos/cm	pH 1:1	OM %	Fe2+ field test
1FT	4437	16	0.65	1.1	9.8	19.0	1.10	8.8	1.8	NEG
2FT	4438	13			10.2	20.7	0.91	8.9	1.0	NEG
3FT	4439	12					1.10	8.9	0.6	

ANALYST/QC________________________

REVIEWED BY_______KEB_______________

soiltest
farm consultants, inc.

SVZ-USA
P.O. BOX 715
OTHELLO, WA 99344

DATE RECEIVED 3/24/2017
DATE REPORTED 4/17/2017
INVOICE # 4440

3

SAMPLE I.D.	LAB NO	NO3-N mg/Kg	NH4-N mg/Kg	TKN mg/Kg	TOTAL P mg/Kg	OLSEN P mg/Kg	NH40AC K mg/Kg	NH40AC Ca meq/100g	NH40AC Mg meq/100g	NH40AC Na meq/100g
1FT	4440	6.1	2.5	810	823	17	356	12.0	3.2	2.75
2FT	4441	6.9	2.9	639	809		116	10.5	2.1	4.06
3FT	4442	6.5	4.4	428	1193		66	8.2	1.90	3.39

SAMPLE I.D.	LAB NO	SULFUR mg/Kg	DTPA EXT B mg/Kg	DTPA EXT Zn mg/Kg	CEC meq/100g	ESP %	Est Sat Paste SOL SALTS mmhos/cm	pH 1:1	OM %	Fe2+ field test
1FT	4440	13	0.70	0.8	11.1	24.8	1.01	9.2	1.3	NEG
2FT	4441	29			10.8	37.6	1.42	9.3	0.7	NEG
3FT	4442	39					1.08	9.4		NEG

ANALYST/QC______________________

REVIEWED BY__________KEB_____________

soiltest
farm consultants, inc.

SVZ-USA
P.O. BOX 715
OTHELLO, WA 99344

DATE RECEIVED 11/9/2017
DATE REPORTED 11/30/2017
INVOICE # 27802

FIELD 3 (north wheelline)

							NH4OAC			
SAMPLE I.D.	LAB NO	NO_3-N mg/Kg	NH_4-N mg/Kg	TKN mg/Kg	TOTAL P mg/Kg	OLSEN P mg/Kg	K mg/Kg	Ca meq/100g	Mg meq/100g	Na meq/100g
1FT	27802	1.3	1.1	906	1014	20	66	9.3	3.6	1.58
2FT	27803	0.7	0.5	632	928		447	7.8	2.5	2.91
3FT	27804	0.8	0.5	532	1043		126	7.6	2.6	3.03

		DTPA EXT					Est Sat Paste			
SAMPLE I.D.	LAB NO	SULFUR mg/Kg	B mg/Kg	Zn mg/Kg	CEC meq/100g	ESP %	SOL SALTS mmhos/cm	pH 1:1	OM %	Fe^{2+} field test
1FT	27802	14	0.43	1.0	42.4	3.7	0.81	9.0	1.3	NEG
2FT	27803	35			34.7	8.4	1.11	9.0	0.8	NEG
3FT	27804	45					1.27	9.1		

REVIEWED BY________AO___________

soiltest
farm consultants, inc.

SVZ-USA
P.O. BOX 715
OTHELLO, WA 99344

DATE RECEIVED 11/9/2017
DATE REPORTED 11/30/2017
INVOICE # 27805

FIELD 1 (south wheelline)

SAMPLE I.D.	LAB NO	NO3-N mg/Kg	NH4-N mg/Kg	TKN mg/Kg	TOTAL P mg/Kg	OLSEN P mg/Kg	NH40AC K mg/Kg	NH40AC Ca meq/100g	NH40AC Mg meq/100g	NH40AC Na meq/100g
1FT	27805	1.9	0.7	1109	1053	33	753	5.7	4.50	1.37
2FT	27806	1.5	1.2	641	1027		749	6.3	3.80	1.99
3FT	AUGER REFUSAL									

SAMPLE I.D.	LAB NO	DTPA EXT SULFUR mg/Kg	DTPA EXT B mg/Kg	DTPA EXT Zn mg/Kg	CEC meq/100g	ESP %	Est Sat Paste SOL SALTS mmhos/cm	pH 1:1	OM %	Fe2+ field test
1FT	27805	42	0.87	2.1	34.3	4.0	1.07	8.2	1.6	NEG
2FT	27806	15			32.7	6.1	0.61	9.0	0.7	NEG
3FT	AUGER REFUSAL									

REVIEWED BY_____AO_____________

LABORATOTRY & CONSULTANT

CERTIFICATIONS

The State of Washington
Department of Ecology

Soiltest Farm Consultants, Inc. Laboratory
Moses Lake, WA

has complied with provisions set forth in Chapter 173-50 WAC and is hereby recognized by the Department of Ecology as an ACCREDITED LABORATORY for the analytical parameters listed on the accompanying Scope of Accreditation. This certificate is effective September 8, 2017 and shall expire September 7, 2018.

Witnessed under my hand on September 5, 2017

Rebecca Wood
Acting Lab Accreditation Unit Supervisor

Laboratory ID
C605

The Soil Science Society of America
Soils Certification Board

has conferred upon

Daniel P. Nelson, PhD

the designation of

Certified Professional Soil Scientist

By successfully fulfilling the requirements, passing a rigorous examination, subscribing to the Certified Professional Soil Scientist Code of Ethics and committing to ongoing professional development.

Certification effective from
1/1/2017 to **12/31/2018**

Certification Number: **03231**

Certified Professional
Soil Scientist

Andrew Sharpley
SSSA President

Soils Certification Board Chair

SVZ-USA, INC.

OTHELLO, WASHINGTON

LAND TREATMENT REPORT FOR 2018
& CROP MANAGEMENT PLAN FOR 2019

Washington State DOE Discharge Permit No. ST8077

prepared by
Dan Nelson, PhD, CPSS
Kyle Bair, PhD, CPSS
Soiltest Farm Consultants, Inc.
2925 Driggs Drive
Moses Lake, WA 98837

6 May 2019

1. INTRODUCTION

The SVZ-USA Inc. processing plant in Othello, Washington, produces fruit and vegetable juice concentrates and purees from fresh and frozen produce. The wastewater produced from the process is treated by a combination of land application and discharge to the City of Othello wastewater treatment facility. This crop management plan was developed to meet Washington State D.O.E. permit ST-8077 requirements for that portion of the wastewater treated by land application. Specific information included was obtained through site visits by Soiltest staff, and by verbal and written information obtained from SVZ staff and the farm operator.

The goal of land application of wastewater is to match the output of the waste constituents to the uptake or consumption of the constituents by crops, soil micro-organisms and natural chemical precipitation or adsorption processes of the soil to which it is applied. Managing applications requires first, measuring the application to the land of wastewater and other constituents and, second, measuring the constituent removal rate for the crops which are grown. The net loading rates are calculated as the difference between additions and removals. Some estimation is involved in calculating applications and removals. The inactivation rate of constituents by internal soil processes is not precisely known for most conditions. Consequently, periodic soil testing is used to monitor concentrations of wastewater constituents in the soil through time to determine whether labile concentrations are increasing or decreasing. Estimates can then be made regarding the likelihood of deleterious effects on soil properties or potential negative impacts. Monitor wells are used to further evaluate impacts on ground water due to the application of wastewater.

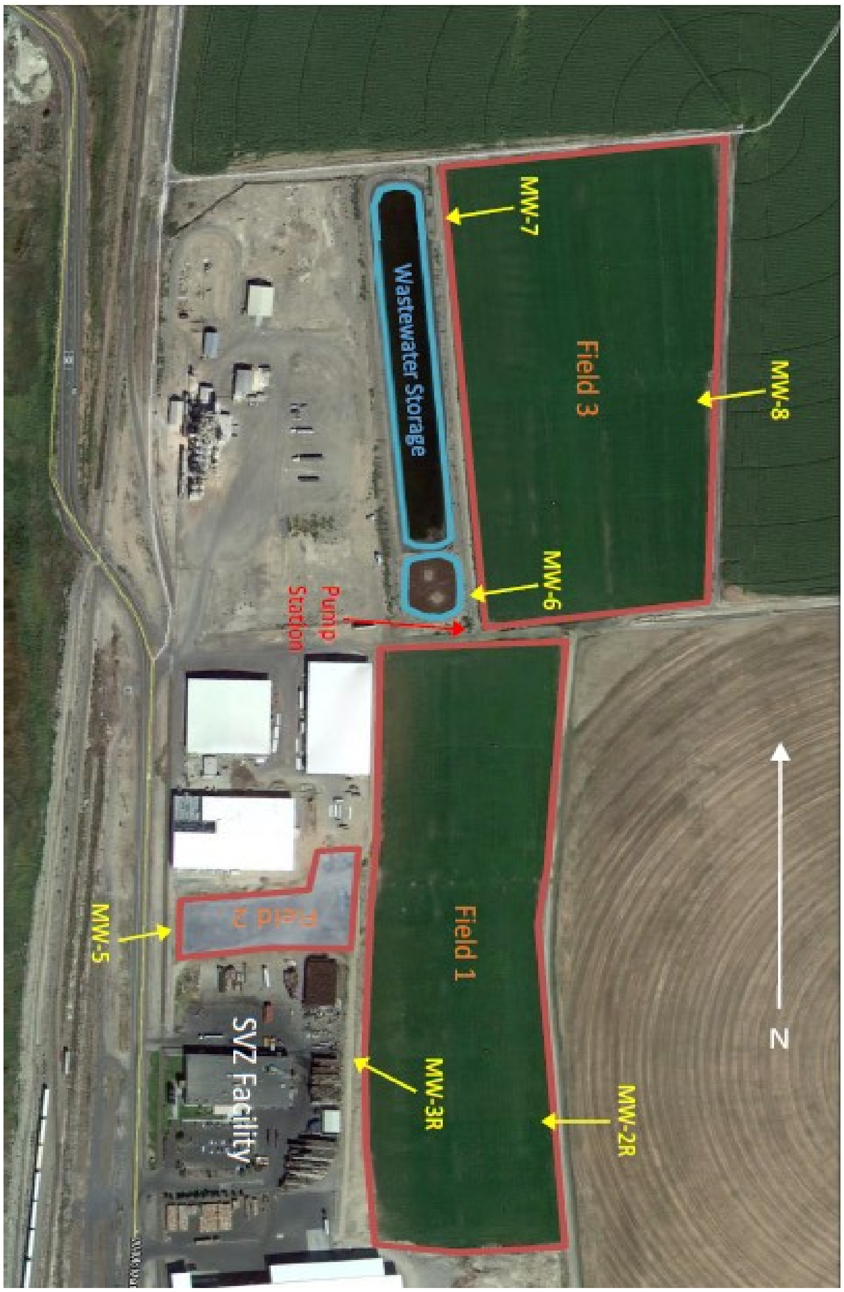
Typically, a few key constituents can be identified and used for the calculations. The constituents of concern with the effluent generated by the SVZ-USA plant in Othello are nitrogen (N), water, sodium (Na) and total salts (TDS). These constituents are the most likely to cause soil, environmental, or plant growth problems. SVZ has made an agreement with the City of Othello to treat a portion of the wastewater generated by SVZ to increase capacity and reduce field loading rates. A small portion of the waste stream was treated by Othello in 2016; all of the wastewater was treated by the Othello POTW in 2018.

1.1 Treatment System

The water management system at SVZ Foods consists of a lined reservoir capable of holding approximately 7.7 million gallons (MG) of plant effluent in its two chambers. A large chamber on the north end holds 7.0 MG and a small chamber equipped with aerators on the south end holds the balance. The effluent in the large chamber is connected by a control valve to a wet well where a pump is situated to pressurize the wheel-line sprinkler systems of the land application fields or to discharge to the City of Othello. Fresh water from the East Columbia Irrigation District can be admitted by means of a control valve into the wet well if supplemental water is needed for the crop. The supplemental water is not blended with the process water at the wet well as the valve controls are set to only admit 100% wastewater or 100% district water.

Three fields make up the land treatment site (see Figure 1). Field 1 comprises 18.2 acres and is planted to grass hay. Field 2 comprises 2.5 acres and is left to native grasses and weeds. It can be watered with a solid set sprinkler system; however, the sprinkler system is in disrepair and the site has only been used for equipment storage. The soil at Field 2 is generally quite shallow, barely one foot in depth. Because of its small size and shallow soil, Field 2 has never been utilized for land treatment by SVZ. Field 3, also planted to grass hay, lies east of the lagoon and comprises 18.4 acres. Fields 1 and 3 are irrigated by means of wheel-line sprinkler systems.

FIGURE 1: MAP OF SVZ-USA LAND TREATMENT SITE



1.2 Irrigation Efficiency and Uniformity

The fraction of pumped irrigation water that enters and stays in the root zone of the growing crop is the application efficiency, sometimes called system uniformity. The typical application efficiency for sprinkler irrigation ranges from 60% to 95%[1] depending on system type, design, maintenance, weather and run-off conditions. On average, wheel line systems operate at approximately 65%-70% overall efficiency. Because the land treatment site is nearly level and no runoff typically occurs, an efficiency factor of 70% is estimated to be appropriate for the wheel line systems in operation on Fields 1 and 3. A comparable factor is probably appropriate for the solid-set system in Field #2, if it was ever repaired and put into use.

1.3 Irrigation Timing

The application of irrigation water is based upon crop need and soil storage. Crop water use or evapotranspiration (ET) is a function of the crop, the growth stage and prevailing weather conditions. Soil moisture storage is dependent upon the texture, structure, organic matter content, coarse fragment content and depth of the soil. Specific crop water consumption is calculated in Table 1 for conditions in 2018.

The basic premise of irrigation frequency is to irrigate before the crop experiences water stress. When crop water use has depleted the available water to approximately 60% in the root zone, an irrigation should be initiated to minimize crop stress. To avoid excessive application, the amount of water applied in any irrigation should be limited to the amount of the available water holding capacity not already filled (i.e. 40% of water holding capacity).

In 2012, a consultant was hired to assist with irrigation timing. Irrigations were planned using dielectric soil moisture probes connected to data loggers and automatic rain gages in conjunction with ET data obtained from the WSU-Othello Experiment Station. In 2015, the loggers were updated to enable connection to a website where soil moisture, rain gage output and temperatures can be viewed in real-time. Weekly reports are generated with suggested irrigation times and amounts (Figures 2A & 2B). The weekly reports are shared with SVZ staff and the farm manager.

2. SOIL FACTORS

The physical and chemical characteristics of the soil determine the suitability of the site for land treatment purposes. Of primary concern is the suitability of the site for crop production. Specific soil properties determine the management strategies to be employed during the land treatment process.

Field 1 of the SVZ, Othello site is well suited for crop production and land treatment uses. The slope is nearly level. The nearest surface water is the Potholes

---

[1] Irrigation Requirements for Washington-Estimates and Methodology. EB 1513. WSU, Pullman. 1989.

FIGURE 2A: EXAMPLE IRRIGATION MANAGEMENT REPORT FOR FIELD 1

soiltest
farm consultants, inc.
2925 Driggs Dr., Moses Lake, Wa 98837 - www.soiltestlab.com
Office: (509)765-1622 - Fax:(509)765-0314 - (800)764-1622

Irrigation Summary & Recommendation

SVZ
Grass Hay
FIELD 1 (S)
Rooting Depth 24 Inches
GPM: 1380
Acres: 170

Soil Type & Water Holding Capacity

Soil Depth, in.	4	12	16	24
AWHC, in/increment	0.80	1.60	0.80	1.60

9.24 inches/24 hrs @ 70% Efficiency
6.0 hour set applies 2.31 inches

Weekly Reporting

2018 DATE	WATER USE, INCHES Last Week	WATER USE, INCHES Next Week	APPLIED INCHES	% of field capacity 4"	12"	16"	24"	MOISTURE GOAL	RECOMMENDATION SYSTEM	INCHES	HRS.	Sets	Hrs/Set	Rain Only
21-Oct	***0.47***	***0.30***	***0.00***	***28%***	***46%***	***46%***	***49%***	***80%***	***7-00***	***2.02***	***5***	***1***	***5***	***0.13***
CUMLATIVE:	**25.44**		**22.13**											
		Rainfall:	**4.93**											
		Irrigation:	**17.20**											

Getting dry. Room for 2 inches this week if you want to apply process water.

Run **0** ***sets @*** ***12*** ***hrs each*** ***and*** **0** ***sets @*** ***8*** ***hrs each*** ***and*** **1** ***sets@*** ***4*** ***hrs each***

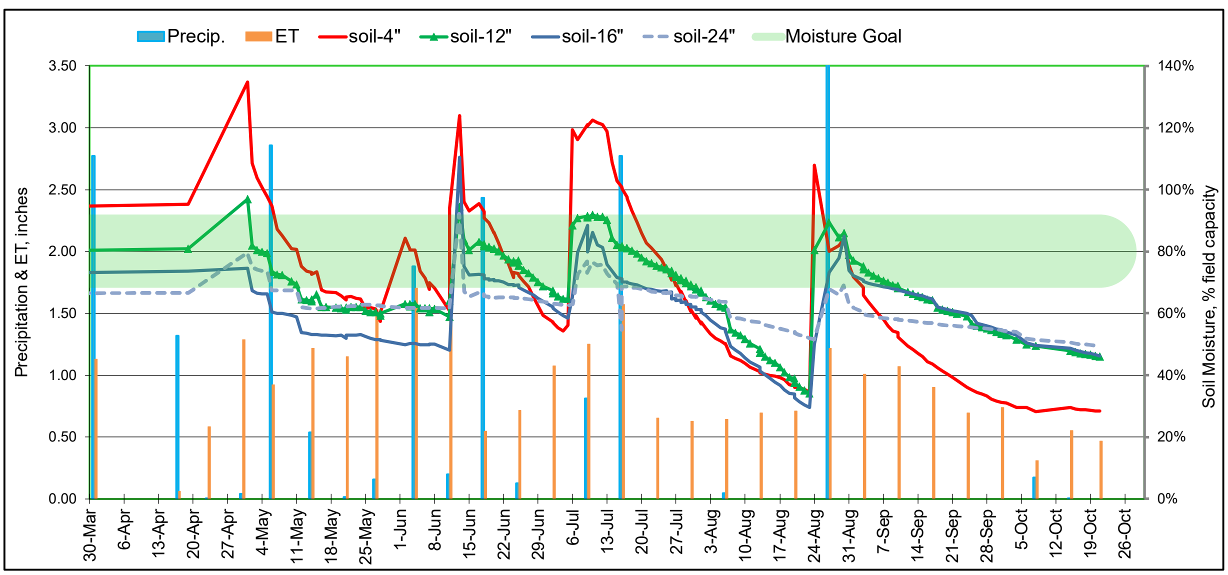


FIGURE 2B: EXAMPLE IRRIGATION MANAGEMENT REPORT FOR FIELD 3

soiltest
farm consultants, inc.
2925 Driggs Dr., Moses Lake, Wa 98837 - www.soiltestlab.com
Office: (509)765-1622 - Fax:(509)765-0314 - (800)764-1622

Irrigation Summary & Recommendation

SVZ
Grass Hay
FIELD 3 (N)

Rooting Depth		16 Inches
GPM:	114	
Acres:	20	

Soil Type & Water Holding Capacity

Soil Depth, in.	4	12	16	24
AWHC, in/increment	0.80	1.60	0.80	1.60

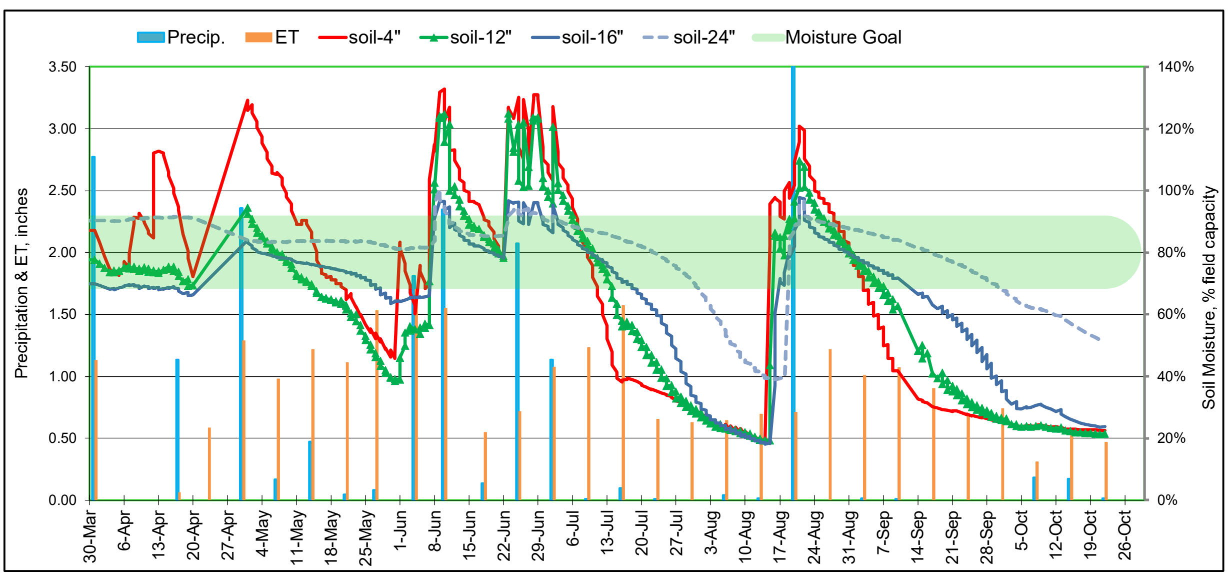
9.24 inches/24 hrs @ 70% Efficiency
6.0 hour set applies 2.31 inches

Weekly Reporting

2018 DATE	WATER USE, INCHES Last Week	Next Week	APPLIED INCHES	% of field capacity 4"	12"	16"	24"	MOISTURE GOAL	RECOMMENDATION SYSTEM	INCHES	HRS.	SETS	HR/SET	Rain Only
22-Oct	***0.47***	***0.30***	***0.02***	***22%***	***22%***	***24%***	***52%***	***80%***	***7-00***	***2.60***	***7***	***1***	***7***	***0.13***
CUMLATIVE:	**25.43**		**19.79**											
		Rainfall:	**4.93**											
		Irrigation:	**14.86**											

Getting dry. Room for 2 inches this week if you want to apply process water.

Run **0** ***sets @*** **12** ***hrs each and*** **1** ***sets @*** **8** ***hrs each and*** **0** ***sets@*** **4** ***hrs each***



Canal of the Columbia Basin Irrigation District. The shallow lakes of the Potholes area are located approximately one mile north and west of the site. Ground water is not found near enough to the surface to interfere with cropping activities. Soil drainage is good, neither excessive nor poor. No areas of salt accumulation or other undesirable chemical characteristics are naturally found. Soil depth to cobbly substratum is a bit shallow in places for root crops, but adequate for forage and grain crops. Yields of production crops at the site have been near Columbia Basin averages. Although Field 2 has never been used for wastewater treatment, forage crops could be grown. The shallow soil at Field 2 will limit the productive capacity of the field and will also require careful water management to avoid excessive leaching or ponding at the site. The soil of Field 3 is like that of Field 1 only it grades to deeper soil as it progresses northward. Although still too rocky for root crop production, Field 3 has a higher yield potential than Field 1 due to greater soil depths (up to five feet).

2.1 Infiltration Rates and Water Holding Capacity

The soil at the land treatment site is predominantly Scooteney loam. The water infiltration rate ranges from 0.8 to 2.5 inches per hour. The available water holding capacity of the loam soils at the land treatment site are approximately 2.0 inches of water per foot of topsoil and approximately 1.0 inch per foot for the cobbly and gravelly subsoil.[2] Site investigations have revealed the depth to cobbly subsoil ranges from 12 to 60 inches, with the soil depth greatest at the northeast edge of the area. The irrigations are managed for a depth of 24 inches as that is the minimum average soil depth of the two functioning fields.

2.2 Compaction and Puddling Potential

The soils at the land treatment site have loam and gravelly loam textures. In addition, the soils have low to moderate organic matter and low clay content. Consequently, the soils have a moderately strong soil structure and tend not to compact easily. Compaction can be ameliorated by minimizing traffic, eliminating traffic during wet periods, and by maintaining a perennial crop to develop a sod.

Generally, sodium becomes problematic when the exchangeable sodium percentage (ESP) reaches 15%. The soil at the land treatment site contains sufficient clay and has moderate enough slopes that 15% is the appropriate limit. This level of sodium should not be exceeded in the surface soils at the SVZ land application site to avoid possible infiltration problems. Elevated soil salinity can facilitate infiltration when the ESP is greater than 15%; however, excessively high salinity levels can impede crop production. Should sodium approach problematic levels in the surface soils, gypsum (calcium sulfate) can be applied to improve soil structure. Controlled leaching events can be planned to remove excess sodium from the surface horizon of the soil.

---

[2] Soil Survey of Adams County Washington. USDA SCS. 1967.

2.3 Soil Monitoring

The soils of the treatment fields have been monitored for many years. The permit guidelines require that the fields are sampled twice each year: once prior to the initiation of crop growth in the spring and again in the fall after the last harvest is completed. Field 2 has not been sampled for several years because equipment has been stored on the site which precluded access to 3 of the 5 monitoring locations. The site has only been used for equipment storage and no plans exist to grow crops on the site or to apply process wastewater on Field 2; it was decided by the consultant to skip the site entirely. In 2007 soil monitoring was initiated on Field 3, which was added to the treatment system. The soil test reports from 2018 are included in the Appendix. Graphical summaries of selected constituents can be found in Figure 3.

Soil nitrate levels at the surface have been typically cyclical in nature. Field 2 monitoring ended in 2012 when 1-ft soil nitrate was at an all-time high for unknown reasons (this field is not utilized). Field 1 nitrate was unusually high in 2013; however, nitrate in both Fields 1 and 2 have been low and stable for the last 4 years. Oscillations in nitrate are common at the 2-foot depth as well. The oscillations in soil nitrate in Field 1 were increasing in magnitude through 2015 but have been stable the last three years. Field 1 has been replanted several times including 2013. The minimal crop growth during replanting cannot remove all the nitrogen mineralized from the organic matter and is the likely cause of the spikes in nitrate. As a stable grass crop was established in Field 1, it was anticipated that fall nitrate levels would decline as they did from 2016 through 2018. Field 3 nitrate levels spiked in the 1-, 2- and 4-foot depths during 2008 after the alfalfa crop was plowed out and grass planted. This was likely the result of mineralization of the alfalfa root mass. Subsequent measurements of nitrate levels in Field 3 have remained stable and very low with only slight seasonal oscillations.

For optimum hay production, it is desirable to maintain soil salinity or soluble salts below 3.5 mmho/cm. Soluble salts have been within acceptable limits throughout the monitoring history. The trend in the two utilized fields appears to be either level or slightly decreasing in the top foot, and slightly increasing in the second foot.

Sodium is monitored by the exchangeable sodium percentage (ESP). ESP is of greatest concern at the surface layer of the soil where it can impact water infiltration. ESP in Fields 1 and 3 have historically exceeded the critical level of 15% at various times at both depths monitored (Fig. 3): Field 1 has a level trend, but Field 3 has an increasing trend in ESP. In the last two years the ESP has dramatically decreased in both fields at both depths. In March of 2015, 3.2 t/ac and 3.8 t/ac of gypsum were applied to Fields 1 and 3 respectively to ensure maintenance of good soil structure and water infiltration. Gypsum was applied again in March 2016 at the same rates as in 2015. Some portion of the wastewater has been sent to the City of Othello since 2016. The combination of gypsum applications and declining wastewater loading since 2016 have resulted in the improving ESP and salinity conditions of the soils.

The first foot soil Total N (TKN) trend line of Field 1 demonstrate an increasing trend, whereas, the total N trend in Field 3 has remained flat. Total N in all fields appear to be trending slightly upward at the 2-foot depth. Total P in the first foot in Fields 1 and 3 are demonstrating a very slight upward trend. Variations in measurements obscure any trends that may be present in the 2-foot total P of all fields.

FIGURE 3: SUMMARY OF SOIL TEST MONITORING

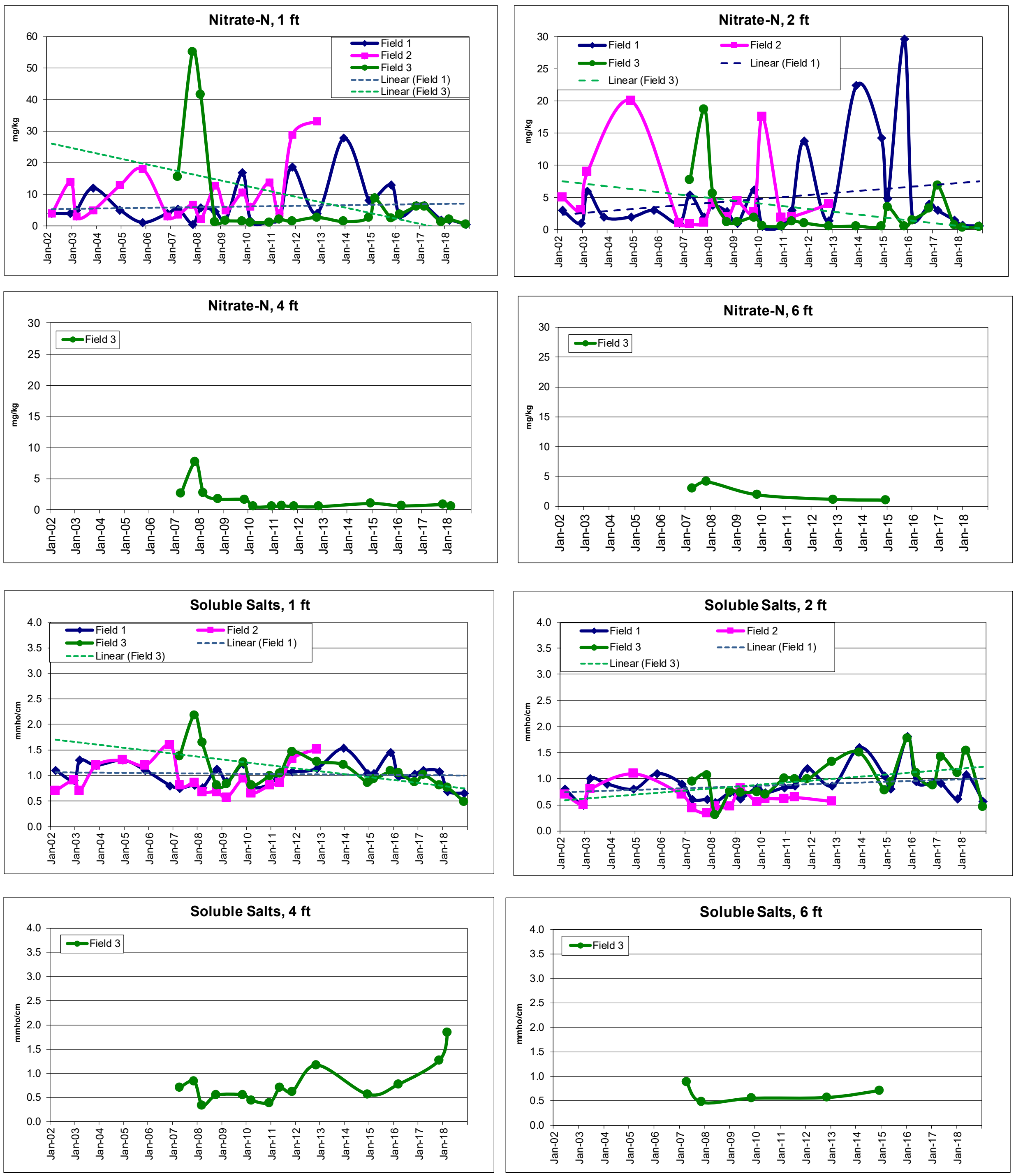
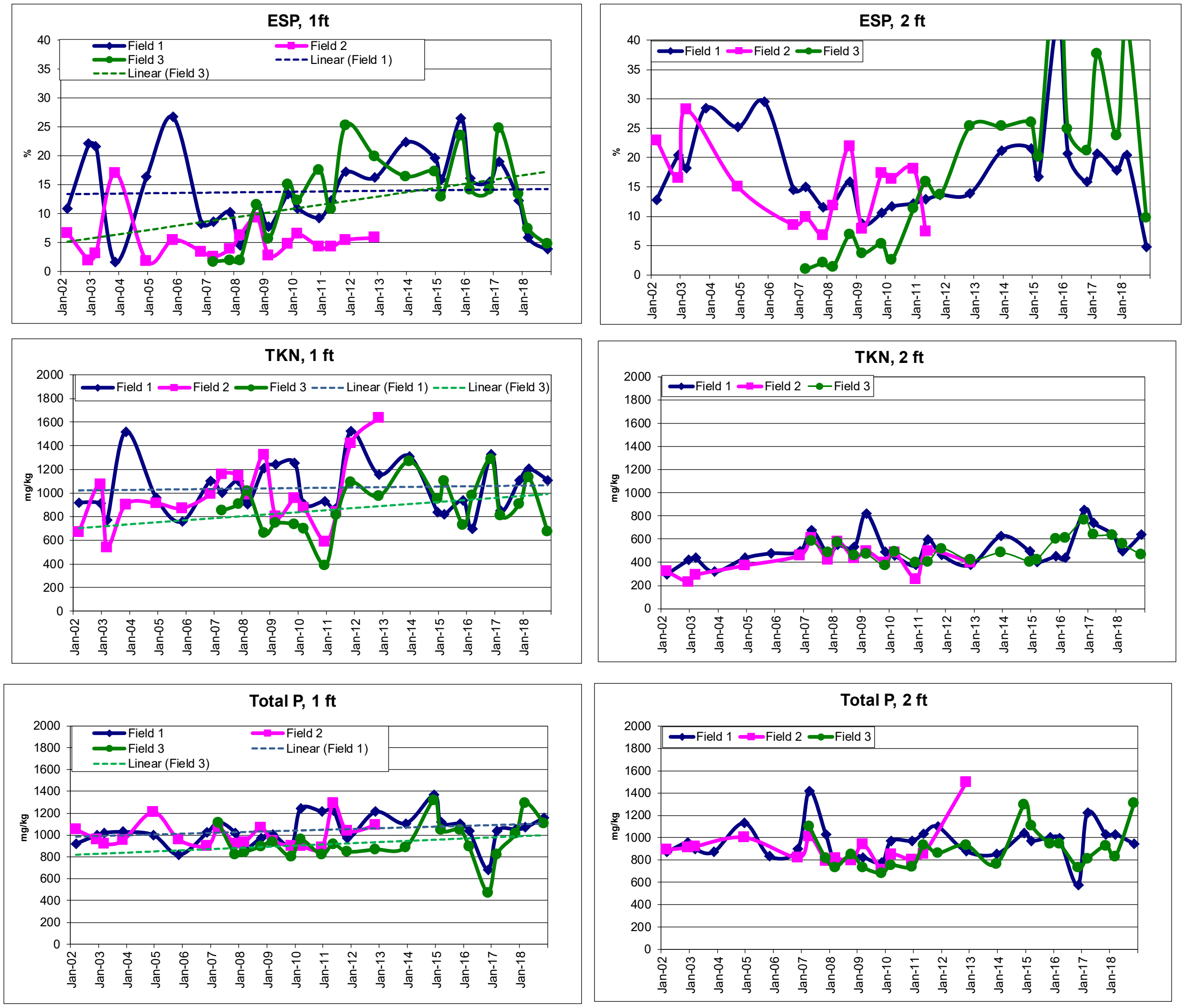


FIGURE 3: SUMMARY OF SOIL TEST MONITORING (CONTINUED)



3. CROP WATER MANAGEMENT

3.1 Crop Water Use and Irrigation Requirement

Grass hay was seeded into Fields 1 and 3 in the fall of 2007 and re-seeded in Field 1 in the fall of 2013. The 2018 monthly and annual water consumption for grass hay can be found in Table 1. Precipitation is subtracted from ET to calculate the Rainfall Balance. Excess precipitation is carried over into the subsequent month to reflect soil storage. The irrigation requirement is calculated from the rainfall balance using a net system application efficiency of 70%. This efficiency may adequately cover any needed leaching requirements; however, soil test data will be used to determine the need for additional planned leaching events. In a typical season, grass hay may utilize

35 inches of water and require 50 inches of irrigation water. The summer of 2018 was near normal: total annual rainfall was 6.8 inches, consumptive water use was approximately 32.5 inches and the irrigation requirement was approximately 39.5 inches.

3.2 Water Balance

In 2018, the total wastewater flow from the SVZ processing facility to the lagoon was 29.45 MG (Table 2A). No wastewater was pumped from the lagoon and land applied. All wastewater pumped into the lagoon was sent to the City of Othello for treatment less any changes in storage and evaporation loss. Flow meter data show that 30.93 MG of fresh water was applied to the fields in 2018. Irrigation water was applied approximately equally to the two fields.

It is estimated in Table 1 that for Field 1, 32.5 inches of water were potentially transpired by the crop and that the irrigation requirement was 39.5 inches. Approximately 31.1 inches of water (100% fresh water) were applied to Field 1. The water balance indicates that the field was under-irrigated by 8.4 inches. The water balance was positive during the month of August. Deficit irrigation was practiced the remaining 6 months of the irrigation season. The hydraulic loading for Field 3 was the same as for Field 1.

The leaching requirement is estimated to be 0.8% as calculated from the water quality parameters in Table 2B as no wastewater was land applied. The leaching requirement is the same for both fields as they receive water from the same sources at very nearly the same ratios; further, they are planted to the same crop and the soil is substantially consistent across both fields. The maximum desirable saturated paste EC for both fields was set at 3.5 mmho/cm for the calculation. As the EC of neither the supplemental water nor the wastewater is measured, it was estimated using a commonly used general relationship: EC=TDS/640. For the fresh/supplemental water the EC = 85/640 which yields 0.13 mmho/cm. Since we generally are concerned with FDS in vegetable wastewater, the same formula was applied using FDS rather than TDS. As indicated in Table 1, wastewater made up 0% of the water applied to each field. The weighted average EC for all the water applied to the field is then the same as the supplemental water, 0.13 mmho/cm. The Leaching Requirement is calculated by the following relationship.

$LR = ECw / [(5xECw) – ECe]$, where

LR is Leaching Requirement;

ECw is the EC of the average water applied

ECe is the maximum allowable EC of the soil solution

Inserting the values calculated above,

$LR = 0.13 / [(5 \times 3.5) – 0.13]$

results in a leaching requirement of 0.8%.

Note that 2018 leaching requirement is substantially less than 2017 because no wastewater was used.

TABLE 1: 2018 HYDRAULIC LOADING SUMMARY

FIELD 1

MONTH	Consumptive Use ac-in/ac	Precipitation ac-in/ac	Rainfall Balance ac-in/ac	Irrigation Req't at 70% Efficiency ac-in/ac	Irrigation Water Load: Process ac-in/ac	Irrigation Water Load: Fresh ac-in/ac	Irrigation Water Load: Total ac-in/ac	Balance ac-in/ac
JAN	0.16	1.39	-1.2	0.0	0.0	0.0	0.0	0.0
FEB	0.37	0.52	-0.1	0.0	0.0	0.0	0.0	0.0
MAR	1.22	0.35	0.9	0.0	0.0	0.0	0.0	0.0
APR	3.33	1.30	2.0	2.9	0.0	2.6	2.6	-0.3
MAY	5.36	0.33	5.0	7.2	0.0	2.3	2.3	-4.8
JUN	5.24	0.14	5.1	7.3	0.0	7.0	7.0	-0.3
JUL	6.38	0.11	6.3	9.0	0.0	5.6	5.6	-3.3
AUG	5.24	0.00	5.2	7.5	0.0	13.5	13.5	6.0
SEP	3.08	0.01	3.1	4.4	0.0	0.1	0.1	-4.3
OCT	1.58	0.67	0.9	1.3	0.0	0.0	0.0	-1.3
NOV	0.42	1.05	-0.6	0.0	0.0	0.0	0.0	0.0
DEC	0.15	0.94	-0.8	0.0	0.0	0.0	0.0	0.0
YEAR	**32.51**	**6.81**	**25.7**	**39.5**	**0.0**	**31.1**	**31.1**	**-8.4**

Total Hydraulic Load, in.	**31.1**	**2018 Load**	**25.9**	
Hydraulic Load Limit, in.	**30.0**	**% Change**	**20%**	**Process, % of Total** **0%**
% of Limit **ac-ft/ac**	**104%**			**Leaching Fraction as-applied** **-21.2%** no
(ET and Precip. data from AgWeatherNet Othello)				**Calculated Leaching Requirement** **0.0%** wastewater

FIELD 3

MONTH	Consumptive Use ac-in/ac	Precipitation ac-in/ac	Rainfall Balance ac-in/ac	Irrigation Req't at 70% efficiency ac-in/ac	Process ac-in/ac	Fresh ac-in/ac	Total ac-in/ac	Balance ac-in/ac
JAN	0.16	1.39	-1.2	0.0	0.0	0.0	0.0	0.0
FEB	0.37	0.52	-0.1	0.0	0.0	0.0	0.0	0.0
MAR	1.22	0.35	0.9	0.0	0.0	0.0	0.0	0.0
APR	3.33	1.30	2.0	2.9	0.0	2.6	2.6	-0.3
MAY	5.36	0.33	5.0	7.2	0.0	2.3	2.3	-4.8
JUN	5.24	0.14	5.1	7.3	0.0	7.0	7.0	-0.3
JUL	6.38	0.11	6.3	9.0	0.0	5.6	5.6	-3.3
AUG	5.24	0.00	5.2	7.5	0.0	13.5	13.5	6.0
SEP	3.08	0.01	3.1	4.4	0.0	0.1	0.1	-4.3
OCT	1.58	0.67	0.9	1.3	0.0	0.0	0.0	-1.3
NOV	0.42	1.05	-0.6	0.0	0.0	0.0	0.0	0.0
DEC	0.15	0.94	-0.8	0.0	0.0	0.0	0.0	0.0
YEAR	**32.51**	**6.81**	**25.7**	**39.5**	**0.0**	**31.1**	**31.1**	**-8.4**

Total Hydraulic Load	**31.1**	**2016 Load**	**26.1**	
Hydraulic Load Limit	**30.0**	**% Change**	**19%**	**Process, % of Total** **0%**
% of Limit **ac-ft/ac**	**104%**			**Leaching Fraction as-applied** **-21.2%** no
(ET and Precip. data from AgWeatherNet Othello)				**Calculated Leaching Requirement** **0.0%** wastewater

4. NUTRIENT MANAGEMENT

A balance sheet approach is used for nutrient management analysis in this report, like the method used for water management. The inputs are identified and quantified. Losses and removals are also identified, quantified and compared to projections from last year. Finally, a balance is calculated and discussed in comparison to soil test results.

4.1 Nutrient Additions

No wastewater was applied to either of the treatment fields in 2018 (Table 2A); thus, no nutrient or salt additions derived from wastewater were applied. In addition, no commercial fertilizer applications were made. The only additions were the nitrogen and salts contained in the supplemental water used for irrigation (Table 2B). Totals of 155 lbs of nitrogen and 21,924 lbs of total salt were derived from the applied irrigation district water.

Nitrogen loss from denitrification and volatilization can result in relatively low uptake efficiencies under fertigation with wastewater containing high BOD. No losses are deducted in Table 2A or 2B, but in calculating the total loading in Table 4 the sums were adjusted by the following nitrogen use efficiencies: 75% of the wastewater-N and 85% of the fresh water-N and fertilizer-N were carried into the total (Allison, F.E. 1965. *Evaluation of Incoming and Outgoing Processes That Affect Soil Nitrogen*, in Soil Nitrogen. Agronomy Monograph 10, Bartholomew, W.V. & Clark, Francis E. eds. American Society of Agronomy, Madison, WI).

4.2 Crop Nutrient Removals

Table 3 summarizes the removal of selected constituents in the harvested portion of the crop. The removal rates were calculated using 2018 yield values and constituent concentrations from the samples obtained from the harvests made in 2018 and 2017. The ash content of the harvested portion of the plant material is used to calculate the total mineral salt removal.

The harvests in 2018 removed approximately 4.09 t/ac of hay (fresh weight). The yield was nearly double that of 2017. The grass hay crop removed a significant amount of most constituents. The hay removed 142 pounds of nitrogen per acre and approximately 478 pounds of total salts per acre. The hay harvests also removed approximately 212 pounds of potassium, 8 pounds of sodium and 31 pounds of chloride per acre.

The nutrient balances are calculated in Table 4. In these calculations, it was assumed that 100% of all constituents, except nitrogen as explained above, passed through the conveyance and application system and entered the soil. Positive values in the balance rows in Table 4 indicate an accumulation of constituent in the soil of the land treatment field.

TABLE 2A: WASTEWATER PRODUCTION AND LAND APPLICATION TOTALS

	PLANT PROCESS WATER PRODUCTION		IRRIGATION WASTEWATER								
			ANALYSES, mg/L							APPLIED	
MONTH	MG	Ac-Ft	TKN	BOD	COD	sBOD	FDS	Na	NH4-N	MG	Ac-Ft
JAN	2.040	6.261									
FEB	1.040	3.192									
MAR	1.750	5.371	0.0	0	0	0	0	0	0.00	0.000	0.00
APR	1.930	5.923	0.0	0	0	0	0	0	0.00	0.000	0.00
MAY	1.950	5.984	0.0	0	0	0	0	0	0.00	0.000	0.00
JUN	2.370	7.273	0.0	0	0	0	0	0	0.00	0.000	0.00
JUL	3.090	9.483	0.0	0	0	0	0	0	0.00	0.000	0.00
AUG	2.960	9.084	0.0	0	0	0	0	0	0.00	0.000	0.00
SEP	2.200	6.752	0.0	0	0	0	0	0	0.00	0.000	0.00
OCT	3.720	11.416	0.0	0	0	0	0	0	0.00	0.000	0.00
NOV	3.690	11.324									
DEC	2.710	8.317									
AVG	2.454	7.532	0.0	0	0	0	0	0	0.00	0.000	0.000
			TOTAL LAND APPLIED, LBS								
TOTAL	29.450	90.38	0	0	0	0	0	0	0	0.000	0.000

Notes: No wastewater applied for irrigation in 2018; thus, no samples collected for analysis

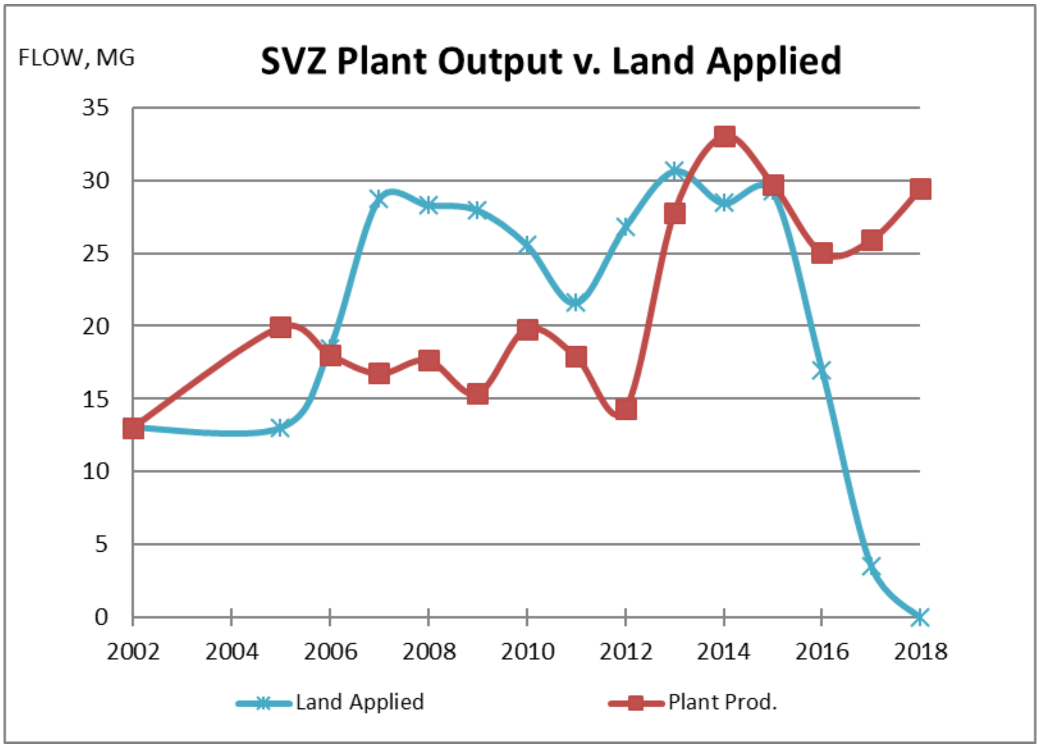
Est. Evaporation Loss
#N/A

TABLE 2B: SUPPLEMENTAL WATER TOTALS

	units	result	MGal Applied		Total Pounds Applied
NITRATE-N	mg/L	**0.09**			
TKN	mg/L	**0.50**			
SUM OF NITROGEN	mg/L	**0.6**	**30.93**	**Nitrogen**	**152.2**
TDS (salts)	mg/L	**85**		**TDS**	**21924**
Sodium (Na)	mg/L	**0.1**		**Sodium**	**26**

Note: Green indicates that MDL was used in place of non-detect for calculation purposes.

FIGURE 4: SVZ WASTEWATER PRODUCTION & LAND APPLICATION



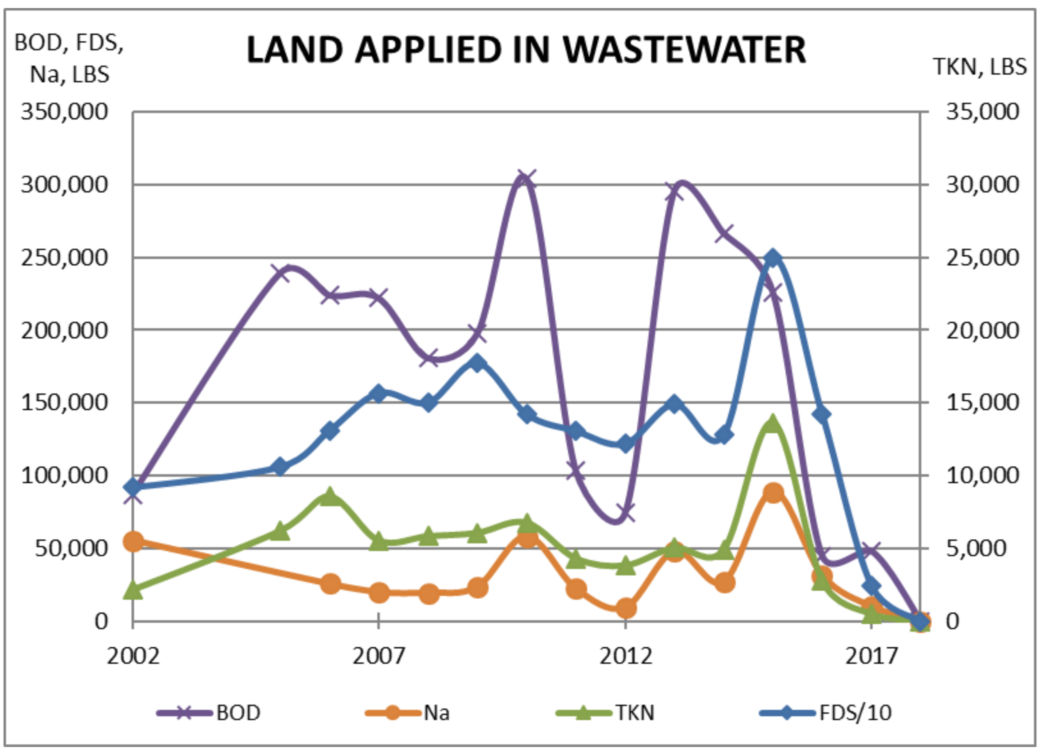


TABLE 3: HARVEST REMOVAL TOTALS

FIELD / DATE	CROP	YIELD, lbs	DM	N	P	Na	Ca	Mg	K	Cl	Ash
					%, TOTAL ANALYSIS						
FIELD 1	**18.2 acres**										
1st Cutting	Grass Mix Hay	73,596	93.2%	1.7%	0.33%	0.12%	0.37%	0.21%	2.34%	0.34%	7.4%
2nd Cutting	Grass Mix Hay	43,869	93.6%	1.9%	0.38%	0.11%	0.48%	0.27%	2.95%	0.43%	5.8%
3rd Cutting	Grass Mix Hay	31,248	94.0%	2.2%	0.42%	0.09%	0.58%	0.32%	3.55%	0.52%	4.2%
4th Cutting	Grass Mix Hay										
Total	lbs	148,713									
	t/ac	4.09									
Net Removal	**lbs/ac**		**7,639**	**142**	**28**	**8**	**34**	**19**	**212**	**31**	**478**
FIELD 3	**18.4 acres**										
1st Cutting	Grass Mix Hay	74,404	93.2%	1.7%	0.33%	0.12%	0.37%	0.21%	2.34%	0.34%	7.4%
2nd Cutting	Grass Mix Hay	44,351	93.6%	1.9%	0.38%	0.11%	0.48%	0.27%	2.95%	0.43%	5.8%
3rd Cutting	Grass Mix Hay	31,592	94.0%	2.2%	0.42%	0.09%	0.58%	0.32%	3.55%	0.52%	4.2%
4th Cutting	Grass Mix Hay										0.0%
Total	lbs	150,347									
	t/ac	4.09									
Net Removal	**lbs/ac**		**7,639**	**142**	**28**	**8**	**34**	**19**	**212**	**31**	**478**

No analysis for 2nd harvest, 3rd harvest data from 2017: green values are average of 1st and 3rd harvest data

4.3 Nutrient Balances

Balances in 2018 were much different than in previous years due to the application of zero irrigation wastewater. More nitrogen, 139 pounds per acre in Fields 1 and 3, was removed in harvests than was applied from all sources. Sodium was removed at rates greater than applied from all sources. Table 4 shows a net removal from the soil of approximately 8 lbs-sodium/ac.

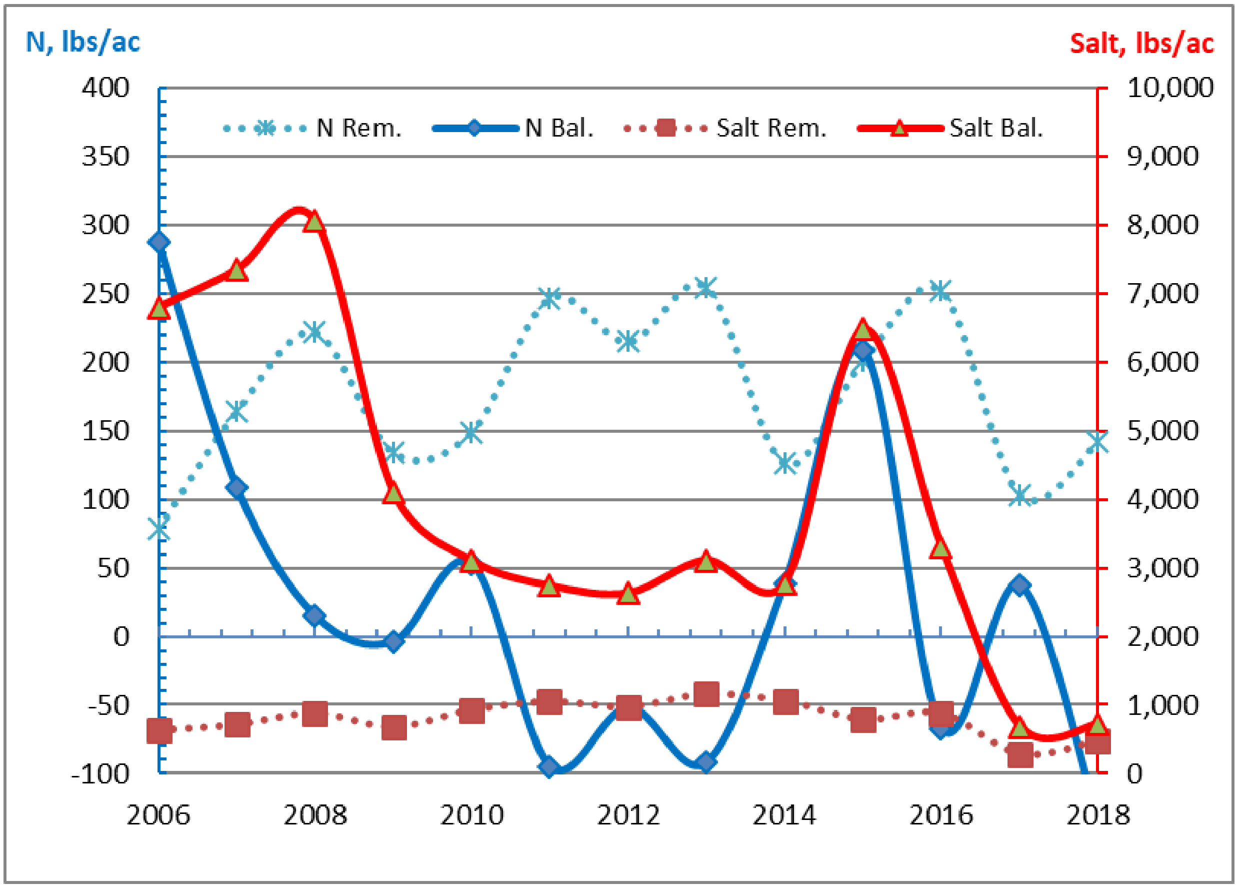
Wastewater land application in 2018 was zero as was fertilizer application. The only nutrients and salts applied came from the supplemental water supply. Thus, all loadings were at record lows. Supplemental nitrogen applications will be required if no wastewater is applied and soil storage nitrogen is depleted. Irrigation with the high-quality Columbia Basin Project water resulted in the application of approximately 600 lbs/ac of salt. Although harvest removal of salt in 2018 was nearly twice that in 2017, 121 lbs/ac of salt remained in the soil at the end of the season. The historical loading rates and balances for nitrogen and salts are depicted in Figure 5. Total salt application in 2018 was 15% of the 11 lbs/day maximum listed in the permit.

TABLE 4: BALANCE OF CONSTITUENTS LAND APPLIED

FIELD 1	18.2 acres							
	N, lbs/ac		Sodium, lbs/ac		FDS or Salt, lbs/ac		BOD, lbs/ac	
Source	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**
Wastewater	0	13	0	277	0	668	0	1,316
Freshwater	4.2	2.55	0.7	0	599	727	0	0
Fertilizer	0	150	0	0	0	300	0	0
SUM^	**4**	140	**1**	277	**599**	1,695	**0**	1,316
% difference from last year	**-97.5%**			**-99.7%**		**-64.7%**		**-100.0%**
					2	lbs/ac/day*	**0**	**lbs/ac/day***
Permit Design	**165**	lbs/yr	**N/A**	**N/A**	**11**	lbs/ac/day	**100**	**lbs/ac/day**
% of Design	**2%**	85%	**N/A**	**N/A**	**15%**	**24%**	**0%**	
Harvest Removal, lbs/ac	**142**	103	**8**	3	**478**	284	**N/A**	**N/A**
Balance, lbs/ac	**-139**	37	**-8**	274	**121**	684	**N/A**	**N/A**
FIELD 3	**18.4 acres**							
Wastewater	0	13	0	860	0	668	0	1,214
Freshwater	4.2	2.55	0.7	0	599	719.00	0	0
Fertilizer	0	150	0	0	0	300	0	0
SUM^	**4**	140	**1**	860	**599**	1,687	**0**	1,214
% difference from last year	**-97.5%**			**-99.9%**		**-64.5%**		**-100.0%**
					2	lbs/ac/day*	**0**	**lbs/ac/day***
Permit Design	**165**	lbs/yr	**N/A**	**N/A**	**11**	lbs/ac/day	**100**	**lbs/ac/day**
% of Design	**2%**	85%	**N/A**	**N/A**	**15%**	**24.1%**	**0%**	
Harvest Removal, lbs/ac	**142**	103	**8**	3	**478**	284	**N/A**	**N/A**
Balance, lbs/ac	**-139**	37	**-8**	274	**121**	684	**N/A**	**N/A**

Notes: ^Sum of Nitrogen was calculated assuming 75% use efficiency of wastewater N and 85% use efficiency of commercial fertilizer N.
* FDS, pounds/acre/day was calculated over 365 days in a year; BOD pounds/ac/day was calculated using the 245 day irrigation season.

FIGURE 5: SVZ HARVEST REMOVAL & NET APPLICATION HISTORY



5. GROUNDWATER MONITORING

Eight monitor wells have been installed at the land treatment site; the location of each is indicated in Figure 1. Monitor wells 1 through 5 were installed prior to the date SVZ assumed operations of the site. Wells 6 through 8 were installed in the spring of 2008 in preparation for adding Field 3 to the treatment site. Wells 1 and 2 were damaged during fall field work in 2013. These well were abandoned along with monitor wells 3 and 4 in 2014 when two new wells, 2R and 3R, were installed. The wells are monitored monthly for water level and various physical and chemical parameters as required by permit.

Historical data for nitrate and TDS is reported in Figure 5. The data for the new wells 2R and 3R is appended to that of the original wells 2 and 3 in Figure 5 as they are in approximately the same locations. In the 2012 Fact Sheet Update for State Waste Discharge Permit ST-8077 the background values for groundwater nitrate and TDS for well 2R were modified to 5.62 and 507 mg/L, respectively. The background values for well 8 as determined in the same Fact Sheet were 18.1 mg/l for nitrate-N and 916 mg/l for TDS. The background lines and data trend lines for these two parameters are included in Figure 5.

The Field 2 up-gradient well, MW2/2R demonstrates variations in TDS of approximately 200 mg/l and an upward trend during the last few years. The overall trend is slightly downward from highs measured shortly after the well was installed. TDS levels in MW2/2R has exceeded background levels during much of 2018. Up-gradient well MW8 in Field 3 demonstrated a steady increase of approximately 200 mg/l from its installation in 2008 until 2012, then decreasing to below original levels by the end of 2017. The overall trend is currently slightly downward and below the 2012 background level.

The down-gradient wells are mixed in their responses over time. TDS in Well 3/3R demonstrates a downward trend but was still above background in 2018. Well 5 demonstrates a very slight upward trend above background with considerable short and long-term variations. Wells 6 and 7 both exhibit relatively consistently increasing TDS over the monitoring period and are both near to above background levels.

The nitrate levels in up-gradient well, MW2, is well above background and exhibits an increasing long-term trend with considerable variations in two- to four-year time spans. Some very high values were recorded since 2016 including 2018. The nitrate level in the Field 3 up-gradient well, MW8, has consistently trended downward and is well below the background level established in 2012.

The nitrate levels in Field 3 down-gradient wells, MW6 and MW7, demonstrate an overall downward trend with significant variations and staying below the 2012 background level. The nitrate level in the Field 1 down-gradient wells, MW3/3R and MW5, demonstrate variably increasing trends with wide variations. Although there are many gyrations, the nitrate level in MW5 has risen from 5 to 20 mg/l. MW3/3R has varied from zero to nearly 30 mg/l at various times with a resultant increasing trend. Nitrate in both wells exceed background levels but declined through 2018.

6. 2019 CROP PLAN

6.1 Soil Monitoring

The DOE land treatment permit requires that soil samples be collected in the spring and fall: this will be accomplished in 2019. The purpose of soil testing is to monitor salt and nutrient concentrations over time and act as a back-up to the nutrient balance calculations. Modifications in management will be triggered by significant changes in soil test values. Soil samples will be collected and analyzed from Fields 1 and 3 to monitor chemical changes and salt conditions. Until SVZ moves the stored equipment, soil sample sites in Field 2 will continue to be inaccessible.

6.2 2019 Cropping Pattern and Wastewater Applications

Fields 1 and 3 will remain in grass hay for the 2019 season. Field 2 will remain idle (see Table 5). It is currently planned that no more than 50% (10 MG) of the effluent from the lagoon will be applied to Fields 1 and 3 this year in order to keep FDS loading below the 4,000 lbs/ac limit. All remaining wastewater will be sent for treatment by the City of Othello. Automated soil moisture, rain gage and ET monitoring will continue to be used to aid in the scheduling of irrigations. The loadings for 2019 are anticipated to be from wastewater, supplemental water and fertilizer.

FIGURE 5: SUMMARY OF SVZ WELL MONITORING

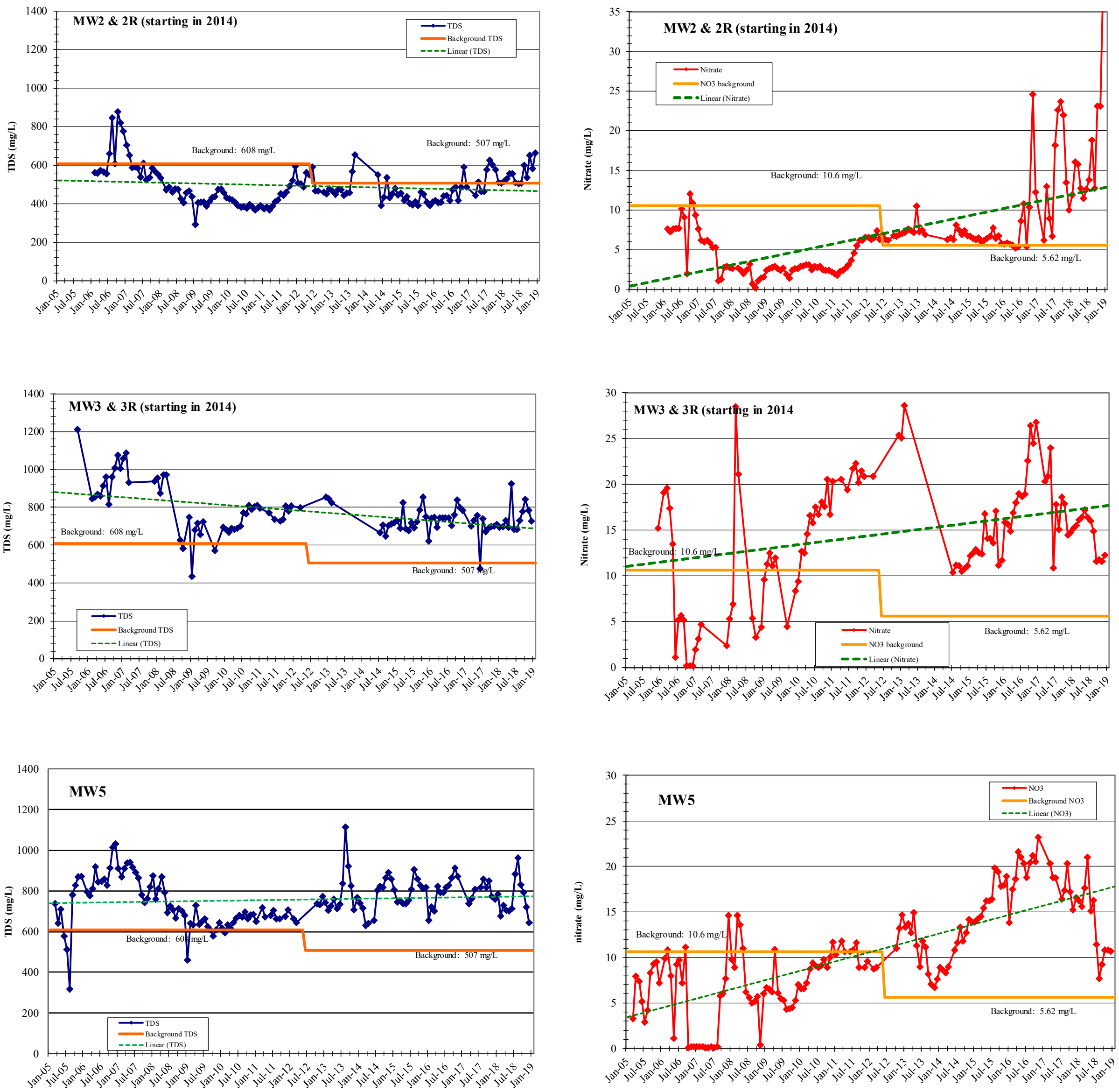


FIGURE 5: SUMMARY OF SVZ WELL MONITORING (CONTINUED)

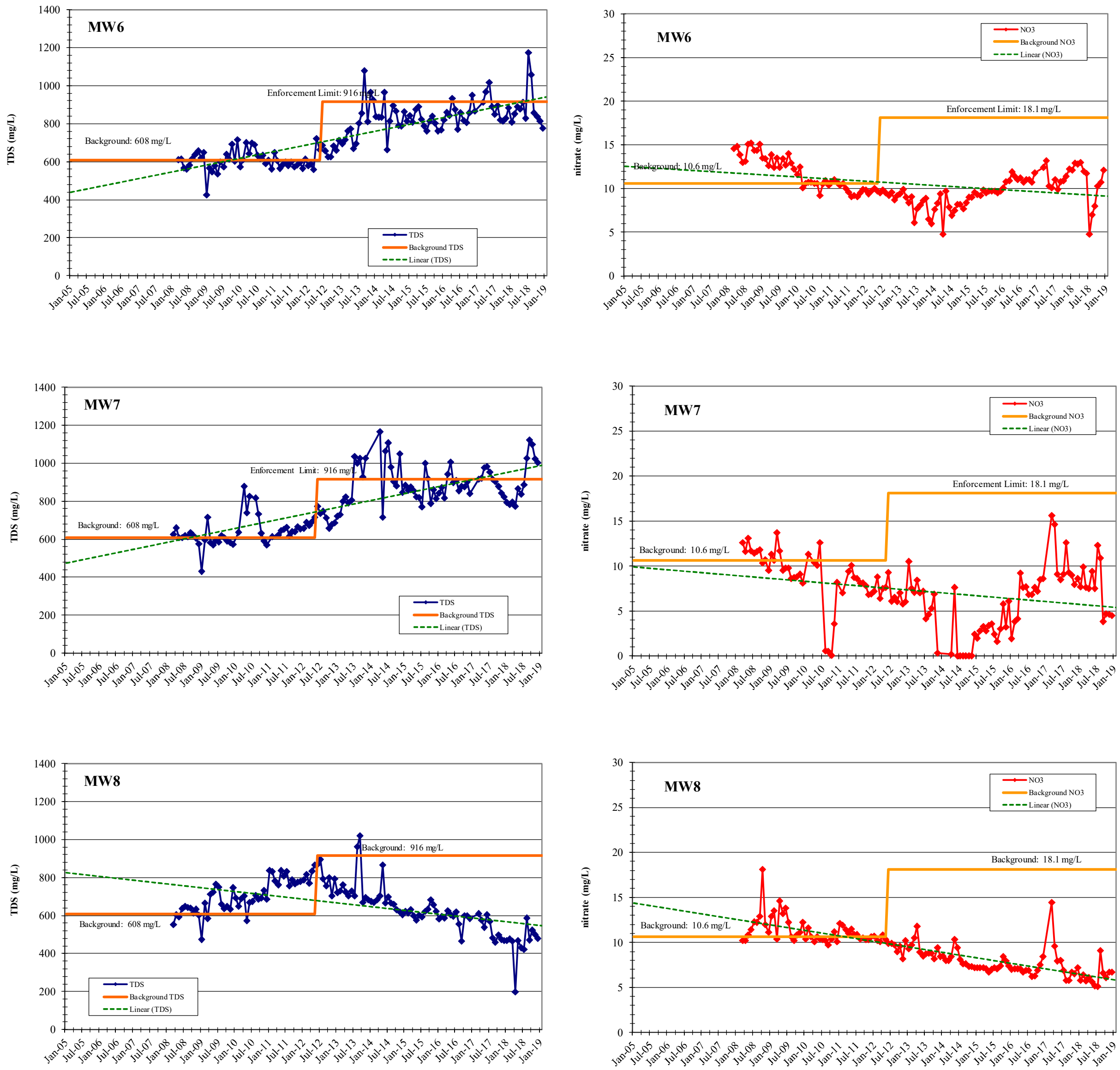


TABLE 5: PROJECTED PLAN FOR 2019

The nitrogen requirement in any given year depends on the crop, growing conditions/weather, water and nutrient management and disease/pest pressure. Most of these factors can only be estimated ahead of time from historical values or experience; the result is called the agronomic rate. The crop nitrogen requirement can be met by nitrogen from four main sources, soil residual, wastewater, fresh water, fertilizer. Not all the nitrogen applied from any of these sources remains available for crop use. Volatilization and denitrification result in nitrogen loss from the system and each of these sources has an efficiency of use that needs to be included in the balance equation. If planning suggests that nitrogen availability from one of these sources is anticipated to be higher, then nitrogen from one or more of the other sources should be reduced.

The Projected Management Plan for 2019, as presented in Table 5 was developed with the following assumptions:

1) The weather, ET and precipitation, for 2019 will not vary substantially from the 2016 to 2018 average.
2) No more than 10 MG of wastewater will be land applied
3) Crop yields in 2019 will continue near those experienced in previous years.

With these considerations in mind, the anticipated fertilizer nitrogen requirement is included in Table 5.

6.3 Summary and Recommendations

The land application system operated well in 2018 and the grass hay crop produced well. On a balance basis, approximately 139 lbs/ac of nitrogen were removed from the fields relative to that applied. The fall nitrogen soil test indicated that approximately 4 lbs/ac of mineral nitrogen remained in Fields 1 and 3. The modest positive balance of salt, TDS, was derived from supplemental water only. The 2018 nitrogen balance demonstrates that the grass can extract much nitrogen from the soil. The hay crops must be managed to produce well and help to maintain a favorable field N balance. Proper water management is the first and most important step. It was noted that SVZ upgraded the soil moisture monitoring equipment for the 2015 season to make real-time visualization of the field conditions available to SVZ and the farm manager. Adequate supplemental water should be applied to optimize crop growth.

Mineral salt loadings (N, Na, FDS) decreased dramatically in 2018 compared to 2015 and 2016 because no wastewater was land applied. The declining loading rates are reflected by the improving soil salinity and ESP values. Not all salts react the same when land applied. Magnesium has minimal effect on soil salinity compared to sodium. Potassium is a plant nutrient removed at significant rates by hay crops. The second year of deficit irrigation practices was instrumental in the decline in crop production in 2017; better irrigation management in 2018 nearly doubled the hay yield. Application of adequate fresh water to achieve the desired leaching fraction of 1.8% will prevent salt accumulation at the surface. Adequate water will also increase hay yield, thus, improving the treatment capacity of the site.

Pesticides will be used only as needed. It is anticipated that some herbicide may be applied to the fields for weed control. Need for chemical and fertilizer applications will be determined by a certified crop advisor or similar professional. All pesticide applications will be made in accordance with label directions by licensed applicators.

The flow meters appear to have worked well in 2018 which allowed accurate evaluation of the hydraulic balances in the fields. It would be advisable to check the calibration of each flow meter at least annually and provide the dates of calibration for inclusion in this report.

APPENDIX

2018

DMR REPORTS FOR

Washington State DOE Discharge Permit No. ST8077

CAN BE VIEWED AT THE FOLLOWING LINK:

https://fortress.wa.gov/ecy/paris/ComplianceAndViolations/ViewDMRData.aspx

HARVEST REPORTS

soiltest farm consultants, inc.
2925 Driggs Dr., Moses Lake, Wa 98837 - www.soiltestlab.com
Office: (509)765-1622 - Fax:(509)765-0314 - (800)764-1622

NATIONAL FORAGE TESTING ASSOCIATION 2018 Certified NIRS by NFTA — Excellence in Forage Testing — DM CP ADF NDF

SVZ-USA
MIKE GREENE
Othello , WA 99344
GROWER:

DATE RECEIVED: *6/12/2018*
DATE REPORTED: *6/19/2018*
LAB NUMBER: F18-02562

FIELD ID.: 2018 1ST 86B
NIR CALIBRATION: Grass Hay

GROWER ACCOUNT #:
GROWER SAMPLE ID:

NIR FEED ANALYSIS

	As Received Basis	100% Dry Matter
MOISTURE %	6.8	
DRY MATTER %	93.2	100
Protein		
CRUDE PROTEIN		10.4
DIGESTIBLE PROTEIN		6.4
Fiber		
ACID DET. FIBER %		36.0
NEUTRAL DET. FIBER %		62.5
LIGNIN %		3.5
RFV		91
FAT %		2.25
STARCH %		0.07
ESC %		7.3
NSC %		10.0
ASH %		7.4
WSC %		9.9
Minerals		
CALCIUM (Ca) %		
PHOSPHORUS (P) %		
POTASSIUM (K) %		
MAGNESIUM (Mg) %		
Other Analysis:		
NITRATE NITROGEN mg/kg		15

	As Received Basis	100% Dry Matter Basis
TDN % [ADF]		60.2
NEL, MCAL/KG [ADF]		1.2
NEM, MCAL/KG [ADF]		1.9
NEG, MCAL/KG [ADF]		1.1
METABOLIZABLE ENERGY		2.23
DIGESTIBLE ENERGY		2.7
DIGESTIBLE DRY MATTER		60.8
DRY MATTER INTAKE		1.9
Wet Chemistry Minerals:		
Boron (B) mg/kg		5.16
Calcium (Ca) %		0.37
Copper (Cu) mg/kg		5.39
Iron (Fe) mg/kg		352
Magnesium (Mg) %		0.21
Manganese (Mn) mg/kg		46.57
Phosphorus (P) %		0.33
Potassium (K) %		2.34
Sodium (Na) %		0.12
Sulfur (S) %		0.24
Zinc (Zn) mg/kg		23.05
Chloride (Cl) mg/kg		3375

* TOTAL AFLATOXIN (B1, B2, G1, G2) (AgraStrip 8.0 ppb)
Relataive Feed value includes both ADF and NDF in accordance with AFGC Hay Market Task Force Equations

We make every effort to provide an accurate analysis of your sample. For reasonable cause we will repeat tests, but because of factors beyond our control in sampling procedures and the inherent variability of feeds, our liability is limited to the price of the tests.

This is your Invoice F18-02562 Account #: 288000 Reviewed by: KEB List Cost

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NATIONAL FORAGE TESTING ASSOCIATION 2017 Certified NIRS by NFTA Excellence in Forage Testing DM CP ADF NDF

SVZ-USA
MIKE GREENE
Othello , WA 99344
GROWER:

DATE RECEIVED: 9/5/2017
DATE REPORTED: 9/6/2017
LAB NUMBER: F17-07502

FIELD ID.: 3RD 58 BALES
NIR CALIBRATION: Grass Hay

GROWER ACCOUNT #:
GROWER SAMPLE ID:

NIR FEED ANALYSIS

	As Received Basis	100% Dry Matter
MOISTURE %	6.0	
DRY MATTER %	94.0	100
Protein		
CRUDE PROTEIN		13.9
DIGESTIBLE PROTEIN		9.7
Fiber		
ACID DET. FIBER %		32.2
NEUTRAL DET. FIBER %		56.2
LIGNIN %		2.0
RFV		106
FAT %		2.62
STARCH %		1.68
ESC %		5.6
NSC %		7.5
ASH %		12.1
WSC %		5.8
Minerals		
CALCIUM (Ca) %		
PHOSPHORUS (P) %		
POTASSIUM (K) %		
MAGNESIUM (Mg) %		
Other Analysis:		
NITRATE NITROGEN mg/kg		227

		As Received Basis	100% Dry Matter Basis
TDN %	[ADF]		64.3
NEL, MCAL/KG	[ADF]		1.3
NEM, MCAL/KG	[ADF]		1.9
NEG, MCAL/KG	[ADF]		1.3
METABOLIZABLE ENERGY			2.41
DIGESTIBLE ENERGY			2.8
DIGESTIBLE DRY MATTER			63.8
DRY MATTER INTAKE			2.1
Wet Chemistry Minerals:			
Boron (B) mg/kg			6.73
Calcium (Ca) %			0.58
Copper (Cu) mg/kg			8.37
Iron (Fe) mg/kg			689
Magnesium (Mg) %			0.32
Manganese (Mn) mg/kg			55.03
Phosphorus (P) %			0.42
Potassium (K) %			3.55
Sodium (Na) %			0.09
Sulfur (S) %			0.33
Zinc (Zn) mg/kg			27.76
Chloride (Cl) mg/kg			5198

* TOTAL AFLATOXIN (B1, B2, G1, G2) (AgraStrip 8.0 ppb)
Relataive Feed value includes both ADF and NDF in accordance with AFGC Hay Market Task Force Equations

We make every effort to provide an accurate analysis of your sample. For reasonable cause we will repeat tests, but because of factors beyond our control in sampling procedures and the inherent variability of feeds, our liability is limited to the price of the tests.

This is your Invoice F17-07502 Account #: 288000 Reviewed by: KEB List Cost

DOE SOIL TESTING RESULTS

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SVZ-USA
P.O. BOX 715
OTHELLO, WA 99344

DATE RECEIVED 3/15/2018
DATE REPORTED 3/22/2018
INVOICE # 2992

NORTH

SAMPLE I.D.	LAB NO	NO3-N mg/Kg	NH4-N mg/Kg	TKN mg/Kg	TOTAL P mg/Kg	OLSEN P mg/Kg	NH4OAC K mg/Kg	NH4OAC Ca meq/100g	NH4OAC Mg meq/100g	NH4OAC Na meq/100g
1FT	2992	2.0	1.7	1132	1293	12	485	15.7	3.6	0.84
2FT	2993	0.3	1.4	561	830		100	18.1	1.9	4.43
3FT	2994	0.5	1.0	421	1000		71	11.2	1.90	3.47

SAMPLE I.D.	LAB NO	SULFUR mg/Kg	DTPA EXT B mg/Kg	DTPA EXT Zn mg/Kg	CEC meq/100g	ESP %	Est Sat Paste SOL SALTS mmhos/cm	pH 1:1	OM %	Fe2+ field test
1FT	2992	25	0.70	0.8	11.4	7.4	0.76	8.3	1.4	NEG
2FT	2993	34			10.3	43.0	1.54	9.2	0.5	NEG
3FT	2994	131					1.84	9.0		NEG

REVIEWED BY________KEB_______________

soiltest farm consultants, inc.
2925 Driggs Dr., Moses Lake, Wa 98837 - www.soiltestlab.com
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SVZ-USA
P.O. BOX 715
OTHELLO, WA 99344

DATE RECEIVED 3/15/2018
DATE REPORTED 3/22/2018
INVOICE # 2990

SOUTH

							NH40AC			
SAMPLE I.D.	LAB NO	NO3-N mg/Kg	NH4-N mg/Kg	TKN mg/Kg	TOTAL P mg/Kg	OLSEN P mg/Kg	K mg/Kg	Ca meq/100g	Mg meq/100g	Na meq/100g
1FT	2990	1.9	0.5	1203	1069	31	666	7.3	3.6	0.68
2FT	2991	0.7	1.1	494	1030		784	6.4	3.5	2.35
	auger refusal									

		DTPA EXT					Est Sat Paste			
SAMPLE I.D.	LAB NO	SULFUR mg/Kg	B mg/Kg	Zn mg/Kg	CEC meq/100g	ESP %	SOL SALTS mmhos/cm	pH 1:1	OM %	Fe2+ field test
1FT	2990	36	0.65	1.1	11.8	5.8	0.69	7.7	1.6	NEG
2FT	2991	46			11.5	20.4	1.08	8.7	0.4	NEG
	auger refusal									

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SVZ-USA
P.O. BOX 715
OTHELLO, WA 99344

DATE RECEIVED 11/8/2018
DATE REPORTED 11/29/2018
INVOICE # 25050

FIELD 3 (north wheelline)

							------NH40AC------			
SAMPLE I.D.	LAB NO	NO3-N mg/Kg	NH4-N mg/Kg	TKN mg/Kg	TOTAL P mg/Kg	OLSEN P mg/Kg	K mg/Kg	Ca meq/100g	Mg meq/100g	Na meq/100g
1FT	25050	0.5	0.5	673	1102	15	303	9.6	2.9	0.51
2FT	25051	0.4	0.5	465	1307		124	9.5	2.7	1.09
3FT	AUGER REFUSAL									

		------ DTPA EXT ------					Est Sat Paste			
SAMPLE I.D.	LAB NO	SULFUR mg/Kg	B mg/Kg	Zn mg/Kg	CEC meq/100g	ESP %	SOL SALTS mmhos/cm	pH 1:1	OM %	Fe2+ field test
1FT	25050	16	0.33	0.9	10.9	4.7	0.48	8.1	1.0	NEG
2FT	25051	10			11.2	9.7	0.46	8.5	0.6	NEG
3FT	AUGER REFUSAL									

REVIEWED BY_____ KEB

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SVZ-USA
P.O. BOX 715
OTHELLO, WA 99344

DATE RECEIVED 11/8/2018
DATE REPORTED 11/29/2018
INVOICE # 25052

FIELD 1 (south wheelline)

							NH40AC			
SAMPLE I.D.	LAB NO	NO3-N mg/Kg	NH4-N mg/Kg	TKN mg/Kg	TOTAL P mg/Kg	OLSEN P mg/Kg	K mg/Kg	Ca meq/100g	Mg meq/100g	Na meq/100g
1FT	25052	0.4	0.6	1109	1161	31	580	7.7	3.5	0.41
2FT	25053	0.6	0.7	641	943		694	8.4	3.4	0.48
3FT	AUGER REFUSAL									

		DTPA EXT					Est Sat Paste			
SAMPLE I.D.	LAB NO	SULFUR mg/Kg	B mg/Kg	Zn mg/Kg	CEC meq/100g	ESP %	SOL SALTS mmhos/cm	pH 1:1	OM %	Fe2+ field test
1FT	25052	25	0.59	1.7	10.9	3.8	0.65	7.6	1.2	NEG
2FT	25053	13			10.1	4.8	0.57	8.2	0.8	NEG
3FT	AUGER REFUSAL									

REVIEWED BY_____ KEB

LABORATOTRY & CONSULTANT

CERTIFICATIONS

The State of Washington
Department of Ecology

Soiltest Farm Consultants, Inc. Laboratory
Moses Lake, WA

has complied with provisions set forth in Chapter 173-50 WAC and is hereby recognized by the Department of Ecology as an ACCREDITED LABORATORY for the analytical parameters listed on the accompanying Scope of Accreditation. This certificate is effective September 8, 2017 and shall expire September 7, 2018.

Witnessed under my hand on September 5, 2017

Rebecca Wood
Acting Lab Accreditation Unit Supervisor

Laboratory ID
C605

The Soil Science Society of America
Soils Certification Board

has conferred upon

Daniel P. Nelson, PhD

the designation of

Certified Professional Soil Scientist

By successfully fulfilling the requirements, passing a rigorous examination, subscribing to the Certified Professional Soil Scientist Code of Ethics and committing to ongoing professional development.

Certification effective from
1/1/2017 to **12/31/2018**

Certification Number: **03231**

CPSS
Certified Professional Soil Scientist

Andrew Sharpley
SSSA President

Soils Certification Board Chair

Thompson, Sean (ECY)

From: dan@soiltestlab.com
Sent: Thursday, May 16, 2019 6:37 AM
To: Thompson, Sean (ECY)
Cc: Dave Shaak; 'Kyle Bair'
Subject: 2018 ICMP
Attachments: SVZ 2018 ICMP FINAL.pdf

Sean,
Here is the Irrigation and Crop Management Plan for SVZ for the 2018 season. No wastewater was land applied in 2018; consequently, there is little to report. The storage and irrigation systems are in good order and the crops are healthy.
Best regards,
Dan

Dan Nelson, PhD, CPSS
509-989-1992
dan@soiltestlab.com
soiltest farm consultants, inc.
www.soiltestlab.com

SVZ-USA, INC.

OTHELLO, WASHINGTON

LAND TREATMENT REPORT FOR 2019
& CROP MANAGEMENT PLAN FOR 2020

Washington State DOE Discharge Permit No. ST8077

prepared by
Dan Nelson, PhD, CPSS
Kyle Bair, PhD, CPSS
Soiltest Farm Consultants, Inc.
2925 Driggs Drive
Moses Lake, WA 98837

15 May 2020

1. INTRODUCTION

The SVZ-USA Inc. processing plant in Othello, Washington, produces fruit and vegetable juice concentrates and purees from fresh and frozen produce. The wastewater produced from the process is treated by a combination of land application and discharge to the City of Othello wastewater treatment facility. This crop management plan was developed to meet Washington State D.O.E. permit ST-8077 requirements for that portion of the wastewater treated by land application. Specific information included was obtained through site visits by Soiltest staff, and by verbal and written information obtained from SVZ staff and the farm operator.

The goal of land application of wastewater is to match the output of the waste constituents to the uptake or consumption of the constituents by crops, soil micro-organisms and natural chemical precipitation or adsorption processes of the soil to which it is applied. Managing applications requires first, measuring the application to the land of wastewater and other constituents and, second, measuring the constituent removal rate for the crops which are grown. The net loading rates are calculated as the difference between additions and removals. Some estimation is involved in calculating applications and removals. The inactivation rate of constituents by internal soil processes is not precisely known for most conditions. Consequently, periodic soil testing is used to monitor concentrations of wastewater constituents in the soil through time to determine whether labile concentrations are increasing or decreasing. Estimates can then be made regarding the likelihood of deleterious effects on soil properties or potential negative impacts. Monitor wells are used to further evaluate impacts on ground water due to the application of wastewater.

Typically, a few key constituents can be identified and used for the calculations. The constituents of concern with the effluent generated by the SVZ-USA plant in Othello are nitrogen (N), water, sodium (Na) and total salts (TDS). These constituents are the most likely to cause soil, environmental, or plant growth problems. SVZ has made an agreement with the City of Othello to treat a portion of the wastewater generated by SVZ to increase capacity and reduce field loading rates. A small portion of the waste stream was treated by Othello in 2016, more in 2017 and all of the wastewater was treated by the Othello POTW in 2018. In 2019 approximately 83% of the wastewater produced was land applied: historical land applications are shown in Figure 4.

1.1 Treatment System

The water management system at SVZ Foods consists of a lined reservoir capable of holding approximately 7.7 million gallons (MG) of plant effluent in its two chambers. A large chamber on the north end holds 7.0 MG and a small chamber equipped with aerators on the south end holds the balance. The effluent in the large chamber is connected by a control valve to a wet well where a pump is situated to pressurize the wheel-line sprinkler systems of the land application fields or to discharge to the City of Othello. Fresh water from the East Columbia Irrigation District can be admitted by means of a control valve into the wet well if supplemental water is needed for the crop. The supplemental water is not blended with the process water at the wet well as the valve controls are set to only admit 100% wastewater or 100% Irrigation District water.

Three fields make up the land treatment site (see Figure 1). Field 1 comprises 18.2 acres and is planted to orchard grass hay. Field 2 comprises 2.5 acres and is left to native grasses and weeds. It can be watered with a solid set sprinkler system; however, the sprinkler system is in disrepair and the site has only been used for equipment storage. The soil at Field 2 is generally quite shallow, barely one foot in depth. Because of its small size and shallow soil, Field 2 has never been utilized for land treatment by SVZ. Field 3, also planted to orchard grass hay, lies east of the lagoon and comprises 18.4 acres. Fields 1 and 3 are irrigated by means of wheel-line sprinkler systems.

FIGURE 1: MAP OF SVZ-USA LAND TREATMENT SITE

1.2 Irrigation Efficiency and Uniformity

The fraction of pumped irrigation water that enters and stays in the root zone of the growing crop is the application efficiency, sometimes called system uniformity. The typical application efficiency for sprinkler irrigation ranges from 60% to 95%[1] depending on system type, design, maintenance, weather and run-off conditions. On average, wheel line systems operate at approximately 65%-70% overall efficiency. Because the land treatment site is nearly level and no runoff typically occurs, an efficiency factor of 70% is estimated to be appropriate for the wheel line systems in operation on Fields 1 and 3. A comparable factor is probably appropriate for the solid-set system in Field #2, if it was ever repaired and put into use.

1.3 Irrigation Timing

The application of irrigation water is based upon crop need and soil storage. Crop water use or evapotranspiration (ET) is a function of the crop, the growth stage and prevailing weather conditions. Soil moisture storage is dependent upon the texture, structure, organic matter content, coarse fragment content and depth of the soil. Specific crop water consumption is calculated in Table 1 for conditions in 2019.

The basic premise of irrigation frequency is to irrigate before the crop experiences water stress. When crop water use has depleted the available water to approximately 60% in the root zone, an irrigation should be initiated to minimize crop stress. To avoid excessive application, the amount of water applied in any irrigation should be limited to the amount of the available water holding capacity not already filled (i.e. 40% of water holding capacity).

In 2012, a consultant was hired to assist with irrigation timing. Irrigations were planned using dielectric soil moisture probes connected to data loggers and automatic rain gages in conjunction with ET data obtained from the WSU-Othello Experiment Station. In 2015, the loggers were updated to enable connection to a website where soil moisture, rain gage output and temperatures can be viewed in real-time. Weekly reports are generated with suggested irrigation times and amounts (Figures 2A & 2B). The weekly reports are shared with SVZ staff and the farm manager.

2. SOIL FACTORS

The physical and chemical characteristics of the soil determine the suitability of the site for land treatment purposes. Of primary concern is the suitability of the site for crop production. Specific soil properties determine the management strategies to be employed during the land treatment process.

Field 1 of the SVZ, Othello site is well suited for crop production and land treatment uses. The slope is nearly level. The nearest surface water is the Potholes

---

[1] Irrigation Requirements for Washington-Estimates and Methodology. EB 1513. WSU, Pullman. 1989.

FIGURE 2A: EXAMPLE IRRIGATION MANAGEMENT REPORT FOR FIELD 1

soiltest

farm consultants, inc.

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Irrigation Summary & Recommendation

SVZ
GRASS HAY
FIELD 1 (S)

Rooting Depth		16 Inches
GPM:	1066	
Acres:	35	

Soil Type & Water Holding Capacity

Soil Depth, in.	4	12	16	24
AWHC, in/increment	0.80	1.60	0.80	1.60

3.00 inches/24 hrs @ 70% Efficiency
12.0 hour set applies 1.5 inches

Weekly Reporting

DATE	WATER USE, INCHES Last Week	WATER USE, INCHES Next Week	APPLIED INCHES	% of field capacity 4"	12"	16"	24"	MOISTURE GOAL	RECOMMENDATION SYSTEM	INCHES	HRS.	Sets	Hrs/Set	Rain Only
2019-11-18	0.03	0.04	0.20	99%	86%	78%	69%	85%	0.00	0.00	0	0	N/A	0.20
CUMLATIVE:	24.65		21.04											
		Rainfall:	4.46											
		Irrigation:	16.58											

No irrigation needed; no room for treatment either.
Last report of the season.

Run **0** *sets @* 12 *hrs each and* **0** *sets @* 8 *hrs each and* **0** *sets@* 4 *hrs each*

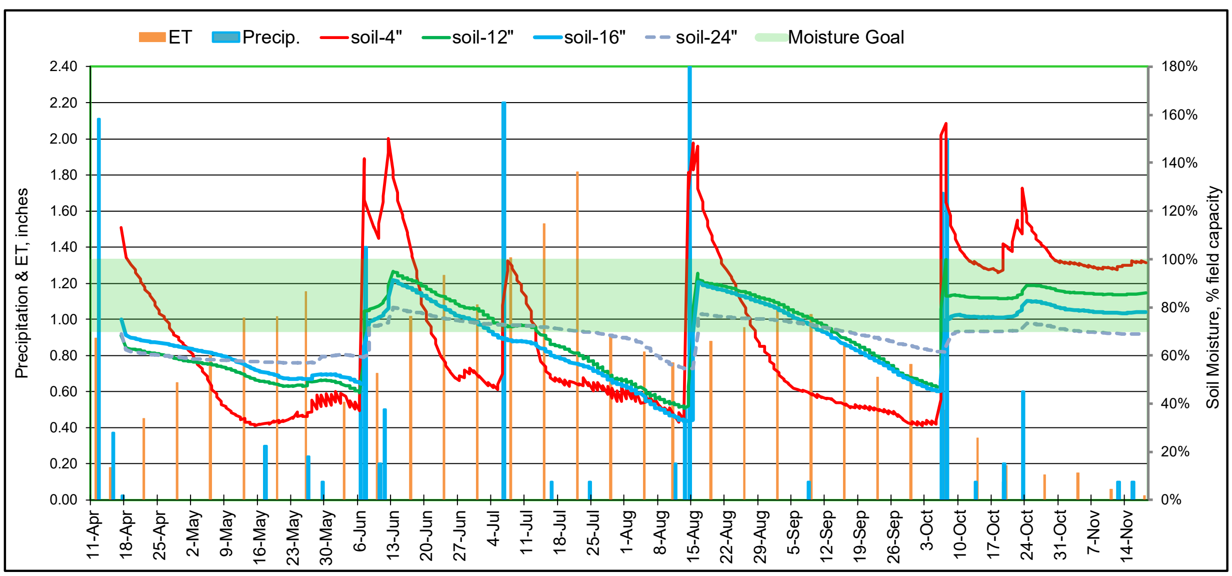


FIGURE 2B: EXAMPLE IRRIGATION MANAGEMENT REPORT FOR FIELD 3

soiltest
farm consultants, inc.
2925 Driggs Dr., Moses Lake, Wa 98837 - www.soiltestlab.com
Office: (509)765-1622 - Fax:(509)765-0314 - (800)764-1622

Irrigation Summary & Recommendation

SVZ
GRASS HAY
FIELD 3 (N)

Rooting Depth		16 Inches
GPM:	1066	
Acres:	35	

Soil Type & Water Holding Capacity

Soil Depth, in.	4	12	16	24
AWHC, in/increment	0.80	1.60	0.80	1.60

3.00 inches/24 hrs @ 70% Efficiency
12.0 hour set applies 1.5 inches

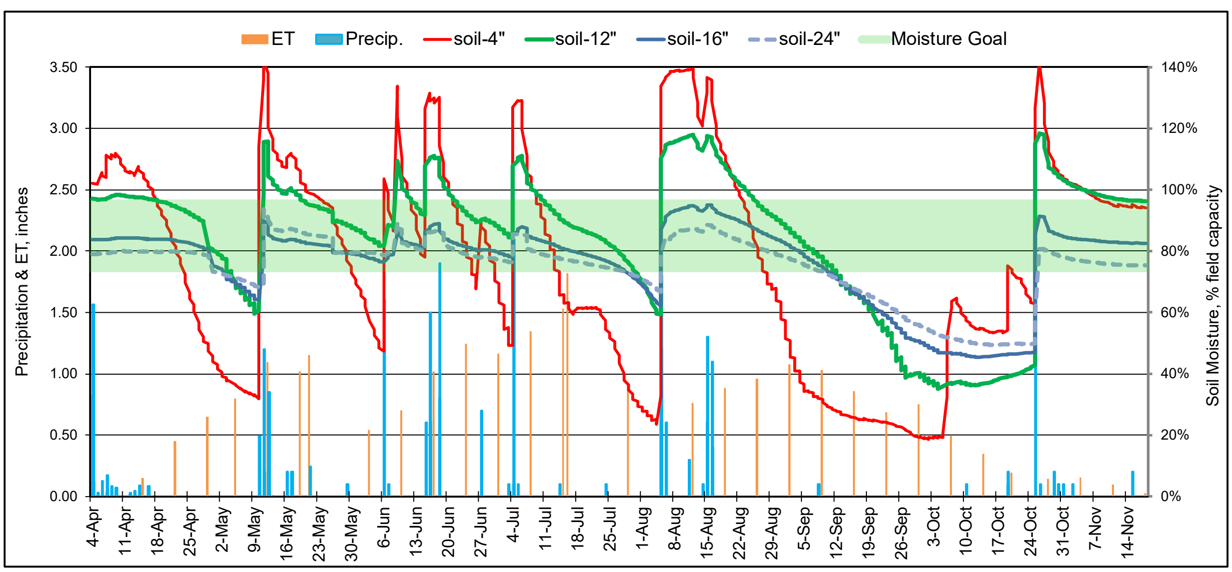
Weekly Reporting

DATE	WATER USE, INCHES Last Week	Next Week	APPLIED INCHES	% of field capacity 4"	12"	16"	24"	MOISTURE GOAL	RECOMMENDATION SYSTEM	INCHES	HRS.	SETS	HR/SET	Rain Only
2019-11-18 0	0.03	0.04	0.20	94%	96%	83%	75%	85%	0.00	0.00	0	0	N/A	0.20

CUMLATIVE:	24.81	31.61
	Rainfall:	5.36
	Irrigation:	26.25

No irrigation needed; no room for treatment either.
Last report of the season.

Run **0** *sets @* 12 *hrs each and* **0** *sets @* 8 *hrs each and* **0** *sets@* 4 *hrs each*



Canal of the Columbia Basin Irrigation District. The shallow lakes of the Potholes area are located approximately one mile north and west of the site. Ground water is not found near enough to the surface to interfere with cropping activities. Soil drainage is good, neither excessive nor poor. No areas of salt accumulation or other undesirable chemical characteristics are naturally found. Soil depth to cobbly substratum is a bit shallow in places for root crops, but adequate for forage and grain crops. Yields of production crops at the site have been near Columbia Basin averages. Although Field 2 has never been used for wastewater treatment, forage crops could be grown. The shallow soil at Field 2 will limit the productive capacity of the field and will also require careful water management to avoid excessive leaching or ponding at the site. The soil of Field 3 is like that of Field 1 only it grades to deeper soil as it progresses northward. Although still too rocky for root crop production, Field 3 has a higher yield potential than Field 1 due to greater soil depths (up to five feet).

2.1 Infiltration Rates and Water Holding Capacity

The soil at the land treatment site is predominantly Scooteney loam. The water infiltration rate ranges from 0.8 to 2.5 inches per hour. The available water holding capacity of the loam soils at the land treatment site are approximately 2.0 inches of water per foot of topsoil and approximately 1.0 inch per foot for the cobbly and gravelly subsoil.[2] Site investigations have revealed the depth to cobbly subsoil ranges from 12 to 60 inches, with the soil depth greatest at the northeast edge of the area. The irrigations are managed for a depth of 24 inches as that is the minimum average soil depth of the two functioning fields.

2.2 Compaction and Puddling Potential

The soils at the land treatment site have loam and gravelly loam textures. In addition, the soils have low to moderate organic matter and low clay content. Consequently, the soils have a moderately strong soil structure and tend not to compact easily. Compaction can be ameliorated by minimizing traffic, eliminating traffic during wet periods, and by maintaining a perennial crop to develop a sod.

Generally, sodium becomes problematic when the exchangeable sodium percentage (ESP) reaches 15%. The soil at the land treatment site contains sufficient clay and has moderate enough slopes that 15% is the appropriate limit. This level of sodium should not be exceeded in the surface soils at the SVZ land application site to avoid possible infiltration problems. Elevated soil salinity can facilitate infiltration when the ESP is greater than 15%; however, excessively high salinity levels can impede crop production. Should sodium approach problematic levels in the surface soils, gypsum (calcium sulfate) can be applied to improve soil structure. Controlled leaching events can be planned to remove excess sodium from the surface horizon of the soil.

[2] Soil Survey of Adams County Washington. USDA SCS. 1967.

2.3 Soil Monitoring

The soils of the treatment fields have been monitored for many years. The permit guidelines require that the fields be sampled twice each year: once prior to the initiation of crop growth in the spring and again in the fall after the last harvest is completed. Field 2 has not been sampled for several years because equipment has been stored on the site which precluded access to 3 of the 5 monitoring locations. The site has only been used for equipment storage and no plans exist to grow crops on the site or to apply process wastewater on Field 2; it was decided skip monitoring the soil of the field entirely. In 2007 soil monitoring was initiated on Field 3, which was added to the treatment system. The soil test reports from 2019 are included in the Appendix. Graphical summaries of selected constituents can be found in Figure 3.

Soil nitrate levels at the surface have been typically cyclical in nature. Field 2 monitoring ended in 2012 when 1-ft soil nitrate was at an all-time high for unknown reasons (this field is not utilized). Field 1 nitrate was unusually high in 2013; however, nitrate in both Fields 1 and 3 have been low and stable for the last 4 years. Oscillations in nitrate are common at the 2-foot depth as well. The oscillations in soil nitrate in Field 1 were increasing in magnitude through 2015 but have been stable the last four years. Field 1 was replanted several times including 2013. The minimal crop growth during replanting cannot remove all the nitrogen mineralized from the organic matter and is the likely cause of the spikes in nitrate. The establishment of a stable grass crop in Field 1 utilized the nitrate mineralized in the soil system resulting in low and consistent soil nitrate levels in subsequent years. Field 3 nitrate levels spiked in the 1-, 2- and 4-foot depths during 2008 after the alfalfa crop was plowed out and grass planted. This was likely the result of mineralization of the alfalfa root mass. Subsequent measurements of nitrate levels in Field 3 have remained stable and low with only slight seasonal oscillations after the establishment of the perennial orchard grass crop.

For optimum hay production, it is desirable to maintain soil salinity or soluble salts below 3.5 mmho/cm. Soluble salts have been within acceptable limits throughout the monitoring history. The trend in the two utilized fields appears to be either level or slightly decreasing in the top foot, and slightly increasing in the second foot.

Sodium is monitored by the exchangeable sodium percentage (ESP, which is the extractable sodium divided by the cation exchange capacity, CEC). ESP is of greatest concern at the surface layer of the soil where it can impact water infiltration. ESP in Fields 1 and 3 have historically exceeded the critical level of 15% at various times at both depths monitored (Fig. 3): Field 1 has a level trend, but Field 3 has a gently increasing trend in ESP. In 2017 and 2018 the ESP dramatically decreased in both fields at both depths; however, ESP increased in both fields in 2020. In March of 2015, 3.2 t/ac and 3.8 t/ac of gypsum were applied to Fields 1 and 3 respectively to ensure maintenance of good soil structure and water infiltration. Gypsum was applied again in March 2016 at the same rates as in 2015. In addition, a portion of the wastewater has been sent to the City of Othello since 2016. The combination of gypsum applications and declining wastewater loading since 2016 have resulted in the improving ESP and salinity conditions of the soils through 2018.

The first foot soil total nitrogen (also called Total Kjeldahl Nitrogen or TKN) trend line of Field 3 shows an increasing trend, whereas, the total N trend in Field 1 has remained flat. Total N in both fields appear to be trending slightly upward at the 2-foot depth. Total phosphorus (Total P) in the first foot in Fields 1 and 3 demonstrates a slight upward trend. Variations in measurements obscure any trends that may be present in the 2-foot total P of all fields.

FIGURE 3: SUMMARY OF SOIL TEST MONITORING

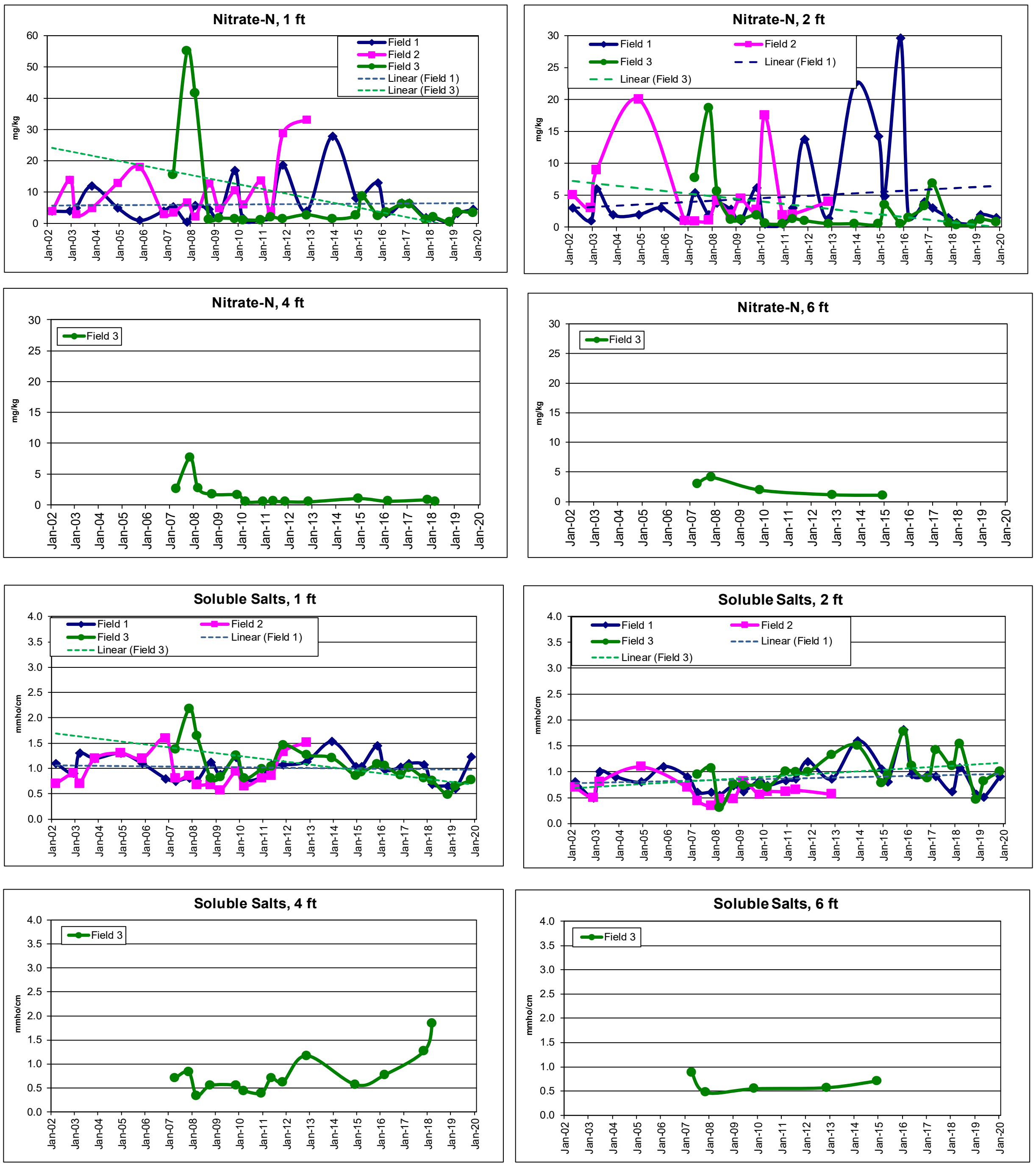
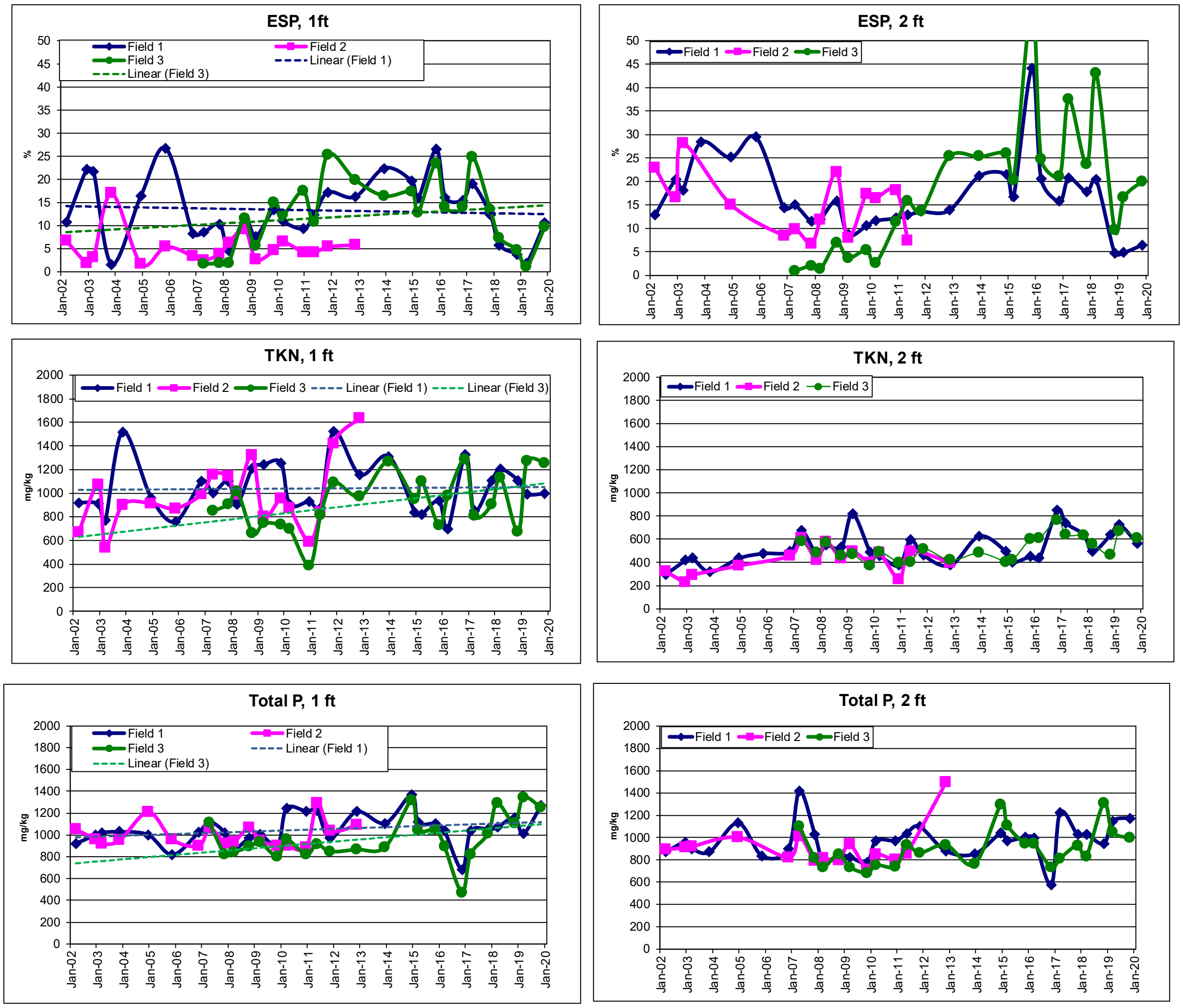


FIGURE 3: SUMMARY OF SOIL TEST MONITORING (CONTINUED)



3. CROP WATER MANAGEMENT

3.1 Crop Water Use and Irrigation Requirement

Grass hay was seeded into Fields 1 and 3 in the fall of 2007 and re-seeded in Field 1 in the fall of 2013. The 2019 monthly and annual water consumption for grass hay can be found in Table 1. Precipitation is subtracted from ET to calculate the Rainfall Balance. Excess precipitation is carried over into the subsequent month to reflect soil storage. The irrigation requirement is calculated from the rainfall balance using a net system application efficiency of 70%. This efficiency may adequately cover any needed leaching requirements; however, soil test data will be used to determine the need for additional planned leaching events. In a typical season, grass hay may utilize 35 inches of water and require 50 inches of irrigation water. The summer of 2019 was near normal: total annual rainfall was 6.2 inches; consumptive water use was approximately 36.3 inches and the irrigation requirement were approximately 44.6 inches.

FIGURE 4: SVZ WASTEWATER PRODUCTION

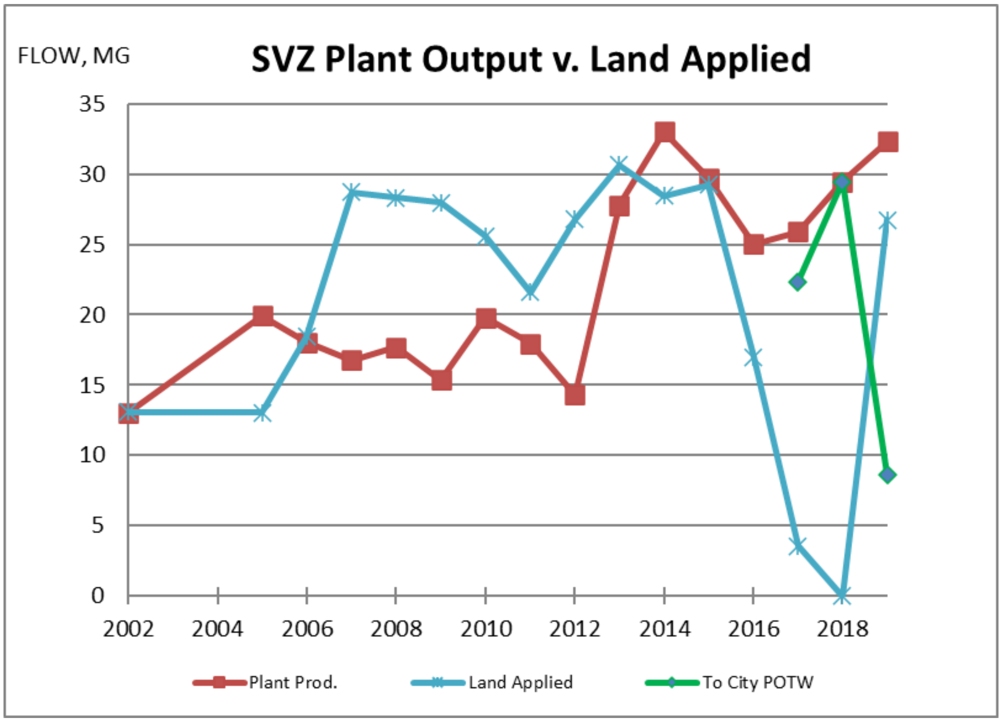


TABLE 1A: WASTEWATER PRODUCTION AND LAND APPLICATION TOTALS

	PLANT PROCESS WATER PRODUCTION		IRRIGATION WASTEWATER								
			AVERAGE MONTHLY ANALYSES, mg/L							LAND-APPLIED	
MONTH	MG	Ac-Ft	TKN	BOD	COD	sBOD	FDS	Na	NH4-N	MG	Ac-Ft
JAN	3.795	11.648									
FEB	2.413	7.406									
MAR	2.739	8.404								0.000	0.00
APR	1.642	5.040	833	880	1,623	843	978	520	11.5	2.235	6.86
MAY	2.273	6.975	173	512	1,216	314	1,409	520	2.1	0.535	1.64
JUN	2.994	9.189	1,747	94	660	34	1,177	520	5.3	4.538	13.93
JUL	3.025	9.283	1,263	407	1,880	351	1,103	494	0.8	2.932	9.00
AUG	3.315	10.173	3,432	183	638	158	1,147	468	18.0	9.558	29.33
SEP	3.003	9.215	753	1,214	3,050	1,045	1,048	468	0.9	1.936	5.94
OCT	2.709	8.315	3,987	534	2,915	142	926	468	1.5	5.011	15.38
NOV	2.679	8.220									
DEC	1.753	5.380									
AVG	2.695	8.271	1,741	546	1,712	412	1,113	494	5.7	3.343	10.259
			TOTAL LAND APPLIED, LBS								
TOTAL	32.340	99.25	12,187	88,615	328,495	62,377	243,071	108,191	1,948	26.744	82.075

Notes: Plant wastewater was used for irrigation all season; in addition, supplemental irrigation district water was also applied.

Est. Evaporation Loss	
3.020	Mgal

TABLE 1B: SUPPLEMENTAL WATER TOTALS

	units	result	MGal Applied		Total Pounds Applied
NITRATE-N	mg/L	**0.09**			
TKN	mg/L	**0.50**			
NITROGEN	mg/L	**0.6**	**9.80**	**Nitrogen**	**48.2**
TDS (salts)	mg/L	**85**		**TDS**	**6947**
Sodium (Na)	mg/L	**0.1**		**Sodium**	**8**

3.2 Water Balance

In 2019, the total wastewater flow from the SVZ processing facility to the lagoon was 32.34 MG (Table 1A). Approximately 26.744 MG of wastewater was pumped from the lagoon and land applied. The balance of the wastewater pumped into the lagoon (approximately 8.662 MG) was sent to the City of Othello for treatment (see Figure 4). Flow meter data show that 9.800 MG of fresh water was applied to the fields in 2019. Flow meters are placed to measure all water applied to each field.

It is estimated in Table 2 that for Field 1, 36.3 inches of water were potentially transpired by the crop and that the irrigation requirement was 44.6 inches. Approximately 42.0 inches of water (72% process wastewater) were applied to Field 1. The water balance indicates that the field was under-irrigated by 2.6 inches. The water balance was positive during the months of March, April, August and October. Deficit irrigation was practiced the remaining 4 months of the irrigation season. The hydraulic loading for Field 3 was the similar to that for Field 1: the irrigation deficit was 12.7 inches for the year. Only March and October had positive water balances.

The leaching requirement is estimated to be 8.1% as calculated from the water quality parameters in Tables 1A and 1B and an average mix of 73% wastewater. The leaching requirement is the same for both fields as they receive water from the same sources at very nearly the same ratios; further, they are planted to the same crop and the soil is substantially consistent across both fields. The maximum desirable saturated paste EC for both fields was set at 3.5 mmho/cm for the calculation. As the EC of neither the supplemental water nor the wastewater is measured, it was estimated using a commonly used general relationship: EC=TDS/640. For the fresh/supplemental water the EC = 85/640 which yields 0.13 mmho/cm. Since we generally are concerned with FDS in vegetable wastewater, the same formula was applied using FDS rather than TDS. As indicated in Table 1, wastewater made up 73% of the water applied to each field on average. The weighted average EC for all the irrigation water applied to the field is then 1.29 mmho/cm. The Leaching Requirement is calculated by the following relationship:

LR= ECw / [(5xECw) – ECe], where LR is Leaching Requirement; ECw is the EC of the average water applied; ECe is the maximum allowable EC of the soil solution. Inserting the values calculated above, yields a LR of 8.1%.

Note that 2019 leaching requirement is substantially more than 2018 because no wastewater was used in 2018. The 2019 leaching requirement is nearly 3 times greater than that calculated in 2017 due to a slightly higher percentage of wastewater applied but mostly due to higher FDS values in 2019.

TABLE 2: HYDRAULIC LOADING SUMMARY

FIELD 1

MONTH	Consump-tive Use ac-in/ac	Precip-itation ac-in/ac	Rainfall Balance ac-in/ac	Irrigation Req't at 70% Efficiency ac-in/ac	Irrigation Process ac-in/ac	Water Fresh ac-in/ac	Loading Total ac-in/ac	Balance ac-in/ac
JAN	0.10	1.02	-0.9	0.0	0.0	0.0	0.0	0.0
FEB	0.15	0.47	-0.3	0.0	0.0	0.0	0.0	0.0
MAR	0.78	0.29	0.5	0.0	0.0	3.0	3.0	3.0
APR	3.61	0.70	2.9	4.2	3.0	3.2	6.2	2.0
MAY	5.36	0.69	4.7	6.7	0.6	5.7	6.3	-0.3
JUN	5.96	0.22	5.7	8.2	4.9	0.0	4.9	-3.3
JUL	7.55	0.22	7.3	10.5	2.7	0.0	2.7	-7.7
AUG	6.74	0.66	6.1	8.7	10.8	0.0	10.8	2.1
SEP	3.92	0.44	3.5	5.0	1.9	0.0	1.9	-3.1
OCT	1.71	0.67	1.0	1.5	6.3	0.0	6.3	4.8
NOV	0.31	0.20	0.1	0.0	0.0	0.0	0.0	0.0
DEC	0.09	0.62	-0.5	0.0	0.0	0.0	0.0	0.0
YEAR	**36.26**	**6.20**	**30.1**	**44.6**	**30.2**	**11.9**	**42.0**	**-2.6**

Total Hydraulic Load, in.	**42.0**	**2018 Load**	**31.1**
Hydraulic Load Limit, in.	**30.0**	**% Change**	**35%**
% of Limit ac-ft/ac	**140%**	**Process, % of Total**	**72%**
% of Irrig Reqirement	**94%**	**Leaching Fraction as-applied**	**-5.9%**
(ET and Precip. data from AgWeatherNet Othello)		**Calculated Leaching Requirement**	**8.1%**

FIELD 3

MONTH	Consump-tive Use ac-in/ac	Precip-itation ac-in/ac	Rainfall Balance ac-in/ac	Irrigation Req't at 70% efficiency ac-in/ac	Irrigation Process ac-in/ac	Water Fresh ac-in/ac	Loading Total ac-in/ac	Balance ac-in/ac
JAN	0.10	1.02	-0.9	0.0	0.0	0.0	0.0	0.0
FEB	0.15	0.47	-0.3	0.0	0.0	0.0	0.0	0.0
MAR	0.78	0.29	0.5	0.0	0.0	1.6	1.6	1.6
APR	3.61	0.70	2.9	4.2	1.6	1.7	3.3	-0.9
MAY	5.36	0.69	4.7	6.7	0.5	4.7	5.1	-1.6
JUN	5.96	0.22	5.7	8.2	4.3	0.0	4.3	-3.9
JUL	7.55	0.22	7.3	10.5	3.2	0.0	3.2	-7.3
AUG	6.74	0.66	6.1	8.7	8.5	0.0	8.5	-0.1
SEP	3.92	0.44	3.5	5.0	2.0	0.0	2.0	-3.0
OCT	1.71	0.67	1.0	1.5	3.9	0.0	3.9	2.4
NOV	0.31	0.20	0.1	0.0	0.0	0.0	0.0	0.0
DEC	0.09	0.62	-0.5	0.0	0.0	0.0	0.0	0.0
YEAR	**36.26**	**6.20**	**30.1**	**44.6**	**24.0**	**8.0**	**31.9**	**-12.7**

Total Hydraulic Load	**31.9**	**2018 Load**	**31.1**
Hydraulic Load Limit	**30.0**	**% Change**	**3%**
% of Limit ac-ft/ac	**106%**	**Process, % of Total**	**75%**
% of Irrig Reqirement	**72%**	**Leaching Fraction as-applied**	**-28.5%**
(ET and Precip. data from AgWeatherNet Othello)		**Calculated Leaching Requirement**	**8.1%**

4. NUTRIENT MANAGEMENT

A balance sheet approach is used for nutrient management analysis in this report, like the method used for water management. The inputs are identified and quantified. Losses and removals are also identified, quantified and compared to projections from last year. Finally, a balance is calculated and discussed in comparison to soil test results.

4.1 Constituent Additions

Significant amounts of wastewater were applied to both of the treatment fields in 2019 (Table 2A); thus, the included nutrients and salt additions included in the wastewater were also applied. The nitrogen and salts contained in the supplemental fresh water added to the loadings (Table 1B). No commercial fertilizer applications were made.

Gross nitrogen additions from wastewater were 373 lbs-N/ac to Field 1 and 293 lbs-N/ac to Field 3: both values exceed the design N loading of 165 lbs-N/ac. Fresh water nitrogen additions were negligible at 1 to 2 lbs-N/ac. Salt additions from wastewater were 7,443 lbs/ac (21 lbs/ac-day) to Field 1 and 5,848 lbs/ac (16 lbs/ac-day) to Field 3: both values exceed the 4,000 lbs/ac-yr or 11 lbs/ac-day design maximum. Salt loading from supplemental water was less than 250 lbs/ac. Negligible sodium loading was derived from the supplemental water; however, wastewater added 3,313 lbs-Na/ac to Field 1 and 2,603 lbs/ac to Field 3. Field 1 received 2,713 lbs/ac (11 lbs/ac-day) of BOD from wastewater and Field 3 received 2,132 lbs/ac (9 lbs/ac-day): both values are well below the 100 lbs/ac-day design maximum.

4.2 Constituent Losses and Harvest Removals

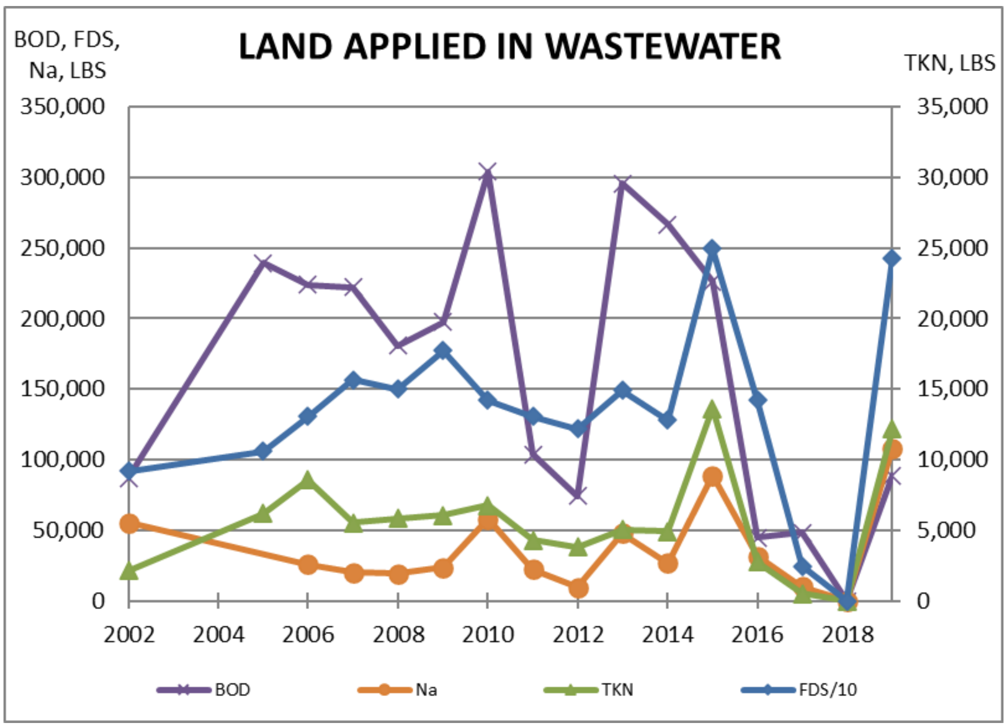
Nitrogen loss from denitrification and volatilization can result in relatively low uptake efficiencies under fertigation with wastewater containing high BOD. No losses are deducted in Table 1A or 1B, but in calculating the total loading in Table 4 the sums were adjusted by the following nitrogen use efficiencies: 75% of the wastewater-N and 85% of the fresh water-N and fertilizer-N were carried into the total (Allison, F.E. 1965. *Evaluation of Incoming and Outgoing Processes That Affect Soil Nitrogen*, in Soil Nitrogen. Agronomy Monograph 10, Bartholomew, W.V. & Clark, Francis E. eds. American Society of Agronomy, Madison, WI).

Table 3 summarizes the harvest removal of selected constituents in the harvested portion of the crop. The removal rates were calculated using 2019 yield values and constituent concentrations from the samples obtained from the harvests made in 2018 and 2019. The ash content of the harvested portion of the plant material is used to calculate the total mineral salt removal.

The harvests in 2019 removed approximately 4.01 t/ac of hay (fresh weight). The yield was nearly equal to that of 2018. The grass hay crop removed a significant amount of some constituents. The hay removed 122 pounds of nitrogen per acre and approximately 608 pounds of total salts per acre. The hay harvests also removed approximately 201 pounds of potassium, 7 pounds of sodium and 27 pounds of chloride per acre.

The nutrient balances are calculated in Table 4. In these calculations, it was assumed that 100% of all constituents, except nitrogen as explained above, passed through the conveyance and application system and entered the soil. Positive values in the balance rows in Table 4 indicate an accumulation of constituent in the soil of the land treatment field.

FIGURE 5: SVZ WASTEWATER CONSTITUENTS LAND APPLIED



4.3 Constituent Balances

Balances in 2019 were much different than 2018 due to the application of zero irrigation wastewater in 2018. More nitrogen, 159 lbs/ac in Field 1 and 98 lbs/ac in Field 3, was applied than removed in harvests. Field 1 received a net loading of over 7,000 lbs/ac of salts and Field 3 received nearly 5,400 lbs/ac of salts. More sodium was also applied than removed in harvests by nearly 3,000 lbs/ac on average.

Historical land application totals are summarized in Figure 5. Loading in 2019 approached record highs. Wastewater land application in 2019 was approximately 73% of all irrigation applied. The 2018 management plan recommended applying wastewater to make up 50% of the irrigation demand. Consequently, all loadings were greater than planned.

Supplemental nitrogen applications will be required if no wastewater is applied and soil storage nitrogen is depleted. However, for 2020, adequate soil nitrogen remains in the soil and irrigation with some wastewater is planned; therefore, no fertilizer nitrogen is needed. The historical loading rates and balances for nitrogen and salts are depicted in Figure 6.

TABLE 3: HARVEST REMOVAL TOTALS

FIELD / DATE	CROP	YIELD, lbs	DM	N	P	Na	Ca	Mg	K	Cl	Ash
			%, TOTAL ANALYSIS								
FIELD 1	**18.2 acres**										
1st Cutting	Grass Mix Hay	66,137	93.2%	1.7%	0.33%	0.12%	0.37%	0.21%	2.34%	0.34%	7.4%
2nd Cutting	Grass Mix Hay	48,136	93.8%	1.8%	0.39%	0.10%	0.69%	0.34%	3.40%	0.49%	11.3%
3rd Cutting	Grass Mix Hay	31,527	91.2%	1.3%	0.33%	0.05%	0.27%	0.18%	2.39%	0.23%	4.9%
4th Cutting	Grass Mix Hay										
Total	lbs	145,799									
	t/ac	4.01									
Net Removal	**lbs/ac**		**7,447**	**122**	**26**	**7**	**34**	**18**	**201**	**27**	**608**
FIELD 3	**18.4 acres**										
1st Cutting	Grass Mix Hay	66,863	93.2%	1.7%	0.33%	0.12%	0.37%	0.21%	2.34%	0.34%	7.4%
2nd Cutting	Grass Mix Hay	48,664	93.8%	1.8%	0.39%	0.10%	0.69%	0.34%	3.40%	0.49%	11.3%
3rd Cutting	Grass Mix Hay	31,873	91.2%	1.3%	0.33%	0.05%	0.27%	0.18%	2.39%	0.23%	4.9%
4th Cutting	Grass Mix Hay										0.0%
Total	lbs	147,401									
	t/ac	4.01									
Net Removal	**lbs/ac**		**7,447**	**122**	**26**	**7**	**34**	**18**	**201**	**27**	**608**

FIGURE 6: SVZ HARVEST REMOVAL & NET APPLICATION HISTORY

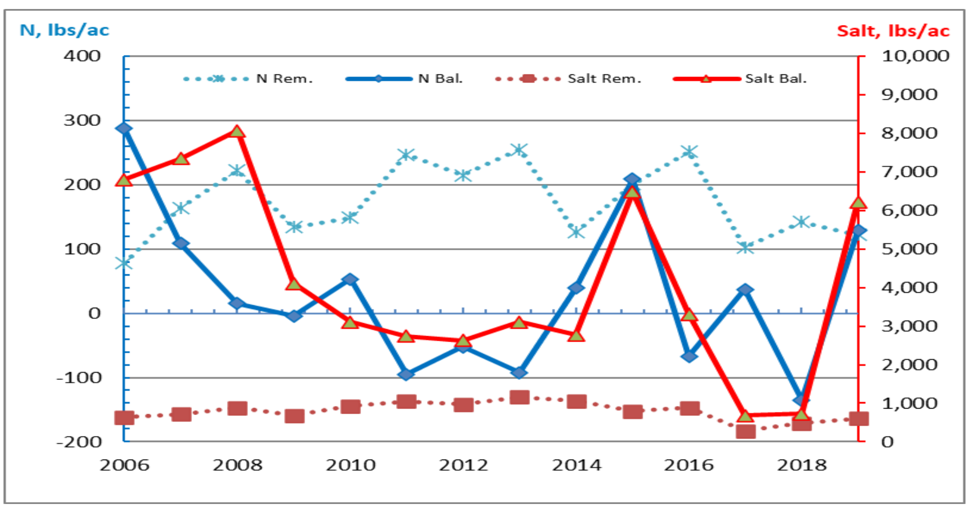


TABLE 4: BALANCE OF CONSTITUENTS LAND APPLIED

FIELD 1	18.2 acres							
	N, lbs/ac		Sodium, lbs/ac		FDS or Salt, lbs/ac		BOD, lbs/ac	
Source	**2019**	**2018**	**2019**	**2018**	**2019**	**2018**	**2019**	**2018**
Wastewater	373	0	3,313	0	7,443	0	2,713	0
Freshwater	1.6	4.2	0.3	0.7	228	599	0	0
Fertilizer	0	0	0	0	0	0	0	0
SUM^	**281**	4	**3,313**	1	**7,671**	599	**2,713**	0
% difference from last year		**7857%**		**470024%**		**1181%**		**---**
					21	lbs/ac/day*	**11**	**lbs/ac/day***
Permit Design	**165**	lbs/yr	**N/A**	**N/A**	**11**	lbs/ac/day	**100**	**lbs/ac/day**
% of Design	**170%**	85%	**N/A**	**N/A**	**191%**	**24%**	**11%**	
Harvest Removal, lbs/ac	**122**	103	**7**	3	**608**	284	**N/A**	**N/A**
Balance, lbs/ac	**159**	37	**3,306**	274	**7,063**	684	**N/A**	**N/A**
FIELD 3	**18.4 acres**							
Wastewater	293	0	2,603	0	5,848	0	2,132	0
Freshwater	1.1	4.2	0.2	0.7	152	599	0	0
Fertilizer	0	0	0	0	0	0	0	0
SUM^	**221**	4	**2,603**	1	**6,000**	599	**2,132**	0
% difference from last year		**6147.7%**		**369298.0%**		**901.6%**		**---**
					16	lbs/ac/day*	**9**	**lbs/ac/day***
Permit Design	**165**	lbs/yr	**N/A**	**N/A**	**11**	lbs/ac/day	**100**	**lbs/ac/day**
% of Design	**134%**	85%	**N/A**	**N/A**	**149%**	**24.1%**	**9%**	
Harvest Removal, lbs/ac	**122**	103	**7**	3	**608**	284	**N/A**	**N/A**
Balance, lbs/ac	**98**	37	**2,596**	274	**5,392**	684	**N/A**	**N/A**

Notes: ^Sum of Nitrogen was calculated assuming 75% use efficiency of wastewater N and 85% use efficiency of commercial fertilizer N.
* FDS, pounds/acre/day was calculated over 365 days in a year; BOD pounds/ac/day was calculated using the 245 day irrigation season.

5. GROUNDWATER MONITORING

Eight monitor wells have been installed at the land treatment site; the location of each is indicated in Figure 1. Monitor wells 1 through 5 were installed prior to the date SVZ assumed operations of the site. Wells 6 through 8 were installed in the spring of 2008 in preparation for adding Field 3 to the treatment site. Wells 1 and 2 were damaged during fall field work in 2013. These well were abandoned along with monitor wells 3 and 4 in 2014 when two new wells, 2R and 3R, were installed. The wells are monitored monthly for water level and various physical and chemical parameters as required by permit.

Historical data for nitrate and TDS is reported in Figure 6. The data for the new wells 2R and 3R is appended to that of the original wells 2 and 3 in Figure 6 as they are in approximately the same locations. In the 2012 Fact Sheet Update for State Waste Discharge Permit ST-8077 the background values for groundwater nitrate and TDS for well 2R were modified to 5.62 and 507 mg/L, respectively. The background values for well 8 as determined in the same Fact Sheet were 18.1 mg/l for nitrate-N and 916 mg/l for TDS. The background lines and data trend lines for these two parameters are included in Figure 5.

The Field 2 up-gradient well, MW2/2R demonstrates variations in TDS of approximately 200 mg/l and an upward trend during the last few years. The overall trend is slightly downward due to highs measured shortly after the well was installed. TDS levels in MW2/2R has exceeded background levels during much of the time since 2017. Up-gradient well MW8 in Field 3 demonstrated a steady increase of approximately 200 mg/l from its installation in 2008 until 2012, then decreasing to below original levels by the end of 2017. The overall trend is currently slightly downward and below the 2012 background level.

The down-gradient wells are mixed in their responses over time. TDS in Well 3/3R demonstrates a downward trend but was still above background in 2019. Well 5 demonstrates a very slight upward trend above background with considerable short and long-term variations. Wells 6 and 7 both exhibit relatively consistently increasing TDS over the monitoring period and are both near to above background levels.

The nitrate levels in up-gradient well, MW2, is well above background and exhibits an increasing long-term trend with considerable variations in two- to four-year time spans. Some very high values were recorded since 2016 including 2019. The nitrate level in the Field 3 up-gradient well, MW8, has trended downward but may have levelled out and may be increasing in 2018 and 2019; nitrate levels are well below the background level established in 2012.

The nitrate levels in Field 3 down-gradient wells, MW6 and MW7, demonstrate an overall downward trend with significant variations and are staying below the 2012 background level. The nitrate level in the Field 1 down-gradient wells, MW3/3R and MW5, remain above background levels and demonstrate variably increasing trends with wide variations. Although there are many gyrations, the nitrate level in MW5 has risen from 5 mg/l in 2005 to 20 mg/l in 2017. Nitrate levels have since declined to less than 10 mg/l. MW3/3R has varied from zero to nearly 30 mg/l at various times with a resultant increasing trend; however, the short-term trend has been sharply downwards since 2017.

FIGURE 5: SUMMARY OF SVZ WELL MONITORING

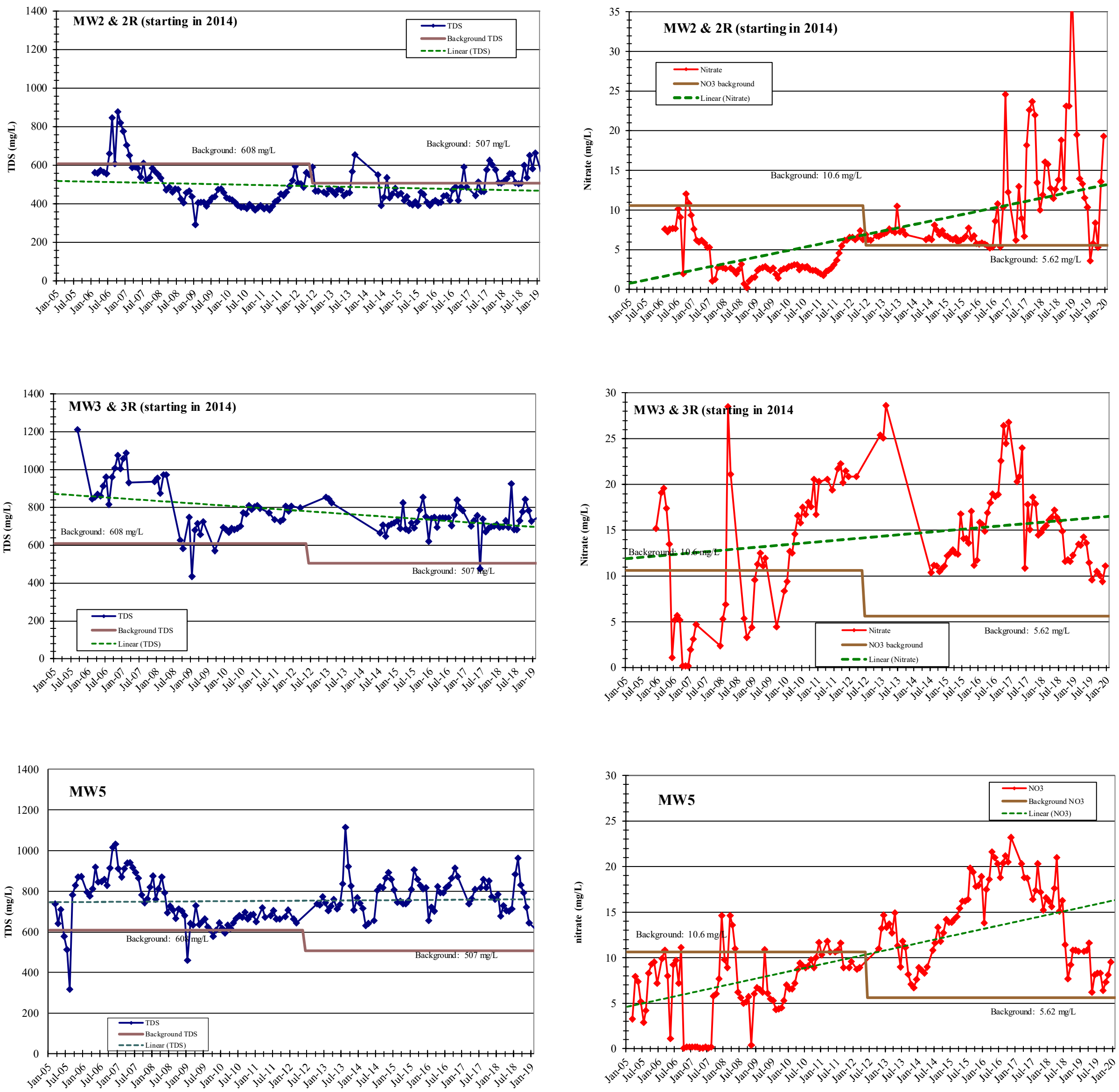
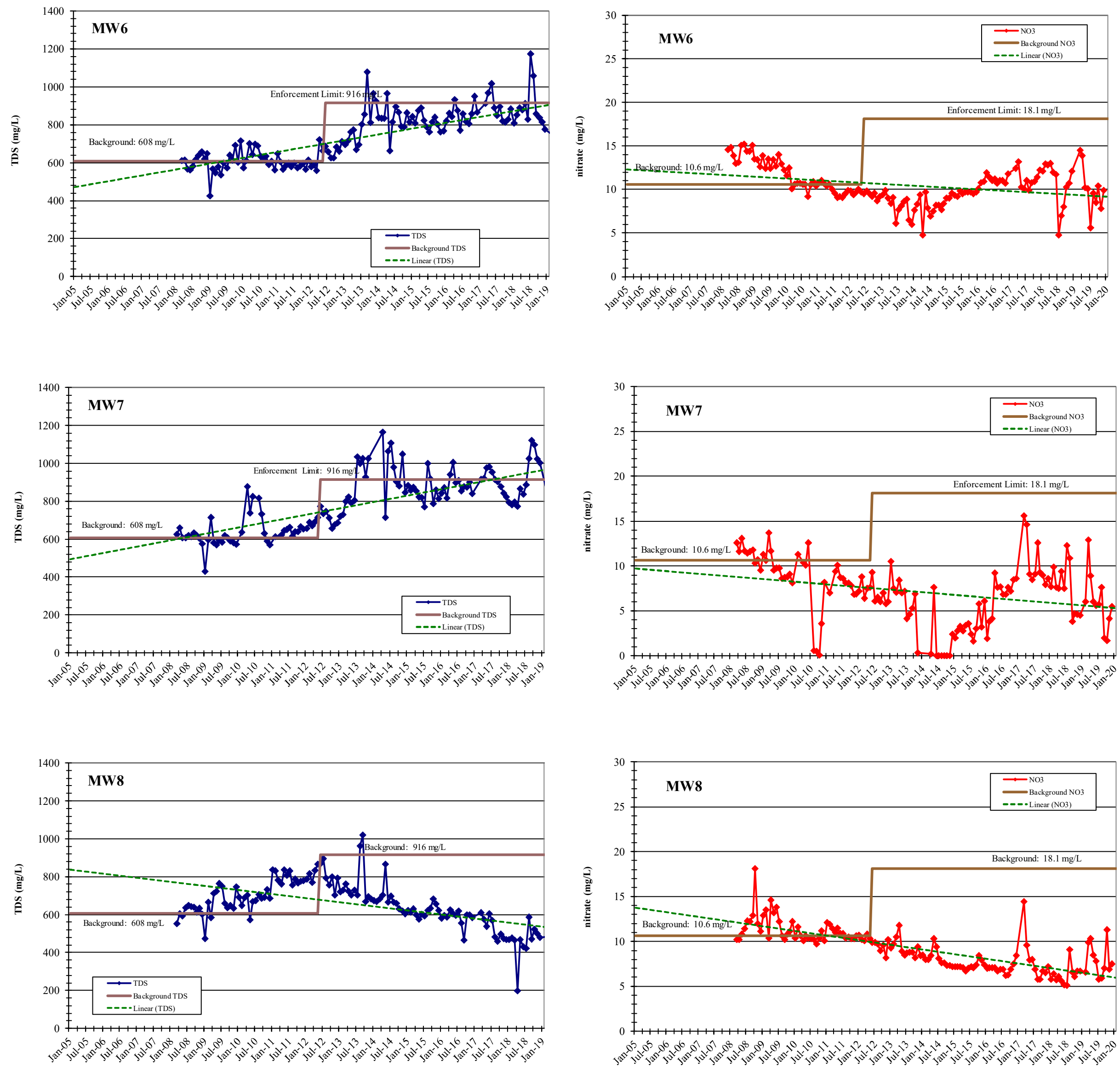


FIGURE 5: SUMMARY OF SVZ WELL MONITORING (CONTINUED)



6. 2020 CROP PLAN

6.1 Soil Monitoring

The DOE land treatment permit requires that soil samples be collected in the spring and fall: this will be accomplished in 2020. The purpose of soil testing is to monitor salt and nutrient concentrations over time and act as a back-up to the nutrient balance calculations. Modifications in management will be triggered by significant changes in soil test values. Soil samples will be collected and analyzed from Fields 1 and 3 to monitor chemical changes and salt conditions. Until SVZ moves the stored equipment, soil sample sites in Field 2 will continue to be inaccessible.

6.2 2020 Cropping Pattern and Wastewater Applications

Fields 1 and 3 will remain in grass hay for the 2020 season and for the foreseeable future. Field 2 will remain idle (see Table 5). It is planned that no more than 35% (14.2 MG) of the anticipated irrigation demand should be met utilizing wastewater from the lagoon in order to keep FDS loading below the 4,000 lbs/ac limit and nitrogen loading from wastewater below 165 lbs/ac. All remaining wastewater will need to be sent to the City of Othello for treatment. Automated soil moisture, rain gage and ET monitoring will continue to be used to aid in the scheduling of irrigations. The loadings for 2020 are anticipated to be from wastewater and supplemental water with no fertilizer additions.

TABLE 5: PROJECTED PLAN FOR 2020

				Anticipated Water Use		Irrigation Plan		Anticipated Wastewater Gross Loading			Soil Resicual N*	Estimated Fertilizer Nitrogen	Gypsum Require-ment
Field I.D.	Total Acres	Treated Acres	Crop	inches	MG	WW** inches	Fresh W inches	N lbs/ac	Salts lbs/ac	BOD lbs/ac	lbs/ac	lbs/ac	lbs/ac
FIELD 1	18.2	18.2	Grass Hay	41.0	20.2	14.3	26.6	133	3,538	1290	101	0	3200
FIELD 2	2.5	0.0	N/A										
FIELD 3	18.4	18.4	Grass Hay	41.0	20.5	14.3	26.6	133	3,538	1290	114	0	3900
	39.1	**36.6**											

* Soil residual N is calculated from the sum of tested nitrogen from the previous fall soil test.
**Wastewater irrigation is adjusted to keep total nitrogen load below 165 lbs-N/ac and wastewater hydraulic loading below 18 inches/ac, and salt loading below 4,000 lbs/ac.

The nitrogen requirement in any given year depends on the crop, growing conditions/weather, water and nutrient management and disease/pest pressure. Most of these factors can only be estimated ahead of time from historical values or experience; the result is called the agronomic rate. The crop nitrogen requirement can be met by nitrogen from four main sources, soil residual, wastewater, fresh water, fertilizer. Not all the nitrogen applied from any of these sources remains available for crop use. Volatilization and denitrification result in nitrogen loss from the system and each of these sources has an efficiency of use that needs to be included in the balance equation. If planning suggests that nitrogen availability from one of these sources is anticipated to be higher, then nitrogen from one or more of the other sources should be reduced.

The Projected Management Plan for 2020, as presented in Table 5 was developed with the following assumptions:

1) The weather, ET and precipitation, for 2020 will not vary substantially from the 2017 to 2019 average.

2) No more than 14.2 MG of wastewater will be land applied
3) Crop yields in 2020 will continue near those experienced in previous years.

With these considerations in mind, it is anticipated that no fertilizer nitrogen will be required (Table 5).

6.3 Summary and Recommendations

The land application system operated well in 2019 and the grass hay crop produced well. However, excess wastewater application resulted in significantly positive loading balances for nitrogen (129 lbs-N/ac average), sodium (2,951 lbs-Na/ac average) and salts (6,227 lbs/ac average). The spring 2020 nitrogen soil test indicated that approximately 110 lbs/ac of mineral nitrogen remained in Fields 1 and 3; thus, no fertilizer nitrogen is recommended for the 2020 crop. The hay crops must be managed to produce well to help maintain a favorable field N balance. Proper water management is the first and most important step. Adequate supplemental water must be applied to optimize crop growth. The second year of deficit irrigation practices was instrumental in the decline in crop production in 2017; better irrigation management in 2018 and 2019 nearly doubled the hay yield. It was noted that SVZ upgraded the soil moisture monitoring equipment in 2015 making real-time visualization of the field conditions available to SVZ and the farm manager.

Mineral salt loadings (N, Na, FDS) increased dramatically in 2019 compared to 2017 and 2018 because much more wastewater was land applied. The heavy loading rate is reflected by the increase in soil salinity and ESP values. Based on spring 2020 soil testing results, it is recommended that approximately 3,000 lbs/acre of gypsum be applied to both fields in 2020 to ensure adequate water infiltration due to sodium buildup in the surface soil. Not all salts react the same when land applied. Magnesium has minimal effect on soil salinity compared to sodium. Potassium is a plant nutrient removed at significant rates by hay crops. Application of adequate fresh water to achieve the desired leaching fraction of 8% will prevent salt accumulation at the surface. Adequate water will also increase hay yield, thus, improving the treatment capacity of the site.

Pesticides will be used only as needed. It is anticipated that some herbicide may be applied to the fields for weed control. Need for chemical and fertilizer applications will be determined by a certified crop advisor or similar professional. All pesticide applications will be made in accordance with label directions by licensed applicators.

The flow meters appear to have worked well in 2019 which allowed accurate evaluation of the hydraulic balances in the fields. It would be advisable to check the calibration of each flow meter at least annually and provide the dates of calibration for inclusion in this report.

APPENDIX

2019

DMR REPORTS FOR

Washington State DOE Discharge Permit No. ST8077

CAN BE VIEWED AT THE FOLLOWING LINK:

https://fortress.wa.gov/ecy/paris/ComplianceAndViolations/ViewDMRData.aspx

HARVEST REPORTS

soiltest
farm consultants, inc.
2925 Driggs Dr., Moses Lake, Wa 98837 · www.soiltestlab.com
Office: (509)765-1622 · Fax:(509)765-0314 · (800)764-1622

NATIONAL FORAGE TESTING ASSOCIATION 2018 Certified NIRS by NFTA Excellence in Forage Testing DM CP ADF NDF

SVZ-USA
MIKE GREENE
Othello , WA 99344
GROWER:

DATE RECEIVED: *6/12/2018*
DATE REPORTED: *6/19/2018*
LAB NUMBER: F18-02562

FIELD ID.: 2018 1ST 86B
NIR CALIBRATION: Grass Hay

GROWER ACCOUNT #:
GROWER SAMPLE ID:

NIR FEED ANALYSIS

	As Received Basis	100% Dry Matter
MOISTURE %	6.8	
DRY MATTER %	93.2	100
Protein		
CRUDE PROTEIN		10.4
DIGESTIBLE PROTEIN		6.4
Fiber		
ACID DET. FIBER %		36.0
NEUTRAL DET. FIBER %		62.5
LIGNIN %		3.5
RFV		91
FAT %		2.25
STARCH %		0.07
ESC %		7.3
NSC %		10.0
ASH %		7.4
WSC %		9.9
Minerals		
CALCIUM (Ca) %		
PHOSPHORUS (P) %		
POTASSIUM (K) %		
MAGNESIUM (Mg) %		
Other Analysis:		
NITRATE NITROGEN mg/kg		15

	As Received Basis	100% Dry Matter Basis
TDN % [ADF]		60.2
NEL, MCAL/KG [ADF]		1.2
NEM, MCAL/KG [ADF]		1.9
NEG, MCAL/KG [ADF]		1.1
METABOLIZABLE ENERGY		2.23
DIGESTIBLE ENERGY		2.7
DIGESTIBLE DRY MATTER		60.8
DRY MATTER INTAKE		1.9
Wet Chemistry Minerals:		
Boron (B) mg/kg		5.16
Calcium (Ca) %		0.37
Copper (Cu) mg/kg		5.39
Iron (Fe) mg/kg		352
Magnesium (Mg) %		0.21
Manganese (Mn) mg/kg		46.57
Phosphorus (P) %		0.33
Potassium (K) %		2.34
Sodium (Na) %		0.12
Sulfur (S) %		0.24
Zinc (Zn) mg/kg		23.05
Chloride (Cl) mg/kg		3375

* TOTAL AFLATOXIN (B1, B2, G1, G2) (AgraStrip 8.0 ppb)
Relataive Feed value includes both ADF and NDF in accordance with AFGC Hay Market Task Force Equations

We make every effort to provide an accurate analysis of your sample. For reasonable cause we will repeat tests, but because of factors beyond our control in sampling procedures and the inherent variability of feeds, our liability is limited to the price of the tests.

This is your Invoice F18-02562 Account #: 288000 Reviewed by: KEB List Cost

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Office: (509)765-1622 - Fax:(509)765-0314 - (800)764-1622

2019 Certified NIRS by NFTA — National Forage Testing Association — Excellence in Forage Testing — DM CP ADF NDF

SVZ-USA
P.O. BOX 715
Othello , WA 99344

DATE RECEIVED: 8/1/2019
DATE REPORTED: 8/2/2019
LAB NUMBER: F19-04773

GROWER: SVZ
FIELD ID.: 104B 2ND
NIR CALIBRATION: GRASS
GROWER ACCOUNT #:
GROWER SAMPLE ID:

NIR FEED ANALYSIS

	As Received Basis	100% Dry Matter
MOISTURE %	6.2	
DRY MATTER %	93.8	100
Protein		
CRUDE PROTEIN	10.7	11.4
DIGESTIBLE PROTEIN	6.8	7.3
Fiber		
ACID DET. FIBER %	32.5	34.7
NEUTRAL DET. FIBER %	50.1	53.4
LIGNIN %	3.0	3.2
RFV		108
FAT %	2.21	2.36
STARCH %	1.48	1.58
ESC %	7.1	7.6
NSC %	11.5	12.3
ASH %	10.6	11.3
WSC %	10.0	10.7
Minerals		
CALCIUM (Ca) %		
PHOSPHORUS (P) %		
POTASSIUM (K) %		
MAGNESIUM (Mg) %		
Other Analysis:		
NITRATE NITROGEN mg/kg	19	20

		As Received Basis	100% Dry Matter Basis
TDN %	[ADF]	57.7	61.5
NEL, MCAL/KG	[ADF]	1.2	1.3
NEM, MCAL/KG	[ADF]	1.8	1.9
NEG, MCAL/KG	[ADF]	1.1	1.2
METABOLIZABLE ENERGY		2.15	2.29
DIGESTIBLE ENERGY		2.5	2.7
DIGESTIBLE DRY MATTER		58.0	61.8
DRY MATTER INTAKE		2.1	2.2
Wet Chemistry Minerals:			
Boron (B) mg/kg		13.17	14.04
Calcium (Ca) %		0.65	0.69
Copper (Cu) mg/kg		8.56	9.13
Iron (Fe) mg/kg		380	405
Magnesium (Mg) %		0.32	0.34
Manganese (Mn) mg/kg		63.47	67.66
Phosphorus (P) %		0.37	0.39
Potassium (K) %		3.19	3.40
Sodium (Na) %		0.09	0.10
Sulfur (S) %		0.47	0.50
Zinc (Zn) mg/kg		27.72	29.55
Chloride (Cl) mg/kg		4637	4943

* TOTAL AFLATOXIN (B1, B2, G1, G2) (AgraStrip 8.0 ppb)
Relataive Feed value includes both ADF and NDF in accordance with AFGC Hay Market Task Force Equations

This is your Invoice F19-04773 Account #: 288000 Reviewed by: KEB List Cost

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farm consultants, inc.
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NATIONAL FORAGE TESTING ASSOCIATION 2019 Certified NIRS by NFTA — DM CP ADF NDF Excellence in Forage Testing

SVZ-USA
MIKE GREENE
Othello , WA 99344
GROWER:

DATE RECEIVED: 4/13/2019
DATE REPORTED: 4/15/2019
LAB NUMBER: F19-00616

FIELD ID.: 2018 3RD
NIR CALIBRATION: Grass Hay

GROWER ACCOUNT #:
GROWER SAMPLE ID:

NIR FEED ANALYSIS

	As Received Basis	100% Dry Matter
MOISTURE %	8.8	
DRY MATTER %	91.2	100
Protein		
CRUDE PROTEIN	7.5	8.2
DIGESTIBLE PROTEIN	3.9	4.3
Fiber		
ACID DET. FIBER %	30.8	33.8
NEUTRAL DET. FIBER %	57.5	63.1
LIGNIN %	3.0	3.3
RFV		92
FAT %	2.15	2.36
STARCH %	0.98	1.08
ESC %	7.5	8.2
NSC %	10.3	11.3
ASH %	4.5	4.9
WSC %	9.4	10.3
Minerals		
CALCIUM (Ca) %		
PHOSPHORUS (P) %		
POTASSIUM (K) %		
MAGNESIUM (Mg) %		
Other Analysis:		
NITRATE NITROGEN mg/kg	16	16

	As Received Basis	100% Dry Matter Basis
TDN % [ADF]	57.1	62.6
NEL, MCAL/KG [ADF]	1.2	1.3
NEM, MCAL/KG [ADF]	1.7	1.9
NEG, MCAL/KG [ADF]	1.1	1.2
METABOLIZABLE ENERGY	2.13	2.34
DIGESTIBLE ENERGY	2.6	2.8
DIGESTIBLE DRY MATTER	57.1	62.6
DRY MATTER INTAKE	1.7	1.9
Wet Chemistry Minerals:		
Boron (B) mg/kg	7.42	8.14
Calcium (Ca) %	0.25	0.27
Copper (Cu) mg/kg	4.01	4.40
Iron (Fe) mg/kg	285	313
Magnesium (Mg) %	0.16	0.18
Manganese (Mn) mg/kg	40.37	44.26
Phosphorus (P) %	0.30	0.33
Potassium (K) %	2.18	2.39
Sodium (Na) %	0.05	0.05
Sulfur (S) %	0.20	0.22
Zinc (Zn) mg/kg	21.00	23.03
Chloride (Cl) mg/kg	2071	2271

* TOTAL AFLATOXIN (B1, B2, G1, G2) (AgraStrip 8.0 ppb)
Relataive Feed value includes both ADF and NDF in accordance with AFGC Hay Market Task Force Equations

This is your Invoice F19-00616 Account #: 288000 Reviewed by: KEB List Cost

DOE SOIL TESTING RESULTS

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SVZ-USA
P.O. BOX 715
OTHELLO, WA 99344

DATE RECEIVED 3/29/2019
DATE REPORTED 4/25/2019
INVOICE # 2655

NORTH

							NH40AC			
SAMPLE I.D.	LAB NO	NO3-N mg/Kg	NH4-N mg/Kg	TKN mg/Kg	TOTAL P mg/Kg	OLSEN P mg/Kg	K mg/Kg	Ca meq/100g	Mg meq/100g	Na meq/100g
1FT	2655	3.6	1.8	1271	1346	18	405	12.5	2.7	0.10
2FT	2656	1.2	1.9	672	1050		218	17.7	2.5	1.97
	auger refusal									

			DTPA EXT				Est Sat Paste			
SAMPLE I.D.	LAB NO	SULFUR mg/Kg	B mg/Kg	Zn mg/Kg	CEC meq/100g	ESP %	SOL SALTS mmhos/cm	pH 1:1	OM %	Fe2+ field test
1FT	2655	16	0.29	1.6	10.2	1.0	0.65	7.9	2.1	NEG
2FT	2656	18			11.9	16.6	0.81	9.2	0.9	NEG
	auger refusal									

REVIEWED BY_____KEB

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SVZ-USA
P.O. BOX 715
OTHELLO, WA 99344

DATE RECEIVED 3/29/2019
DATE REPORTED 4/25/2019
INVOICE # 2657

SOUTH

SAMPLE I.D.	LAB NO	NO3-N mg/Kg	NH4-N mg/Kg	TKN mg/Kg	TOTAL P mg/Kg	OLSEN P mg/Kg	NH40AC K mg/Kg	NH40AC Ca meq/100g	NH40AC Mg meq/100g	NH40AC Na meq/100g
1FT	2657	3.2	1.1	994	1012	25	496	7.8	3.2	0.22
2FT	2658	2.0	1.1	728	1147		674	5.3	4.1	0.54
	auger refusal									

SAMPLE I.D.	LAB NO	SULFUR mg/Kg	DTPA EXT B mg/Kg	DTPA EXT Zn mg/Kg	CEC meq/100g	ESP %	Est Sat Paste SOL SALTS mmhos/cm	pH 1:1	OM %	Fe2+ field test
1FT	2657	26	0.22	1.2	11.3	1.9	0.60	7.9	1.5	NEG
2FT	2658	20			11.1	4.9	0.51	8.2	1.1	NEG
	auger refusal									

REVIEWED BY_____ **KEB**

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SVZ-USA
P.O. BOX 715
OTHELLO, WA 99344

DATE RECEIVED 10/24/2019
DATE REPORTED 10/31/2019
INVOICE # 21199

FIELD 3 (north wheelline)

SAMPLE I.D.	LAB NO	NO3-N mg/Kg	NH4-N mg/Kg	TKN mg/Kg	TOTAL P mg/Kg	OLSEN P mg/Kg	NH40AC K mg/Kg	NH40AC Ca meq/100g	NH40AC Mg meq/100g	NH40AC Na meq/100g
1FT	21199	3.3	1.5	1255	1251	12	308	14.1	2.7	1.06
2FT	21200	0.8	1.1	606	997		171	16.4	2.7	1.88
3FT	AUGER REFUSAL									

SAMPLE I.D.	LAB NO	DTPA EXT SULFUR mg/Kg	DTPA EXT B mg/Kg	Zn mg/Kg	CEC meq/100g	ESP %	Est Sat Paste SOL SALTS mmhos/cm	pH 1:1	OM %	Fe2+ field test
1FT	21199	19	0.37	1.4	10.9	9.7	0.77	8.7	1.4	NEG
2FT	21200	39			9.4	20.0	1.01	8.9	0.8	NEG
3FT	AUGER REFUSAL									

REVIEWED BY_______KEB_________________

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SVZ-USA
P.O. BOX 715
OTHELLO, WA 99344

DATE RECEIVED 10/24/2019
DATE REPORTED 10/31/2019
INVOICE # 21201

FIELD 1 (south wheelline)

							NH40AC			
SAMPLE I.D.	LAB NO	NO3-N mg/Kg	NH4-N mg/Kg	TKN mg/Kg	TOTAL P mg/Kg	OLSEN P mg/Kg	K mg/Kg	Ca meq/100g	Mg meq/100g	Na meq/100g
1FT	21201	4.5	0.6	998	1270	21	410	8.4	3.0	1.32
2FT	21202	1.5	1.3	567	1173		589	5.2	4.2	0.59
3FT	AUGER REFUSAL									

		DTPA EXT					Est Sat Paste			
SAMPLE I.D.	LAB NO	SULFUR mg/Kg	B mg/Kg	Zn mg/Kg	CEC meq/100g	ESP %	SOL SALTS mmhos/cm	pH 1:1	OM %	Fe2+ field test
1FT	21201	6	0.27	1.4	12.5	10.6	1.23	8.8	1.4	NEG
2FT	21202	8			9.1	6.5	0.91	8.4	0.6	NEG
3FT	AUGER REFUSAL									

REVIEWED BY__________KEB__________

LABORATOTRY & CONSULTANT

CERTIFICATIONS

The State of Washington Department of Ecology

Soiltest Farm Consultants, Inc. Laboratory

Moses Lake, WA

has complied with provisions set forth in Chapter 173-50 WAC and is hereby recognized by the Department of Ecology as an ACCREDITED LABORATORY for the analytical parameters listed on the accompanying Scope of Accreditation. This certificate is effective September 8, 2018 and shall expire September 7, 2019.

Witnessed under my hand on September 7, 2018

Rebecca Wood
Lab Accreditation Unit Supervisor

Laboratory ID
C605

The Soil Science Society of America
Soils Certification Board

has conferred upon

Daniel P. Nelson, PhD

the designation of

Certified Professional Soil Scientist

By successfully fulfilling the requirements, passing a rigorous examination, subscribing to the Certified Professional Soil Scientist Code of Ethics and committing to ongoing professional development.

Certification effective from
1/1/2019 to **12/31/2020**

Certification Number: **03231**

CPSS
Certified Professional
Soil Scientist

SSSA President

Mark S. McClain
Soils Certification Board Chair

SVZ-USA, INC.

OTHELLO, WASHINGTON

LAND TREATMENT REPORT FOR 2020
& CROP MANAGEMENT PLAN FOR 2021

Washington State DOE Discharge Permit No. ST8077

prepared by
Dan Nelson, PhD, CPSS
Kyle Bair, PhD, CPSS
Soiltest Farm Consultants, Inc.
2925 Driggs Drive
Moses Lake, WA 98837

26 May 2021

1. INTRODUCTION

The SVZ-USA Inc. processing plant in Othello, Washington, produces fruit and vegetable juice concentrates and purees from fresh and frozen produce. The wastewater produced from the process is treated by a combination of land application and discharge to the City of Othello publicly owned wastewater treatment facility. This crop management plan was developed to meet Washington State D.O.E. permit ST-8077 requirements for that portion of the wastewater treated by land application. Specific information included was obtained through site visits by Soiltest staff, and by verbal and written information obtained from SVZ staff and the farm operator.

The goal of land application of wastewater is to match the application of the waste constituents to the uptake or consumption of the constituents by crops, soil micro-organisms and natural chemical precipitation or adsorption processes of the soil to which it is applied. Managing applications requires first, measuring the application to the land of wastewater and other constituents and, second, measuring the constituent removal rate for the crops which are grown. The net loading rates are calculated as the difference between additions and removals. Some estimation is involved in calculating applications and removals. The inactivation rate of constituents by internal soil processes is not precisely known for most conditions. Consequently, periodic soil testing is used to monitor concentrations of wastewater constituents in the soil through time to determine whether labile concentrations are increasing or decreasing. Estimates can then be made regarding the likelihood of deleterious effects on soil properties or potential negative impacts. Monitor wells are used to further evaluate impacts on ground water due to the application of wastewater.

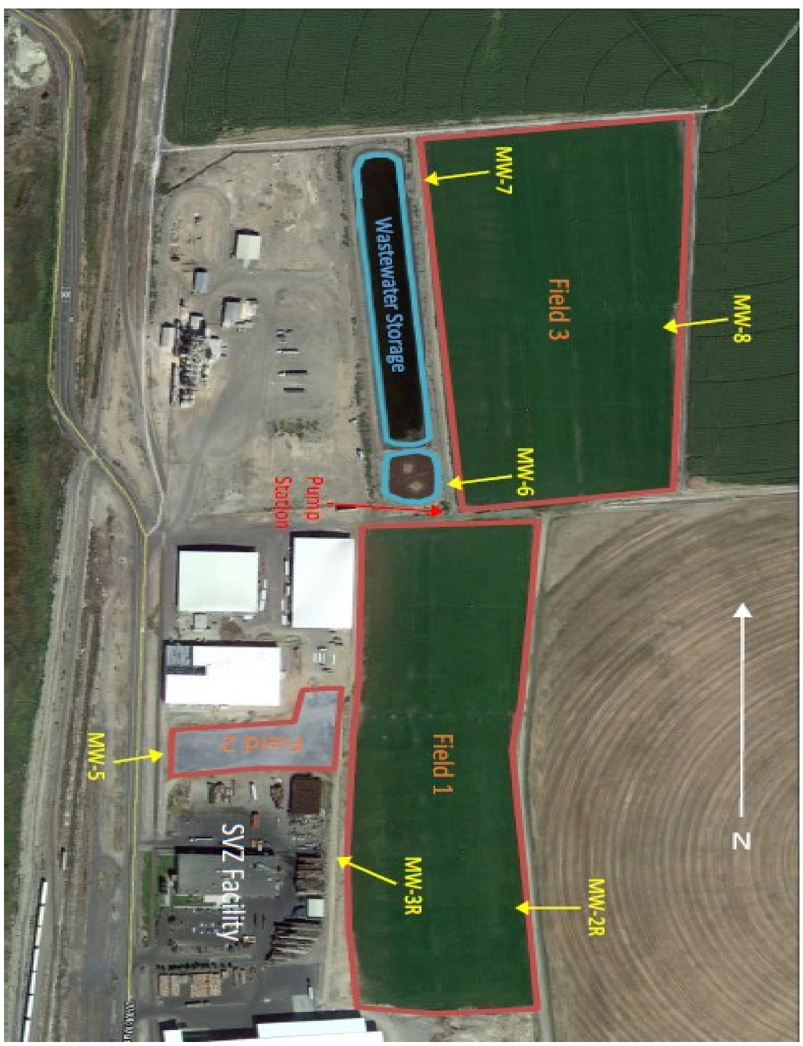
Typically, a few key constituents can be identified and used for these calculations. The constituents of concern with the effluent generated by the SVZ-USA plant in Othello are nitrogen (N), water, sodium (Na), biological oxygen demand (BOD) and total salts (specifically fixed dissolved solids, FDS). These constituents are the most likely to cause soil, environmental, or plant growth problems. SVZ has made an agreement with the City of Othello to treat a portion of the wastewater generated by SVZ to increase capacity and reduce field loading rates. A small portion of the waste stream was initially treated by Othello in 2016, more in 2017 and all of the wastewater was treated by the Othello POTW in 2018. In 2020 approximately 56% of the wastewater produced was land applied (historical land applications are in Figure 4).

1.1 Treatment System

The water management system at SVZ Foods consists of a lined reservoir capable of holding approximately 7.7 million gallons (MG) of plant effluent in its two chambers. A large chamber on the north end holds 7.0 MG and a small chamber equipped with aerators on the south end holds the balance. The effluent in the large chamber is connected by a control valve to a wet well where a pump is situated to pressurize the wheel-line sprinkler systems of the land application fields or to discharge to the City of Othello. Fresh water from the East Columbia Irrigation District can be admitted by means of a control valve into the wet well if supplemental water is needed for the crop. The supplemental water is not blended with the process water at the wet well as the valve controls are set to only admit 100% wastewater or 100% Irrigation District water.

Three fields make up the land treatment site (see Figure 1). Field 1 comprises 18.2 acres and is planted to orchard grass hay. Field 2 comprises 2.5 acres and is left to native grasses and weeds. It can be watered with a solid set sprinkler system; however, the sprinkler system is in disrepair and the site has only been used for equipment storage. The soil at Field 2 is generally quite shallow, barely one foot in depth. Because of its small size and shallow soil, Field 2 has never been utilized for land treatment by SVZ. Field 3, also planted to orchard grass hay, lies east of the lagoon, north of Field 1, and comprises 18.4 acres. Fields 1 and 3 are irrigated by means of wheel-line sprinkler systems.

FIGURE 1: MAP OF SVZ-USA LAND TREATMENT SITE



1.2 Irrigation Efficiency and Uniformity

The fraction of pumped irrigation water that enters and stays in the root zone of the growing crop is the application efficiency, sometimes called system uniformity. The typical application efficiency for sprinkler irrigation ranges from 60% to 95%[1] depending on system type, design, maintenance, weather, and run-off conditions. On average, wheel line systems operate at approximately 65%-70% overall efficiency. Because the land treatment site is nearly level and no runoff typically occurs, an efficiency factor of 70% is estimated to be appropriate for the wheel line systems in operation on Fields 1 and 3. A comparable factor is probably appropriate for the solid-set system in Field #2, if it was ever repaired and put into use.

1.3 Irrigation Timing

The application of irrigation water is based upon crop need and soil storage. Crop water use or evapotranspiration (ET) is a function of the crop, the growth stage and prevailing weather conditions. Soil moisture storage is dependent upon the texture, structure, organic matter content, coarse fragment content, and depth of the soil. Specific crop water consumption is calculated in Table 1 for conditions in 2020.

The basic premise of irrigation frequency is to irrigate before the crop experiences water stress. When crop water use has depleted the available water to approximately 60% in the root zone, an irrigation should be initiated to minimize crop stress. To avoid excessive application, the amount of water applied in any irrigation should be limited to the amount of the available water holding capacity not already filled (i.e., 40% of water holding capacity).

In 2012, a consultant was hired to assist with irrigation timing. Irrigations were planned using dielectric soil moisture probes connected to data loggers and automatic rain gages in conjunction with ET data obtained from the WSU-Othello Experiment Station. In 2015, the loggers were updated to enable connection to a website where soil moisture, rain gage output and temperatures can be viewed in real-time. Reports are generated with suggested irrigation times and amounts (Figures 2A & 2B).

2. SOIL FACTORS

The physical and chemical characteristics of the soil determine the suitability of the site for land treatment purposes. Of primary concern is the suitability of the site for crop production. Specific soil properties determine the management strategies to be employed during the land treatment process.

Field 1 of the SVZ, Othello site is well suited for crop production and land treatment uses. The slope is nearly level. The nearest surface water is the Potholes

[1] Irrigation Requirements for Washington-Estimates and Methodology. EB 1513. WSU, Pullman. 1989.

FIGURE 2A: EXAMPLE IRRIGATION MANAGEMENT REPORT FOR FIELD 1

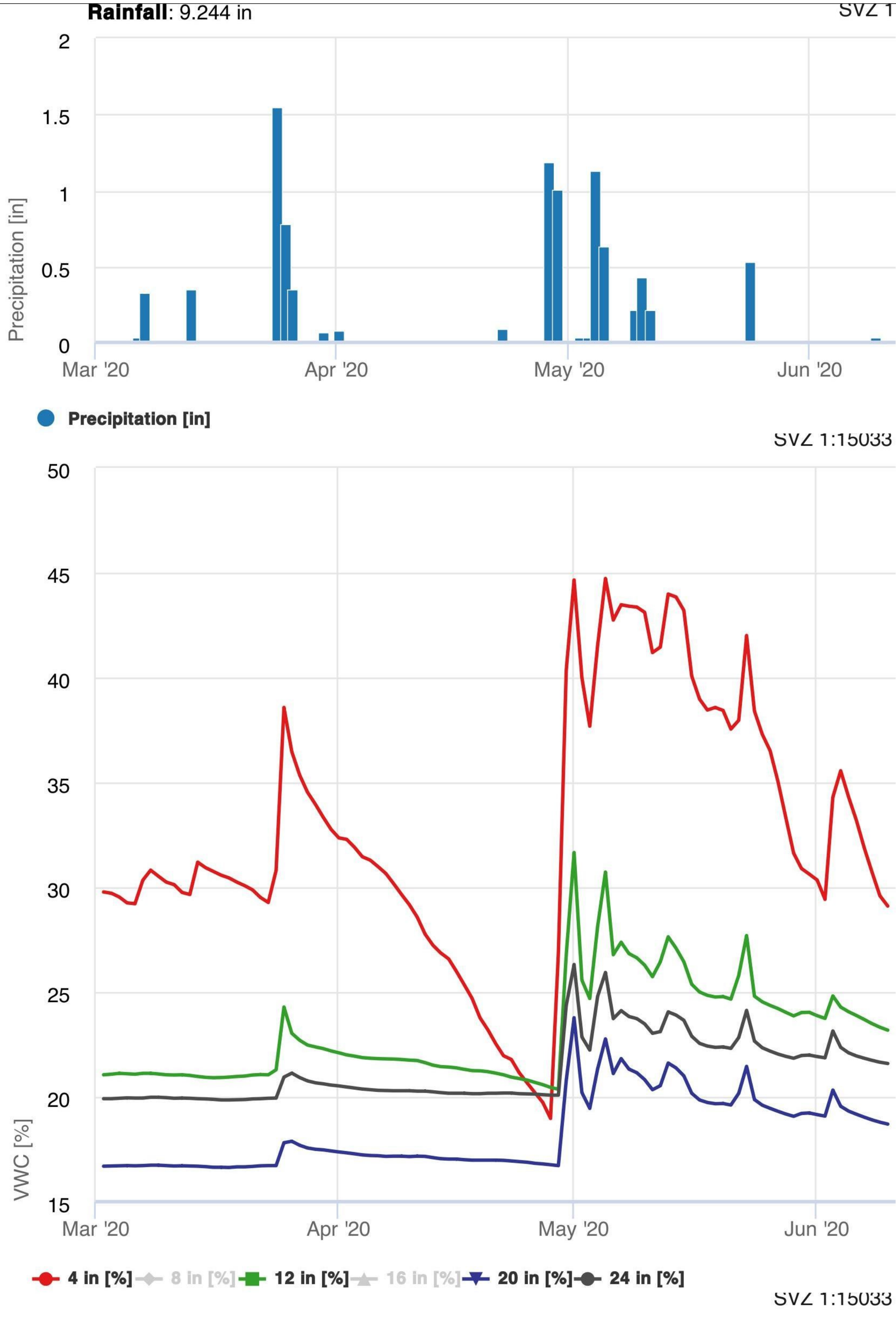
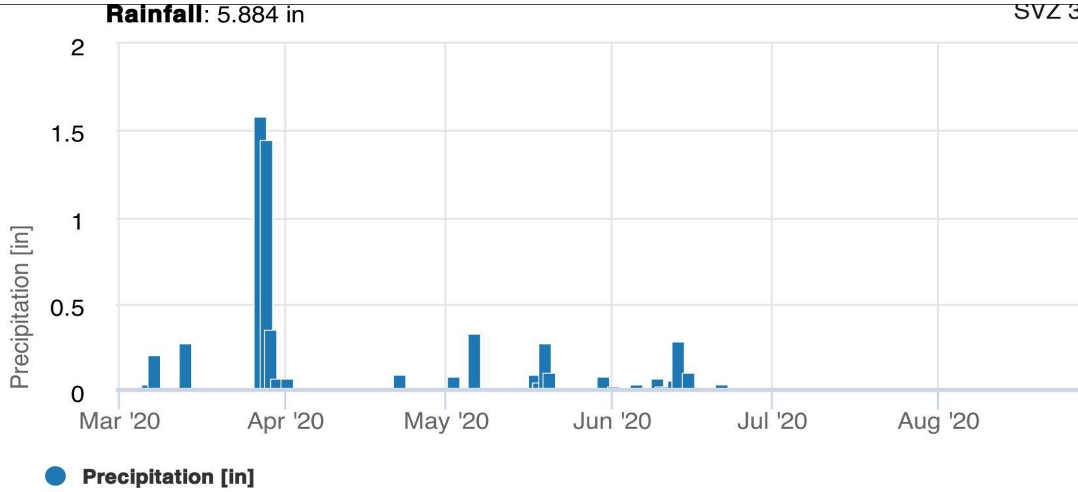
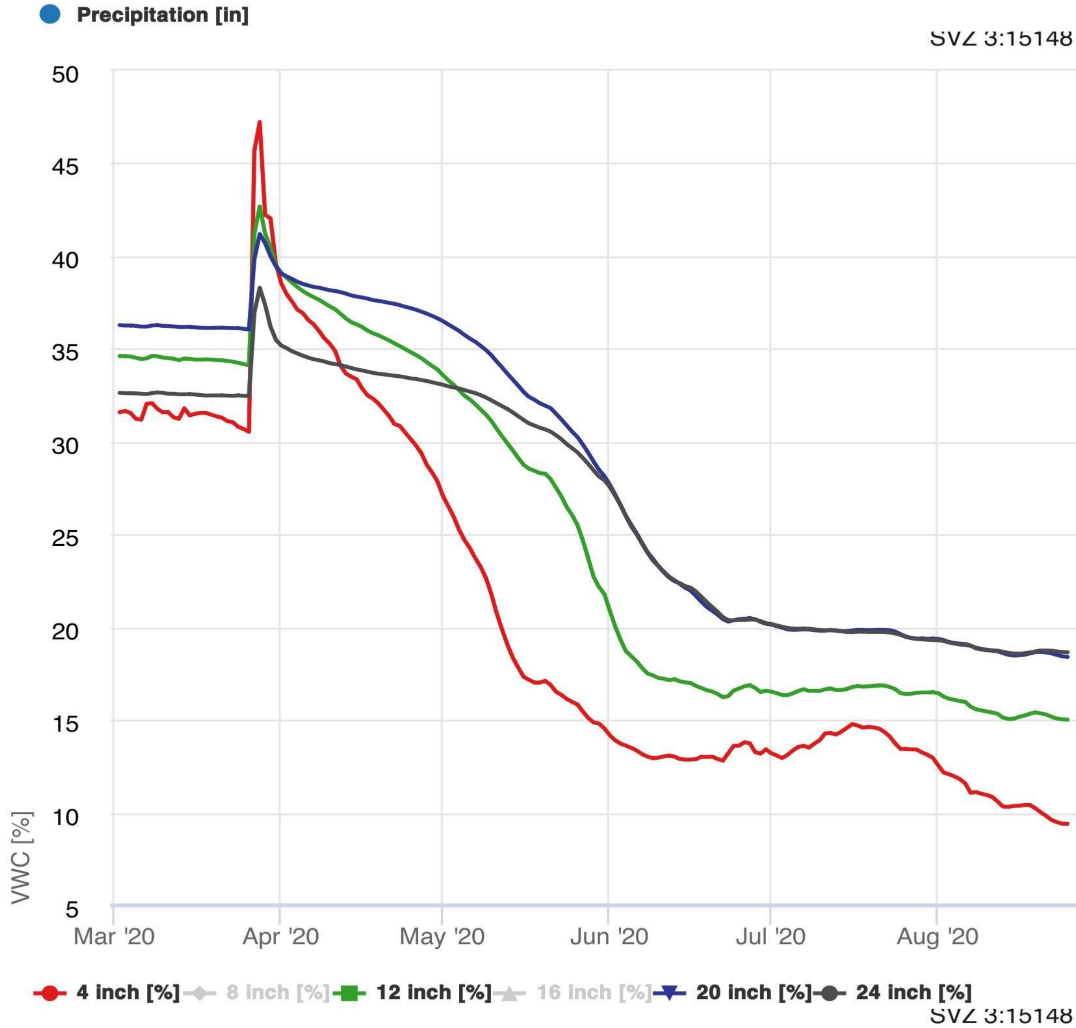


FIGURE 2B: EXAMPLE IRRIGATION MANAGEMENT REPORT FOR FIELD 3





Canal of the Columbia Basin Irrigation District. The shallow lakes of the Potholes area are located approximately one mile north and west of the site. Ground water is not found near enough to the surface to interfere with cropping activities. Soil drainage is good, neither excessive nor poor. No areas of salt accumulation or other undesirable chemical characteristics are naturally found. Soil depth to cobbly substratum is a bit shallow in places for root crops, but adequate for forage and grain crops. Yields of production crops at the site have been near Columbia Basin averages. Although Field 2 has never been used for wastewater treatment, forage crops could be grown. The shallow soil at Field 2 will limit the productive capacity of the field and will also require careful water management to avoid excessive leaching or ponding at the site. The soil of Field 3 is like that of Field 1 only it grades to deeper soil as it progresses northward. Although still too rocky for root crop production, Field 3 has a higher yield potential than Field 1 due to greater soil depths (up to five feet).

2.1 Infiltration Rates and Water Holding Capacity

The soil at the land treatment site is predominantly Scooteney loam. The water infiltration rate ranges from 0.8 to 2.5 inches per hour. The available water holding capacity of the loam soils at the land treatment site are approximately 2.0 inches of water per foot of topsoil and approximately 1.0 inch per foot for the cobbly and gravelly subsoil.[2] Site investigations have revealed the depth to cobbly subsoil ranges from 12 to 60 inches, with the soil depth greatest at the northeast edge of the area. The irrigations are managed for a depth of 24 inches as that is the minimum average soil depth of the two functioning fields.

2.2 Compaction and Puddling Potential

The soils at the land treatment site have loam and gravelly loam textures. In addition, the soils have low to moderate organic matter and low clay content. Consequently, the soils have a moderately strong soil structure and tend not to compact easily. Compaction can be ameliorated by minimizing traffic, eliminating traffic during wet periods, and by maintaining a perennial crop to develop a sod.

Generally, sodium becomes problematic when the exchangeable sodium percentage (ESP) reaches 15%. The soil at the land treatment site contains sufficient clay and has moderate enough slopes that 15% is the appropriate limit. This level of sodium should not be exceeded in the surface soils at the SVZ land application site to avoid possible infiltration problems. Elevated soil salinity can facilitate infiltration when the ESP is greater than 15%; however, excessively high salinity levels can impede crop production. Should sodium approach problematic levels in the surface soils, gypsum (calcium sulfate) can be applied to improve soil structure. Controlled leaching events can be planned to remove excess sodium from the surface horizon of the soil.

[2] Soil Survey of Adams County Washington. USDA SCS. 1967.

2.3 Soil Monitoring

The soils of the treatment fields have been monitored for many years. The permit guidelines require that the fields be sampled twice each year: once prior to the initiation of crop growth in the spring and again in the fall after the last harvest is completed. Field 2 has not been sampled for several years because equipment has been stored on the site which precluded access to some of the monitoring locations. The site has only been used for equipment storage and no plans exist to grow crops on the site or to apply process wastewater on Field 2; it was decided skip monitoring the soil of the field entirely. In 2007 soil monitoring was initiated on Field 3, which was added to the treatment system. All soil samples at all sampling events tested negative for the presence of ferrous iron. The soil test reports from 2020 are included in the Appendix. Graphical summaries of selected constituents can be found in Figure 3.

Sodium is monitored by the exchangeable sodium percentage (ESP, which is the extractable sodium divided by the cation exchange capacity, CEC). ESP is of greatest concern at the surface layer of the soil where it can impact water infiltration. ESP in Fields 1 and 3 have historically exceeded the critical level of 15% at various times and at both depths monitored (Fig. 3): Field 1 has a slightly declining trend for ESP, but Field 3 has a gently increasing trend. In 2017 through 2019 the ESP dramatically decreased in both fields at both depths. ESP increased to over 15% in both fields in 2020. In March of 2015, 3.2 t/ac and 3.8 t/ac of gypsum were applied to Fields 1 and 3 respectively to ensure maintenance of good soil structure and water infiltration. Gypsum was applied again in March 2016 at the same rates as in 2015. A portion of the wastewater has been sent to the City of Othello since 2016. The combination of gypsum applications and declining wastewater loading since 2016 have resulted in the improving ESP and salinity conditions of the soils through 2019. An application of approximately 3/4 tons/ac are recommended for 2021.

The first foot soil total nitrogen (also called Total Kjeldahl Nitrogen or TKN) trend line of Field 3 shows an increasing trend, whereas the total N trend in Field 1 has remained nearly flat. Total N in both fields appear to be trending slightly upward at the 2-foot depth. Total phosphorus (Total P) in the first foot in Fields 1 and 3 demonstrates a slight upward trend. Variations in measurements obscure any trends that may be present in the 2-foot total P of both fields.

Soil nitrate levels at the surface have been typically cyclical in nature. Field 2 monitoring ended in 2012 when 1-ft soil nitrate was at an all-time high for unknown reasons (this field was never utilized). Field 1 nitrate was unusually high in 2013. Nitrate in both Fields 1 and 3 have been low and stable for the last 4 years. In 2020, nitrate in both fields increased dramatically while the nitrate levels in the second foot remained low. Oscillations in nitrate are common at the 2-foot depth as well. The oscillations in soil nitrate in Field 1 were increasing in magnitude through 2015 but have been stable the last four years. Field 1 was replanted several times including in 2013. The minimal crop growth during replanting cannot remove all the nitrogen mineralized from the organic matter and is the likely cause of the spikes in nitrate. The establishment of a stable crop will usually result in minimal residual soil nitrogen. In 2020, field management was transferred to another person. During the changeover irrigation management and crop care were neglected: no harvests were made and inadequate irrigation water was applied. It is felt that this combination resulted in an accumulation of nitrate and salts, including sodium, at the surface of the soil.

For optimum hay production, it is desirable to maintain soil salinity or soluble salts below 3.5 mmho/cm. Soluble salts have been within acceptable limits throughout the monitoring history; however, a spike in salinity is apparent in the 2020 monitoring data. The long-term trend in the two utilized fields remains either level or slightly decreasing in the top foot, and level or slightly increasing in the second foot.

FIGURE 3: SUMMARY OF SOIL TEST MONITORING

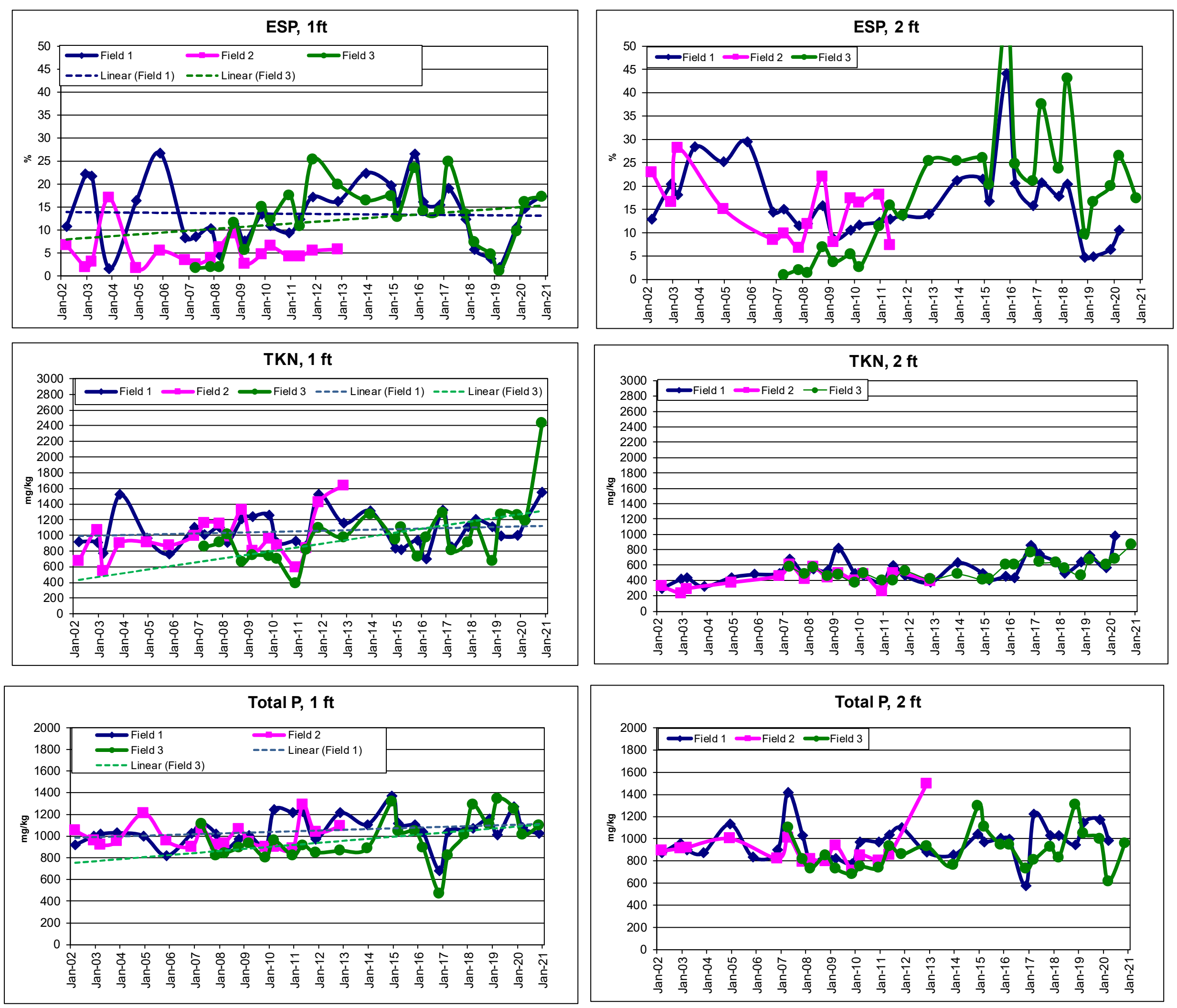
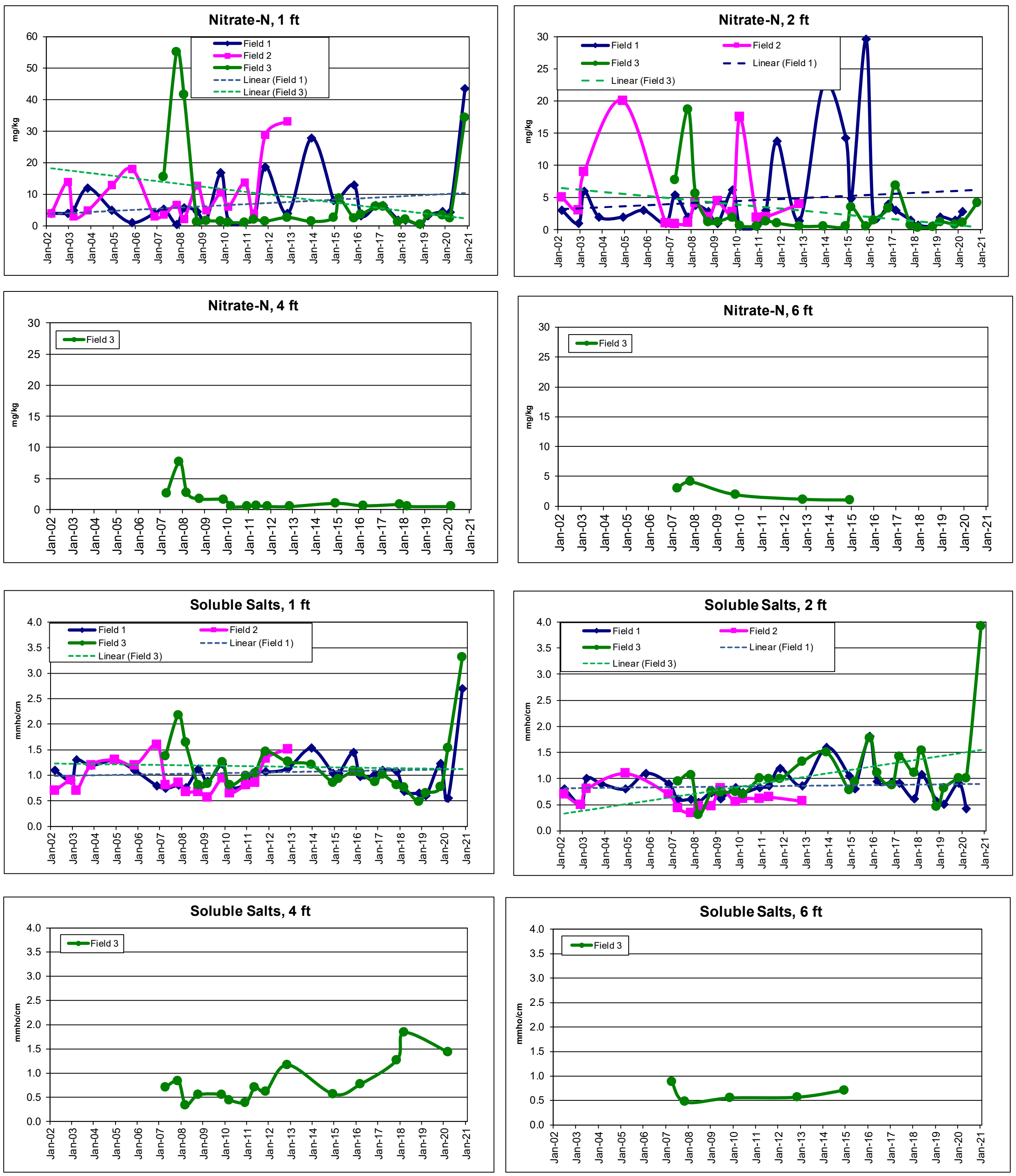


FIGURE 3: SUMMARY OF SOIL TEST MONITORING (CONTINUED)



3. CROP WATER MANAGEMENT

3.1 Crop Water Use and Irrigation Requirement

Grass hay was seeded into Fields 1 and 3 in the fall of 2007 and re-seeded in Field 1 in the fall of 2013. The 2020 monthly and annual water consumption for grass hay can be found in Table 1. Precipitation is subtracted from ET to calculate the Rainfall Balance. Excess precipitation is carried over into the subsequent month to reflect soil storage. The irrigation requirement is calculated from the rainfall balance using a net system application efficiency of 70%. This efficiency may adequately cover some of the needed leaching requirements; however, soil test data will be used to determine the need for additional planned leaching events. In a typical season, grass hay may utilize 35 inches of water and require 50 inches of irrigation water. The summer weather of 2020 was near normal: total annual rainfall was 5.7 inches; consumptive water use was approximately 24.9 inches. The water requirement was reduced by to poor crop growth due to water stress; the irrigation requirement was approximately 29.4 inches. Figures 2A & B demonstrate the declining soil moisture content as irrigations progressively undershot crop demands through the season.

3.2 Water Balance

In 2020, the total wastewater flow from the SVZ processing facility to the lagoon was 32.49 MG (Table 1A). Approximately 18.07 MG of wastewater was pumped from the lagoon and land applied. The balance of the wastewater pumped into the lagoon (approximately 12.14 MG) was sent to the City of Othello for treatment (see Figure 4). Flow meter data show that 4.46 MG of fresh water was applied to the fields in 2020. Flow meters are placed to measure all water applied to each field.

It is estimated in Table 2 that for Field 1, 24.9 inches of water were potentially transpired by the crop and that the irrigation requirement was 29.8 inches. Approximately 25.2 inches of water (66% process wastewater) were applied to Field 1. The water balance indicates that the field was under-irrigated by 4.6 inches (negative balance). The water balance was positive during the months of March, August and October. Deficit irrigation was practiced the remaining 5 months of the irrigation season. The hydraulic loading for Field 3 was 20.3 inches and the ratio of wastewater was 62%, similar to that for Field 1: the irrigation deficit was 9.5 inches for the year. Only March and October had positive water balances.

FIGURE 4: SVZ WASTEWATER PRODUCTION

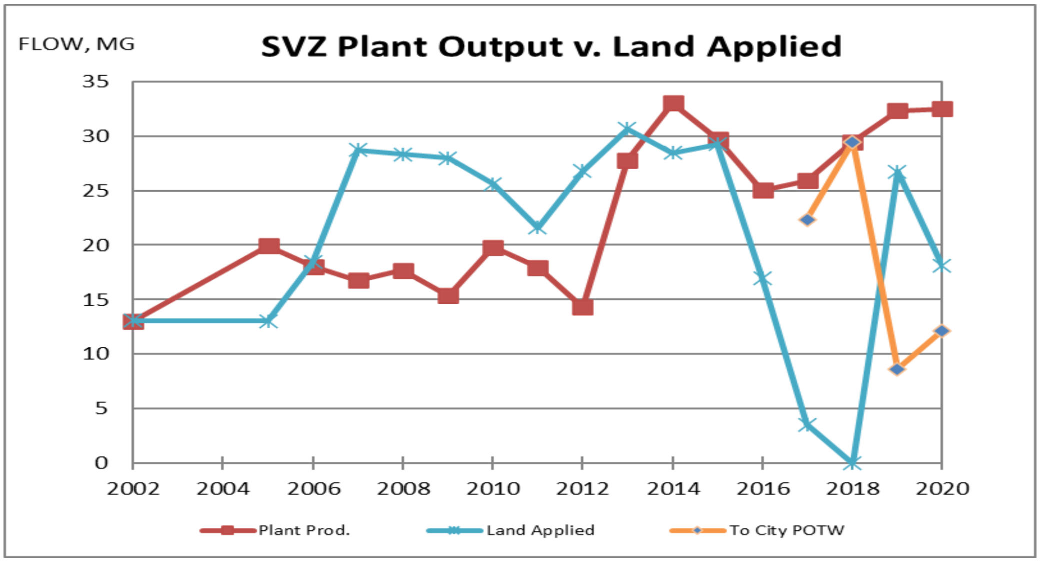


TABLE 1A: WASTEWATER PRODUCTION AND LAND APPLICATION TOTALS

	PLANT PROCESS WATER PRODUCTION		IRRIGATION WASTEWATER								
			AVERAGE MONTHLY ANALYSES, mg/L							LAND-APPLIED	
MONTH	MG	Ac-Ft	TKN	BOD	COD	sBOD	FDS	Na	NH4-N	MG	Ac-Ft
JAN	3.795	11.648									
FEB	2.413	7.406									
MAR	2.739	8.404								0.000	0.00
APR	1.642	5.040	833	880	1,623	843	978	520	11.5	2.235	6.86
MAY	2.273	6.975	173	512	1,216	314	1,409	520	2.1	0.535	1.64
JUN	2.994	9.189	1,747	94	660	34	1,177	520	5.3	4.538	13.93
JUL	3.025	9.283	1,263	407	1,880	351	1,103	494	0.8	2.932	9.00
AUG	3.315	10.173	3,432	183	638	158	1,147	468	18.0	9.558	29.33
SEP	3.003	9.215	753	1,214	3,050	1,045	1,048	468	0.9	1.936	5.94
OCT	2.709	8.315	3,987	534	2,915	142	926	468	1.5	5.011	15.38
NOV	2.679	8.220									
DEC	1.753	5.380									
AVG	2.695	8.271	1,741	546	1,712	412	1,113	494	5.7	3.343	10.259
			TOTAL LAND APPLIED, LBS								
TOTAL	32.340	99.25	12,187	88,615	328,495	62,377	243,071	108,191	1,948	26.744	82.075
Notes: Plant wastewater was used for irrigation all season; in addition, supplemental irrigation district water was also applied.										Est. Evaporation Loss	
										3.020	Mgal

TABLE 1B: SUPPLEMENTAL WATER TOTALS

	units	result	MGal Applied		Total Pounds Applied
NITRATE-N	mg/L	**0.09**			
TKN	mg/L	**0.50**			
NITROGEN	mg/L	**0.6**	**4.45**	**Nitrogen**	**21.9**
TDS (salts)	mg/L	**85**		**TDS**	**3158**
Sodium (Na)	mg/L	**0.1**		**Sodium**	**4**

Note: Green indicates that MDL was used in place of non-detect for calculation purposes.

The leaching requirement is estimated to be 5.6% as calculated from the water quality parameters in Tables 1A and 1B and an average mix of 64% wastewater. The leaching requirement is the same for both fields as they receive water from the same sources at nearly the same ratios; further, they are planted to the same crop and the soil is substantially consistent across both fields. The maximum desirable saturated paste EC for both fields was set at 3.5 mmho/cm for the calculation. As the EC of neither the supplemental water nor the wastewater is measured, it was estimated using a commonly used general relationship: EC=TDS/640. Since we generally are concerned with FDS in vegetable wastewater, the same formula was applied using FDS rather than TDS. As indicated in Table 1, wastewater made up 64% of the water applied to each field on average. The weighted average EC for all the rain and irrigation water applied to the field is then 0.93 mmho/cm. The Leaching Requirement is calculated by the following relationship:

LR= ECw / [(5xECw) – ECe], where LR is Leaching Requirement; ECw is the EC of the average water applied; ECe is the maximum allowable EC of the soil solution. Inserting the values calculated above, yields a LR of 5.6%.

The 2020 leaching requirement is somewhat less than 2019 because less wastewater was irrigated in 2020.

4. NUTRIENT MANAGEMENT

A balance sheet approach is used for nutrient management analysis in this report, like the method used for water management. The inputs are identified and quantified. Losses and removals are also identified, quantified and compared to projections from last year. Finally, a balance is calculated and discussed in comparison to soil test results.

4.1 Constituent Additions

Significant amounts of wastewater were applied to both of the treatment fields in 2020 (Table 2); thus, the nutrients and salts included in the wastewater were also applied. The nitrogen and salts contained in the supplemental fresh water added little to the loadings (Table 1B). No commercial fertilizer applications were made.

Gross nitrogen additions from wastewater were 109 lbs-N/ac to Field 1 and 86 lbs-N/ac to Field 3: both values were less than the design N loading of 165 lbs-N/ac. Fresh water nitrogen additions were negligible at approximately 0.5 lbs-N/ac. Salt additions from wastewater were 3,446 lbs/ac (9 lbs/ac-day) to Field 1 and 2,646 lbs/ac (7 lbs/ac-day) to Field 3: both values were less than the 4,000 lbs/ac-yr or 11 lbs/ac-day design maximum. Salt loading from supplemental water was less than 100 lbs/ac. Negligible sodium loading was derived from the supplemental water; however, wastewater added 1,057 lbs-Na/ac to Field 1 and 830 lbs/ac to Field 3. Field 1 received 2,902 lbs/ac (12 lbs/ac-day) of BOD from wastewater and Field 3 received 2,277 lbs/ac (9 lbs/ac-day): both values are well below the 100 lbs/ac-day design maximum. Loading trends are plotted in Figure 5.

TABLE 2: HYDRAULIC LOADING SUMMARY

FIELD 1

MONTH	Consump-tive Use ac-in/ac	Precip-itation ac-in/ac	Rainfall Balance ac-in/ac	Irrigation Req't at 70% Efficiency ac-in/ac	Irrigation Process ac-in/ac	Water Fresh ac-in/ac	Loading Total ac-in/ac	Balance ac-in/ac
JAN	0.10	1.02	-0.9	0.0	0.0	0.0	0.0	0.0
FEB	0.15	0.47	-0.3	0.0	0.0	0.0	0.0	0.0
MAR	0.78	0.29	0.5	0.0	0.0	3.0	3.0	3.0
APR	3.61	0.70	2.9	4.2	3.0	3.2	6.2	2.0
MAY	5.36	0.69	4.7	6.7	0.6	5.7	6.3	-0.3
JUN	5.96	0.22	5.7	8.2	4.9	0.0	4.9	-3.3
JUL	7.55	0.22	7.3	10.5	2.7	0.0	2.7	-7.7
AUG	6.74	0.66	6.1	8.7	10.8	0.0	10.8	2.1
SEP	3.92	0.44	3.5	5.0	1.9	0.0	1.9	-3.1
OCT	1.71	0.67	1.0	1.5	6.3	0.0	6.3	4.8
NOV	0.31	0.20	0.1	0.0	0.0	0.0	0.0	0.0
DEC	0.09	0.62	-0.5	0.0	0.0	0.0	0.0	0.0
YEAR	**36.26**	**6.20**	**30.1**	**44.6**	**30.2**	**11.9**	**42.0**	**-2.6**

Total Hydraulic Load, in.	**42.0**	**2018 Load**	**31.1**
Hydraulic Load Limit, in.	**30.0**	**% Change**	**35%**
% of Limit ac-ft/ac	**140%**	**Process, % of Total**	**72%**
% of Irrig Reqirement	**94%**	**Leaching Fraction as-applied**	**-5.9%**
(ET and Precip. data from AgWeatherNet Othello)		**Calculated Leaching Requirement**	**8.1%**

FIELD 3

MONTH	Consump-tive Use ac-in/ac	Precip-itation ac-in/ac	Rainfall Balance ac-in/ac	Irrigation Req't at 70% efficiency ac-in/ac	Irrigation Process ac-in/ac	Water Fresh ac-in/ac	Loading Total ac-in/ac	Balance ac-in/ac
JAN	0.10	1.02	-0.9	0.0	0.0	0.0	0.0	0.0
FEB	0.15	0.47	-0.3	0.0	0.0	0.0	0.0	0.0
MAR	0.78	0.29	0.5	0.0	0.0	1.6	1.6	1.6
APR	3.61	0.70	2.9	4.2	1.6	1.7	3.3	-0.9
MAY	5.36	0.69	4.7	6.7	0.5	4.7	5.1	-1.6
JUN	5.96	0.22	5.7	8.2	4.3	0.0	4.3	-3.9
JUL	7.55	0.22	7.3	10.5	3.2	0.0	3.2	-7.3
AUG	6.74	0.66	6.1	8.7	8.5	0.0	8.5	-0.1
SEP	3.92	0.44	3.5	5.0	2.0	0.0	2.0	-3.0
OCT	1.71	0.67	1.0	1.5	3.9	0.0	3.9	2.4
NOV	0.31	0.20	0.1	0.0	0.0	0.0	0.0	0.0
DEC	0.09	0.62	-0.5	0.0	0.0	0.0	0.0	0.0
YEAR	**36.26**	**6.20**	**30.1**	**44.6**	**24.0**	**8.0**	**31.9**	**-12.7**

Total Hydraulic Load	**31.9**	**2018 Load**	**31.1**
Hydraulic Load Limit	**30.0**	**% Change**	**3%**
% of Limit ac-ft/ac	**106%**	**Process, % of Total**	**75%**
% of Irrig Reqirement	**72%**	**Leaching Fraction as-applied**	**-28.5%**
(ET and Precip. data from AgWeatherNet Othello)		**Calculated Leaching Requirement**	**8.1%**

4.2 Constituent Losses and Harvest Removals

Nitrogen loss from denitrification and volatilization can result in relatively low uptake efficiencies under fertigation with wastewater containing high BOD. No losses are deducted in Table 1A or 1B, but in calculating the total loading in Table 4 the sums were adjusted by the following nitrogen use efficiencies: 75% of the wastewater-N and 85% of the fresh water-N and fertilizer-N were carried into the total (Allison, F.E. 1965. *Evaluation of Incoming and Outgoing Processes That Affect Soil Nitrogen*, in Soil Nitrogen. Agronomy Monograph 10, Bartholomew, W.V. & Clark, Francis E. eds. American Society of Agronomy, Madison, WI).

Table 3 summarizes the harvest removal of selected constituents in the harvested portion of the crop. No harvests were made from either field in 2020 so no losses are deducted in Table 4.

4.3 Constituent Balances

The nutrient balances are calculated in Table 4. In these calculations, it was assumed that 100% of all constituents, except nitrogen as explained above, passed through the conveyance and application system and entered the soil. Positive values in the balance rows in Table 4 indicate an accumulation of constituent in the soil of the land treatment field. Balances in 2020 were much different than 2019 due to the application of less irrigation wastewater and no harvest removals in 2020. More nitrogen, 83 lbs/ac in Field 1 and 65 lbs/ac in Field 3, was applied than removed in harvests. Field 1 received a net loading of 3,466 lbs/ac of salts and Field 3 received 2,725 lbs/ac of salts. More sodium was also applied than removed in harvests by approximately 950 lbs/ac on average.

Historical land application totals are summarized in Figure 5 while nitrogen and salt removals and balances are summarized in Figure 6. Loading in 2020 was down significantly from 2019. Approximately 56% of all wastewater produced in 2020 was land applied. The 2019 management plan recommended applying 14.3 inches of wastewater to the fields in 2020. Wastewater loading to Field 1 was approximately 30% over the 2019 plan and wastewater loading to Field 2 was 12% over that planned.

TABLE 3: HARVEST REMOVAL TOTALS

FIELD / DATE	CROP	YIELD, lbs	%, TOTAL ANALYSIS								
			DM	N	P	Na	Ca	Mg	K	Cl	Ash
FIELD 1	18.2 acres										
Total	lbs	0									
	t/ac	0.00									
Net Removal	**lbs/ac**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
FIELD 3	18.4 acres										
Total	lbs	0									
	t/ac	0.00									
Net Removal	**lbs/ac**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

No harvest taken in 2020

TABLE 4: BALANCE OF CONSTITUENTS LAND APPLIED

Source	N, lbs/ac 2020	N, lbs/ac 2019	Sodium, lbs/ac 2020	Sodium, lbs/ac 2019	FDS or Salt, lbs/ac 2020	FDS or Salt, lbs/ac 2019	BOD, lbs/ac 2020	BOD, lbs/ac 2019
FIELD 1 18.2 acres								
Wastewater	109	373	1,057	3,313	3,372	7,443	2,902	2,713
Freshwater	0.6	1.6	0.1	0.3	93	228	0	0
Fertilizer	0	0	0	0	0	0	0	0
SUM^	**83**	281	**1,057**	3,313	**3,466**	7,671	**2,902**	2,713
% difference from last year		**-71%**		**-68%**		**-55%**		**7%**
					9	lbs/ac/day*	**12**	**lbs/ac/day***
Permit Design	**165**	lbs/yr	**N/A**	**N/A**	**11**	lbs/ac/day	**100**	**lbs/ac/day**
% of Design	**50%**	85%	**N/A**	**N/A**	**86%**		**12%**	
Harvest Removal, lbs/ac	**0**	103	**0**	3	**0**	284	**N/A**	**N/A**
Balance, lbs/ac	**83**	37	**1,057**	274	**3,466**	684	**N/A**	**N/A**
FIELD 3 18.4 acres								
Wastewater	86	293	830	2,603	2,646	5,848	2,277	2,132
Freshwater	0.5	1.1	0.1	0.2	79	152	0	0
Fertilizer	0	0	0	0	0	0	0	0
SUM^	**65**	221	**830**	2,603	**2,725**	6,000	**2,277**	2,132
% difference from last year		**-70.7%**		**-68.1%**		**-54.6%**		**7%**
					7	lbs/ac/day*	**9**	**lbs/ac/day***
Permit Design	**165**	lbs/yr	**N/A**	**N/A**	**11**	lbs/ac/day	**100**	**lbs/ac/day**
% of Design	**39%**	85%	**N/A**	**N/A**	**68%**		**9%**	
Harvest Removal, lbs/ac	**0**	103	**0**	3	**0**	284	**N/A**	**N/A**
Balance, lbs/ac	**65**	37	**830**	274	**2,725**	684	**N/A**	**N/A**

Notes: ^Sum of Nitrogen was calculated assuming 75% use efficiency of wastewater N and 85% use efficiency of commercial fertilizer N.
* FDS, pounds/acre/day was calculated over 365 days in a year; BOD pounds/ac/day was calculated using the 245 day irrigation season.

FIGURE 5: WASTEWATER CONSTITUENTS LAND APPLIED

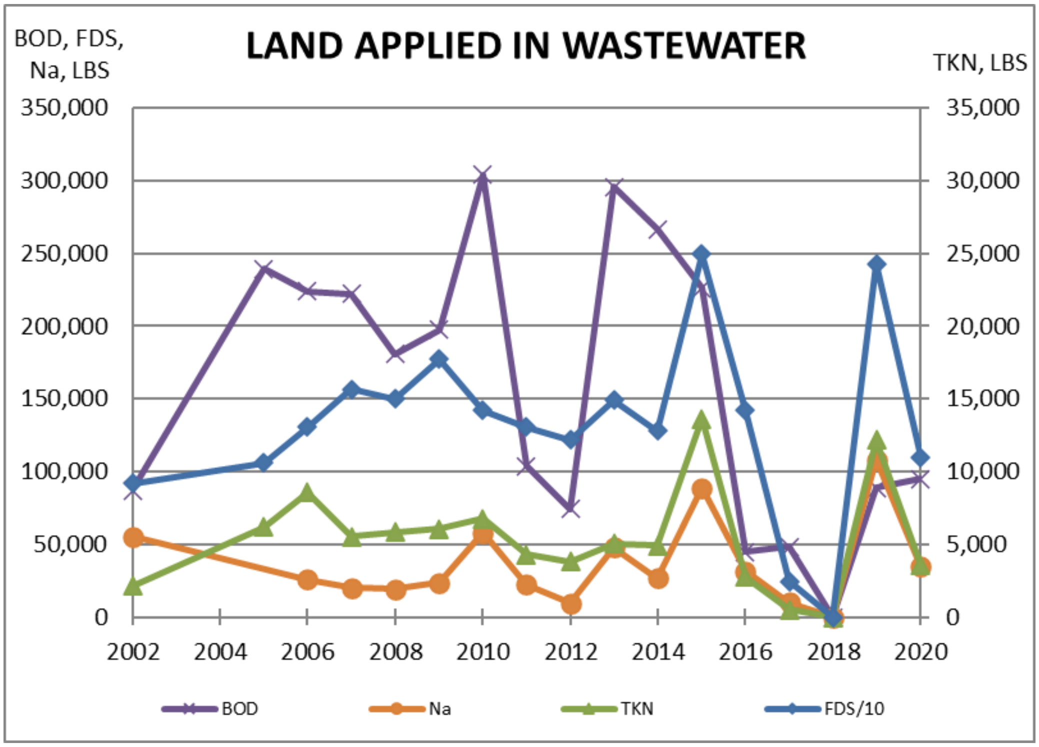
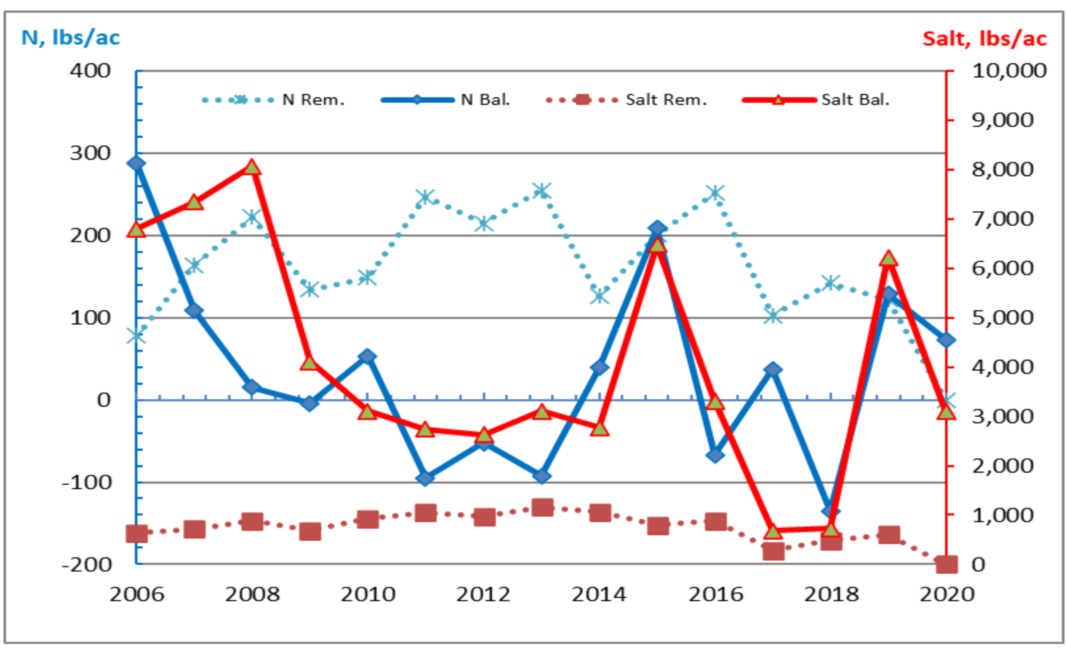


FIGURE 6: NITROGEN AND SALT REMOVAL & NET APPLICATION



5. GROUNDWATER MONITORING

Eight monitor wells have been installed at the land treatment site; the location of each is indicated in Figure 1. Monitor wells 1 through 5 were installed prior to the date SVZ assumed operations of the site. Wells 6 through 8 were installed in the spring of 2008 in preparation for adding Field 3 to the treatment site. Wells 1 and 2 were damaged during fall field work in 2013. These wells were abandoned along with monitor wells 3 and 4 in 2014 when two new wells, 2R and 3R, were installed. The wells are monitored monthly for water level and various physical and chemical parameters as required by permit.

Historical data for nitrate and TDS is reported in Figure 5. The data for the new wells 2R and 3R is appended to that of the original wells 2 and 3 in Figure 5 as they are in approximately the same locations. In the 2012 Fact Sheet Update for State Waste Discharge Permit ST-8077 the background values for groundwater nitrate and TDS for well 2R were modified to 5.62 and 507 mg/L, respectively. The background values for well 8 as determined in the same Fact Sheet were 18.1 mg/l for nitrate-N and 916 mg/l for TDS. The background lines and data trend lines for these two parameters are included in Figure 5.

The Field 2 up-gradient well, MW2/2R demonstrates variations in TDS of approximately 200 mg/l and an upward trend that has leveled out the last couple years. The overall trend is slightly downward due to highs measured shortly after the well was installed. TDS levels in MW2/2R has exceeded background levels during much of the time in 2017 and 2018, subsequently, exceedances have declined. Up-gradient well MW8 in Field 3 demonstrated a steady increase of approximately 200 mg/l from its installation in 2008 until 2012, then decreasing to below original levels by the end of 2017. The more recent trend is currently flat and below the 2012 background level.

The down-gradient wells are mixed in their responses over time. TDS in Well 3/3R demonstrates a downward trend but was still above background in 2020. Well 5 demonstrates no trend and remains above background with considerable short and long-term variations. Wells 6 and 7 both exhibit long-term increasing TDS over the monitoring period but TDS in both wells has declined slightly over the last 2 years. Both wells are near to above background TDS levels.

The nitrate levels in up-gradient well, MW2, is well above background and exhibits an increasing long-term trend with considerable annual variations. Some very high values were recorded in the winters of 2016, 2017 and 2018. The nitrate level in the Field 3 up-gradient well, MW8, has trended downward but has levelled out and begun to increase since 2018. Nitrate levels are well below the background level established in 2012.

The nitrate levels in Field 3 down-gradient wells, MW6 and MW7, demonstrate an overall downward trend but have been increasing the last two years. Nevertheless, the nitrate levels are staying below the 2012 background level. The nitrate level in the Field 1 down-gradient wells, MW3/3R and MW5, remain above background levels and demonstrate variably increasing trends with wide variations. Although there are many gyrations, the nitrate level in MW5 has risen from 5 mg/l in 2005 to 20 mg/l in 2017. Nitrate levels have since declined. MW3/3R has varied from zero to nearly 40 mg/l at various times with a resultant increasing trend; however, the recent trend has been downward.

FIGURE 5: SUMMARY OF SVZ WELL MONITORING (Field 1 Wells)

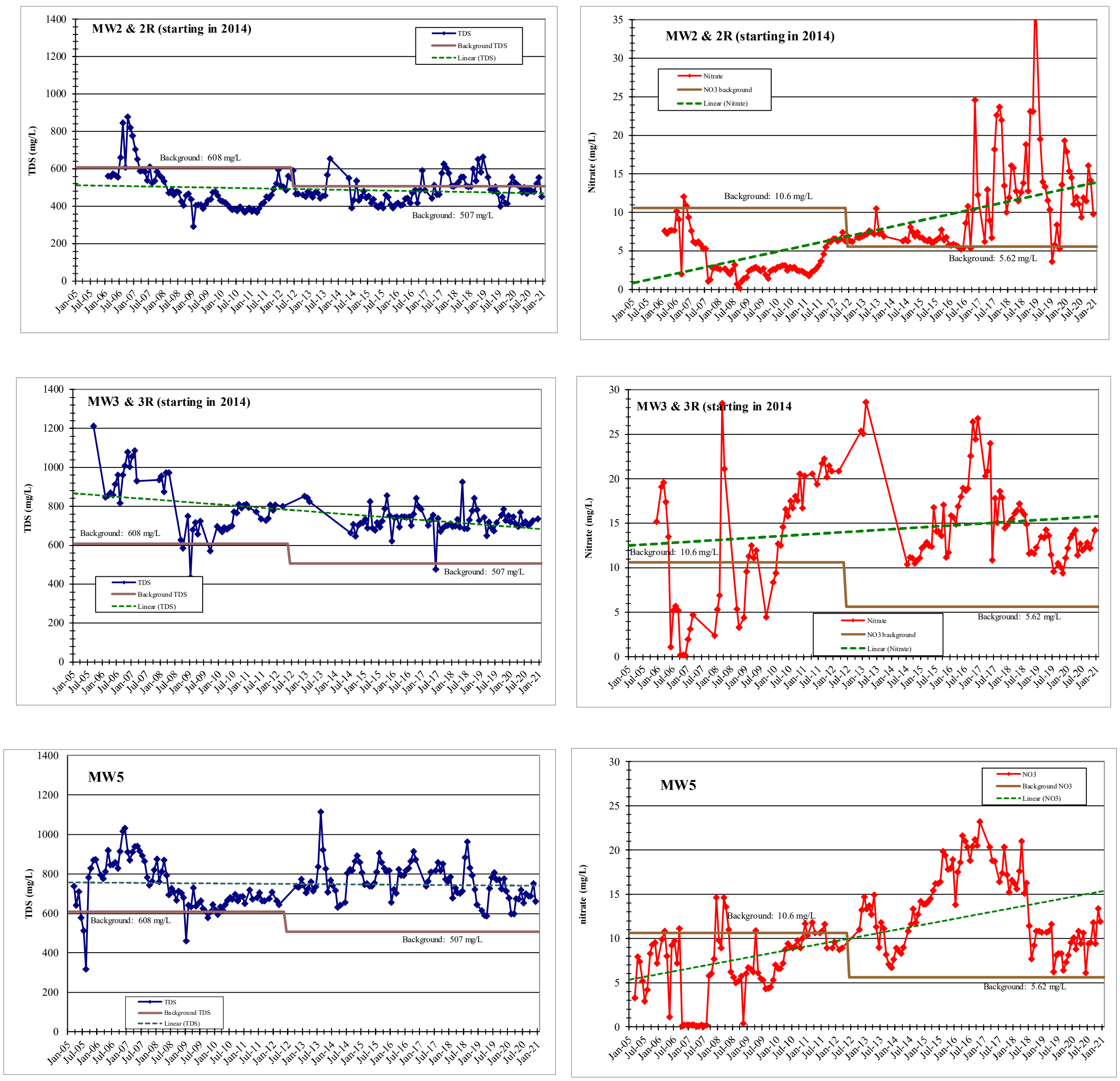
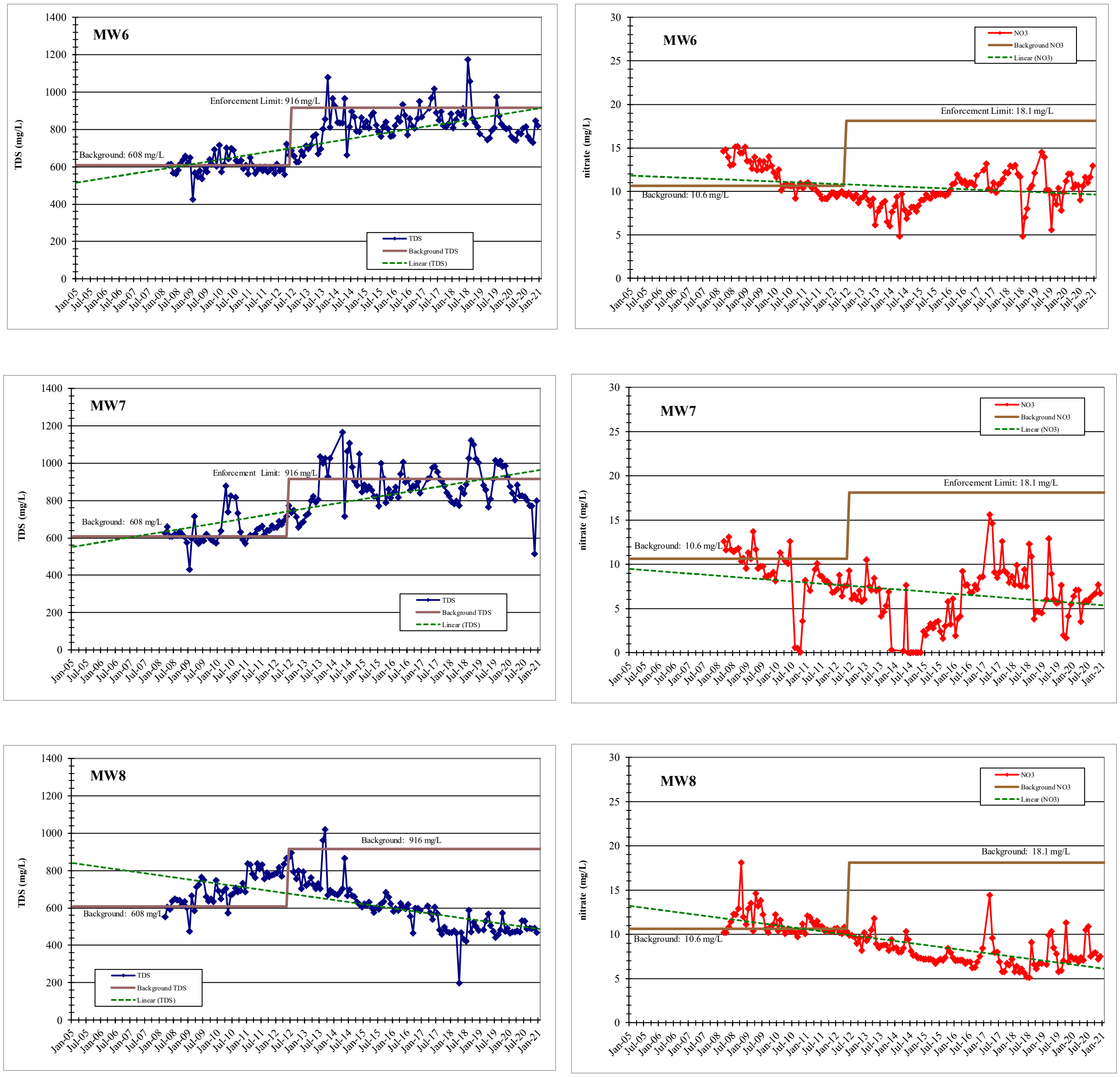


FIGURE 5: SUMMARY OF SVZ WELL MONITORING (Field 3 Wells)



6. 2021 CROP PLAN

In 2021, SVZ will remove the wheel-line irrigation systems from Fields 1 and 3 and replace them with 3 small center pivot half-circle systems. As the old Field 2 has no plans for use, the naming system in future reports will be modified to match that used by SVZ. Field 1 will continue to be the name for the south field which will be irrigated with two half-circle center pivot systems, Pivot 1 to the south and Pivot 2 to the north.

The north field will be called Field 2 and will be irrigated with a single half-circle system, Pivot 3. All three pivots will be seeded to alfalfa in the spring of 2021. The total acres under irrigation will be slightly less than that when irrigated by wheel-lines.

6.1 Soil Monitoring

The DOE land treatment permit requires that soil samples be collected in the spring and fall: this will continue to be accomplished in 2021. The purpose of soil testing is to monitor salt and nutrient concentrations over time and act as a back-up to the nutrient balance calculations. Modifications in management will be triggered by significant changes in soil test values. Soil samples will be collected and analyzed from Fields 1 and 2 to monitor chemical changes and salt conditions. The monitoring sites may need to be modified due to the change to center pivot irrigation systems but will be maintained as close to the original sites as practical. No sampling will occur on the old Field 2 as SVZ has no plans to utilize it for treatment or crop production.

6.2 2021 Cropping Pattern and Wastewater Applications

After the new center pivot irrigation systems are installed, Fields 1 and 2 will seeded to alfalfa hay for the 2021 season and for the foreseeable future. It is planned that no more than 15.9 MG of wastewater will be applied to the 3 pivots. This will apply approximately 18 inches, the permitted maximum, of wastewater if distributed evenly over all pivots. This application amount will keep FDS loading below the 4,000 lbs/ac limit and nitrogen loading from wastewater below 165 lbs/ac. All additional wastewater will need to be sent to the City of Othello for treatment. Any additional irrigation requirements will need to be met with supplemental water, as approximated in Table 5. The loadings for 2021 are anticipated to be from wastewater and supplemental water with no fertilizer additions.

The nitrogen requirement in any given year depends on the crop, growing conditions/weather, water and nutrient management and disease/pest pressure. Most of these factors can only be estimated ahead of time from historical values or experience; the result is called the agronomic rate. The crop nitrogen requirement can be met by nitrogen from four main sources, soil residual, wastewater, fresh water, and fertilizer. Not all the nitrogen applied from any of these sources remains available for crop use. Volatilization and denitrification result in nitrogen loss from the system and each of these sources has an efficiency of use that needs to be included in the balance equation. If planning suggests that nitrogen availability from one of these sources is anticipated to be higher, then nitrogen from one or more of the other sources should be reduced.

The Projected Management Plan for 2021, as presented in Table 5 was developed with the following assumptions and goals:

1) The weather, ET and precipitation, for 2021 will not vary substantially from the 2017 to 2020 average.

2) No more than 15.9 MG of wastewater will be land applied
3) Crop yields in 2021 will be near those experienced in previous years.

With these considerations in mind, it is anticipated that no fertilizer nitrogen will be required for the alfalfa crop (Table 5).

TABLE 5: PROJECTED PLAN FOR 2021

			Anticipated Water Use less Anticipated in-season Rain		Irrigation Plan				Anticipated Wastewater Gross Loading			Soil Resicual N*	Estimated Fertilizer Nitrogen Needed	Gypsum Require-ment
	Treated				Wastewater		Fresh Water		N	Salts	BOD			
Field I.D.@	Acres	Crop	inches	MG	inches	MG	inches	MG	lbs/ac	lbs/ac	lbs/ac-day	lbs/ac	lbs/ac	lbs/ac
CIRCLE 1 (S)	16.7	New	43.0	19.5	18.0	8.18	24.9	16.86	97	2,985	10	88	0	1700
CIRCLE 2 (Mid)	7.3	Seeding	43.0	8.5	18.0	3.58	24.9	16.86	97	2,985	10	85	0	1400
CIRCLE 3 (N)	8.6	Alfalfa	43.0	10.0	18.0	4.21	24.9	16.86	97	2,985	10	83	0	1100
					total MG	15.97	total MG	50.59						
	32.6			WW limits**	18	15.93			165	4,000	100			

* Soil residual N is calculated from the sum of tested nitrogen from the previous fall soil test.

**Wastewater irrigation is adjusted to keep total nitrogen load below 165 lbs-N/ac and wastewater hydraulic loading below 18 inches/ac (15.9 MG total), and salt loading below 4,000 lbs/ac per design criteria.

@The two wheel-line fields will be replaced with 3 small center-pivots in 2021 with new names and acreages. The listed acreages are estimates from drawings.

6.3 Summary and Recommendations

The land application system was not operated completely in 2020 as no grass hay was harvested. However, reduced wastewater applications resulted in modestly positive loading balances for nitrogen (74 lbs-N/ac average), sodium (943 lbs-Na/ac average) and salts (3,096 lbs/ac average). The fall 2020 nitrogen soil test indicated that approximately 85 lbs/ac of mineral nitrogen remained in Fields 1 and 3; thus, no fertilizer nitrogen is recommended for the 2021 new-seeding alfalfa crop. The hay crops must be managed to produce well to help maintain soil health and a favorable field N balance. Proper water management is the first and most important step. Adequate supplemental water must be applied to optimize crop growth. The third year of deficit irrigation practices was instrumental in the decline in crop production in 2020; better irrigation management will greatly improve crop production and thereby treatment capacity. SVZ upgraded the soil moisture monitoring equipment in 2015 making real-time visualization of the field conditions available to SVZ and the farm manager. Proper utilization of such information will assist the manager in matching irrigations to crop water requirements.

Mineral salt loadings (N, Na, FDS) decreased in 2020 compared to 2019 because much less wastewater was land applied. Even with the lighter loading rate, the lack of harvest removal and leaching fraction resulted in increases in soil salinity and ESP values in the surface soil. Based on fall 2020 soil testing results, it is recommended that approximately 1,500 lbs/acre of gypsum be applied to both fields in 2021 to ensure adequate water infiltration due to sodium buildup in the surface soil. Not all salts react the same when land applied. Magnesium has minimal effect on soil salinity compared to sodium. Potassium is a plant nutrient removed at significant rates by hay crops. Application of adequate fresh water to achieve the desired leaching fraction of approximately 6% will prevent salt accumulation at the surface. Adequate water will also increase hay yield, thus, improving the treatment capacity of the site.

Pesticides will be used only as needed. It is anticipated that some herbicide may be applied to the fields for weed control. Need for chemical and fertilizer applications will be determined by a certified crop advisor or similar professional. All pesticide applications will be made in accordance with label directions by licensed applicators.

Except for a period of maintenance on the lagoon liner, the flow meters appear to have worked well in 2020 which allowed accurate evaluation of the hydraulic balances in the fields. It would be advisable to check the calibration of each flow meter at least annually and provide the dates of calibration for inclusion in this report.

APPENDIX

2020

DMR REPORTS FOR

Washington State DOE Discharge Permit No. ST8077

CAN BE VIEWED AT THE FOLLOWING LINK:

https://fortress.wa.gov/ecy/paris/ComplianceAndViolations/ViewDMRData.aspx

HARVEST REPORTS

(none)

DOE SOIL TESTING RESULTS

soiltest
farm consultants, inc.
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SVZ-USA
P.O. BOX 715
OTHELLO, WA 99344

DATE RECEIVED 3/26/2020
DATE REPORTED 3/31/2020
INVOICE # 4209

NORTH

SAMPLE I.D.	LAB NO	NO3-N mg/Kg	NH4-N mg/Kg	TKN mg/Kg	TOTAL P mg/Kg	OLSEN P mg/Kg	NH40AC K mg/Kg	NH40AC Ca meq/100g	NH40AC Mg meq/100g	NH40AC Na meq/100g
1FT	4209	2.5	2.1	1185	1013	17	381	13.3	2.8	1.96
2FT	4210	1.1	2.4	677	617		275	19.3	3.5	2.78
3FT	4211	0.5	1.5	537	909		103	10.4	2.8	3.61

SAMPLE I.D.	LAB NO	SULFUR mg/Kg	DTPA EXT B mg/Kg	DTPA EXT Zn mg/Kg	CEC meq/100g	ESP %	Est Sat Paste SOL SALTS mmhos/cm	pH 1:1	OM %	Fe2+ field test
1FT	4209	22	0.55	1.3	12.2	16.1	1.53	7.8	2.5	NEG
2FT	4210	13			10.5	26.5	1.01	8.4	1.0	NEG
3FT	4211	55					1.43	8.9		NEG

REVIEWED BY______________ AO

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SVZ-USA
P.O. BOX 715
OTHELLO, WA 99344

DATE RECEIVED 3/26/2020
DATE REPORTED 3/31/2020
INVOICE # 4212

SOUTH

							NH40AC			
SAMPLE I.D.	LAB NO	NO3-N mg/Kg	NH4-N mg/Kg	TKN mg/Kg	TOTAL P mg/Kg	OLSEN P mg/Kg	K mg/Kg	Ca meq/100g	Mg meq/100g	Na meq/100g
1FT	4212	4.4	2.6	1182	1077	23	552	8.4	3.1	1.70
2FT	4213	2.8	2.5	979	986		756	6.9	4.6	1.25
	auger refusal									

		DTPA EXT					Est Sat Paste			
SAMPLE I.D.	LAB NO	SULFUR mg/Kg	B mg/Kg	Zn mg/Kg	CEC meq/100g	ESP %	SOL SALTS mmhos/cm	pH 1:1	OM %	Fe2+ field test
1FT	4212	16	0.37	1.9	11.6	14.7	0.55	8.7	1.8	NEG
2FT	4213	7			11.8	10.6	0.42	8.4	1.2	NEG
	auger refusal									

REVIEWED BY______________ **AO**

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SVZ-USA
P.O. BOX 715
OTHELLO, WA 99344

DATE RECEIVED 11/3/2020
DATE REPORTED 11/5/2020
INVOICE # 22823

FIELD 1 (south wheelline)

SAMPLE I.D.	LAB NO	NO3-N mg/Kg	NH4-N mg/Kg	TKN mg/Kg	TOTAL P mg/Kg	OLSEN P mg/Kg	NH40AC K mg/Kg	NH40AC Ca meq/100g	NH40AC Mg meq/100g	NH40AC Na meq/100g
1FT	22825	43.5	2.8	1552	1027	40	648	8	3	2.23
2FT	AUGER REFUSAL									
3FT	AUGER REFUSAL									

SAMPLE I.D.	LAB NO	SULFUR mg/Kg	DTPA EXT B mg/Kg	DTPA EXT Zn mg/Kg	CEC meq/100g	ESP %	Est Sat Paste SOL SALTS mmhos/cm	pH 1:1	OM %	Fe2+ field test
1FT	22825	22.3	0.77	2.5	12.8	17.4	2.70	8.2	2.1	NEG
2FT	AUGER REFUSAL									
3FT	AUGER REFUSAL									

REVIEWED BY__________KEB__________

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SVZ-USA
P.O. BOX 715
OTHELLO, WA 99344

DATE RECEIVED 11/3/2020
DATE REPORTED 11/5/2020
INVOICE # 22823

FIELD 3 (north wheelline)

SAMPLE I.D.	LAB NO	NO3-N mg/Kg	NH4-N mg/Kg	TKN mg/Kg	TOTAL P mg/Kg	OLSEN P mg/Kg	NH40AC K mg/Kg	NH40AC Ca meq/100g	NH40AC Mg meq/100g	NH40AC Na meq/100g
1FT	22823	34.3	7.3	2433	1100	27	496	17.1	3.3	2.33
2FT	22824	4.2	1.9	871	959		232	11.3	2.7	2.16
3FT	AUGER REFUSAL									

SAMPLE I.D.	LAB NO	SULFUR mg/Kg	DTPA EXT B mg/Kg	DTPA EXT Zn mg/Kg	CEC meq/100g	ESP %	Est Sat Paste SOL SALTS mmhos/cm	pH 1:1	OM %	Fe2+ field test
1FT	22823	46.9	0.88	4.4	13.6	17.1	3.31	8.5	2.7	NEG
2FT	22824	30.7			12.5	17.3	3.92	8.2	1.2	NEG
3FT	AUGER REFUSAL									

REVIEWED BY_______KEB________________

LABORATOTRY & CONSULTANT

CERTIFICATIONS

The State of Washington Department of Ecology

Soiltest Farm Consultants, Inc. Laboratory

Moses Lake, WA

has complied with provisions set forth in Chapter 173-50 WAC and is hereby recognized by the Department of Ecology as an ACCREDITED LABORATORY for the analytical parameters listed on the accompanying Scope of Accreditation. This certificate is effective September 8, 2018 and shall expire September 7, 2019.

Witnessed under my hand on September 7, 2018

Rebecca Wood
Lab Accreditation Unit Supervisor

Laboratory ID
C605

The Soil Science Society of America
Soils Certification Board

has conferred upon

Daniel P. Nelson, PhD

the designation of

Certified Professional Soil Scientist

By successfully fulfilling the requirements, passing a rigorous examination, subscribing to the Certified Professional Soil Scientist Code of Ethics and committing to ongoing professional development.

Certification effective from
1/1/2019 to **12/31/2020**

Certification Number: **03231**

CPSS
Certified Professional
Soil Scientist

SSSA President

Soils Certification Board Chair

SVZ-USA, INC.

OTHELLO, WASHINGTON

LAND TREATMENT REPORT FOR 2021
& CROP MANAGEMENT PLAN FOR 2022

Washington State DOE Discharge Permit No. ST8077

prepared by
Dan Nelson, PhD, CPSS
Kyle Bair, PhD, CPSS
Soiltest Farm Consultants, Inc.
2925 Driggs Drive
Moses Lake, WA 98837

12 May 2022

1. INTRODUCTION

The SVZ-USA Inc. processing plant in Othello, Washington, produces fruit and vegetable juice concentrates and purees from fresh and frozen produce. The wastewater produced from the process is treated by a combination of land application and discharge to the City of Othello publicly owned wastewater treatment facility. This crop management plan was developed to meet Washington State D.O.E. permit ST-8077 requirements for that portion of the wastewater treated by land application. Specific information included was obtained through site visits by Soiltest staff, and by verbal and written information obtained from SVZ staff and the farm operator.

The goal of land application of wastewater is to match the application of the waste constituents to the uptake or consumption of the constituents by crops, soil micro-organisms and natural chemical precipitation or adsorption processes of the soil to which it is applied. Managing applications requires first, measuring the application to the land of wastewater and other constituents and, second, measuring the constituent removal rate by the crops which are grown. The net loading rates are calculated as the difference between additions and removals. Some estimation is involved in calculating applications and removals. The inactivation rate of constituents by internal soil processes is not precisely known for most conditions. Consequently, periodic soil testing is used to monitor concentrations of wastewater constituents in the soil through time to determine whether labile concentrations are increasing or decreasing. Estimates can then be made regarding the likelihood of deleterious effects on soil properties or potential negative impacts. Monitor wells are used to further evaluate impacts on ground water due to the application of wastewater.

Typically, a few key constituents can be identified and used for these calculations. The constituents of concern with the effluent generated by the SVZ-USA plant in Othello are nitrogen (N), water, sodium (Na), biological oxygen demand (BOD) and total salts (specifically fixed dissolved solids, FDS). These constituents are the most likely to cause soil, environmental, or plant growth problems. SVZ has made an agreement with the City of Othello to treat a portion of the wastewater generated by SVZ to increase capacity and reduce field loading rates. A small portion of the waste stream was initially treated by Othello in 2016, more in 2017 and all of the wastewater was treated by the Othello POTW in 2018. In 2021 approximately 84% of the wastewater produced was land applied (Figure 4).

1.1 Treatment System

The water management system at SVZ Foods consists of a lined reservoir capable of holding approximately 7.7 million gallons (MG) of plant effluent in its two chambers. A large chamber on the north end holds 7.0 MG and a small chamber equipped with aerators on the south end holds the balance. The effluent in the large chamber is connected by a control valve to a wet well where a pump is situated to pressurize the wheel-line sprinkler systems of the land application fields or to discharge to the City of Othello. Fresh water from the East Columbia Irrigation District can be admitted by means of a control valve into the wet well if supplemental water is needed for the crop. The supplemental water is not blended with the process water at the wet well as the valve controls are set to only admit 100% wastewater or 100% Irrigation District water.

Two fields make up the land treatment site. At the beginning of 2021, three half-circle, center pivot irrigation systems were installed in the two fields (Figure 1). Field 1 lies immediately east of the SVZ facility and encompasses 15.9 acres comprised of two half pivots, Circle 1 (8.6 acres) and Circle 2 (7.3 acres). Field 3 lies east of the lagoon and north of Field 1; it comprises Circle 3 (16.7 acres). Fields 1 and 3 were seeded to alfalfa hay in the spring of 2021. A third field, Field 2, comprises 2.5 acres and is left to native grasses and weeds. It can be watered with a solid set sprinkler system; however, the sprinkler system is in disrepair and the site has only been used for equipment storage. The soil at Field 2 is generally quite shallow, barely one foot in depth. Because of its small size and shallow soil, Field 2 has never been utilized for land treatment by SVZ.

1.2 Irrigation Efficiency and Uniformity

The fraction of pumped irrigation water that enters and stays in the root zone of the growing crop is the application efficiency, sometimes called system uniformity. The typical application efficiency for sprinkler irrigation ranges from 60% to 95%[1] depending on system type, design, maintenance, weather, and run-off conditions. On average, center pivot systems operate at approximately 75%-85% overall efficiency, much more efficient than the wheel line systems previously used. Because the system is brand new and the land treatment site is nearly level and no runoff typically occurs, an efficiency factor of 85% is estimated to be appropriate for the center pivot systems installed on Fields 1 and 3.

1.3 Irrigation Timing

The application of irrigation water is based upon crop need and soil storage. Crop water use or evapotranspiration (ET) is a function of the crop, the growth stage and prevailing weather conditions. Soil moisture storage is dependent upon the texture, structure, organic matter content, coarse fragment content, and depth of the soil. Specific crop water consumption is calculated in Table 1 for conditions in 2021.

The basic premise of irrigation frequency is to irrigate before the crop experiences water stress. When crop water use has depleted the available water to approximately 60% in the root zone, an irrigation should be initiated to minimize crop stress. To avoid excessive application, the amount of water applied in any irrigation should be limited to the amount of the available water holding capacity not already filled (i.e., 40% of water holding capacity).

In 2012, a consultant was hired to assist with irrigation timing. Irrigations were planned using dielectric soil moisture probes connected to data loggers and automatic rain gages in conjunction with ET data obtained from the WSU-Othello Experiment Station. In 2015, the loggers were updated to enable connection to a website where soil moisture, rain gage output and temperatures can be viewed in real-time. Reports

[1]USDA, NRCS. National Engineering Handbook, Irrigation Guide. 1997.

are generated with suggested irrigation times and amounts (Figures 2A & 2B).

FIGURE 1: MAP OF SVZ-USA LAND TREATMENT SITE

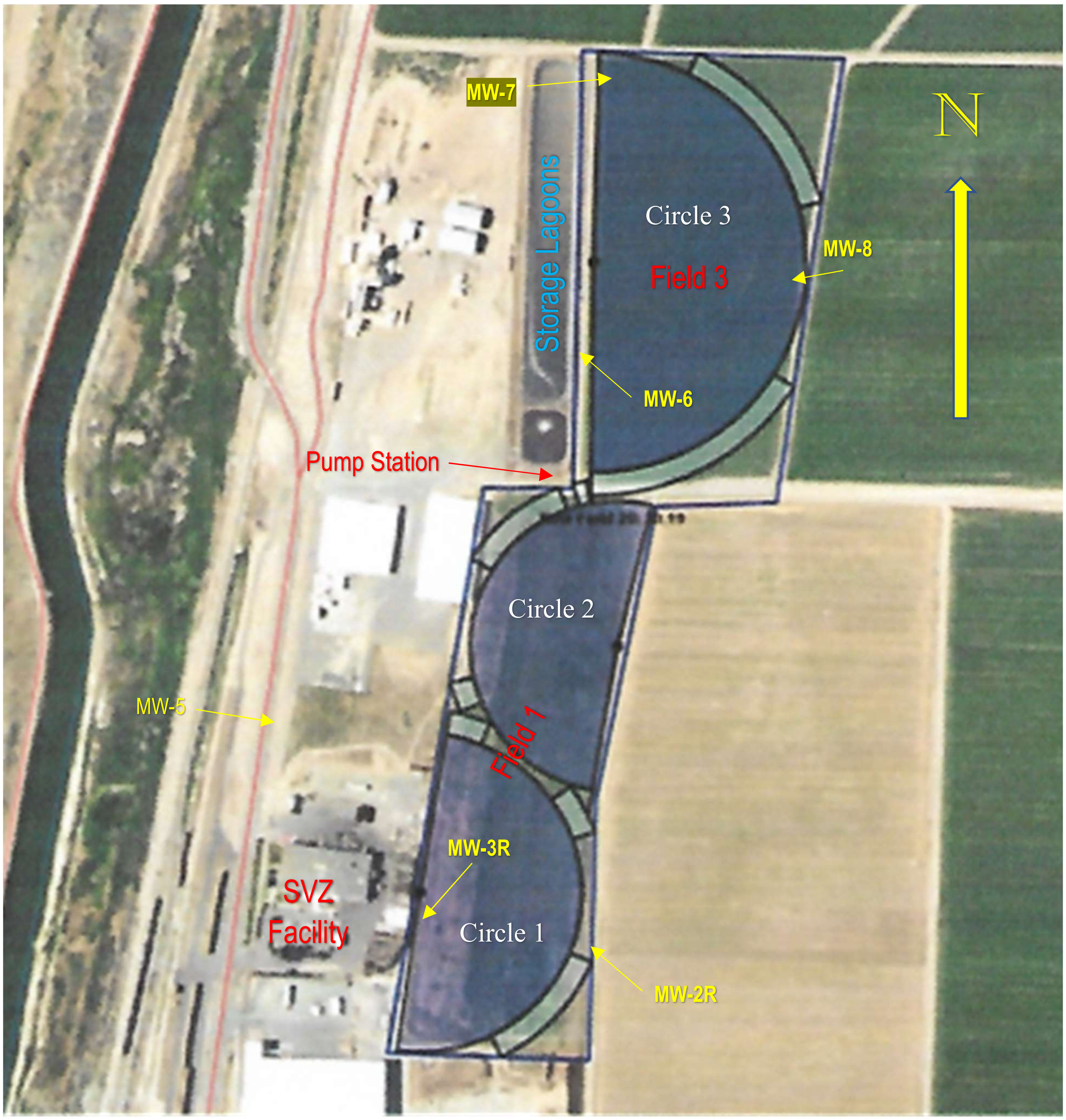

FIGURE 2A: EXAMPLE IRRIGATION MANAGEMENT REPORT FOR FIELD 1

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Irrigation Summary & Recommendation

SVZ
ALFALFA
Field 1 S

Rooting Depth		24 Inches
GPM:	260	
Acres:	30	

Soil Type & Water Holding Capacity

Soil Depth, in.	4	12	24	36
AWHC, in/increment	0.80	1.60	2.30	2.40

0.39 inches/24 hrs @ 85% Efficiency
2.5 hours @ 100%

Weekly Reporting

DATE	WATER USE, INCHES Last Week	Next Week	APPLIED INCHES	% of field capacity 4"	12"	24"	MOISTURE GOAL	RECOMMENDATION SYSTEM	INCHES	HRS.	REVS	%	Rain Only
5-Oct	0.00	0.00	0.00	186%	121%	57%	85%	9-00	0.00	0	0	0	0.00

CUMLATIVE:	4.04		10.17
		Rainfall:	2.03
		Irrigation:	8.14

2021 Report

Run 0 *sets @* 24 *hrs each* *and* 0 *sets @* 16 *hrs each* *and* 0 *sets@* 8 *hrs each*

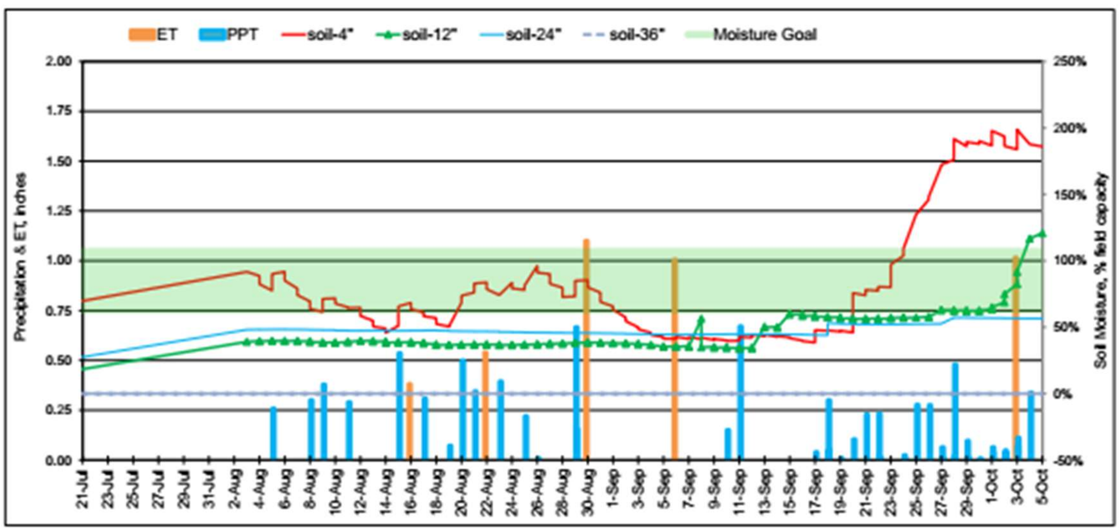


FIGURE 2B: EXAMPLE IRRIGATION MANAGEMENT REPORT FOR FIELD 3

soiltest
farm consultants, inc.
2925 Driggs Dr., Moses Lake, Wa 98837 - www.soiltestlab.com
Office: (509)765-1622 - Fax:(509)765-0314 - (800)764-1622

Irrigation Summary & Recommendation

SVZ
ALFALFA
Field North 3 N
Rooting Depth 24 Inches
GPM: 300
Acres: 15

Soil Type & Water Holding Capacity

Soil Depth, in.	4	12	24	36
AWHC, in/increment	0.80	1.60	2.30	2.40

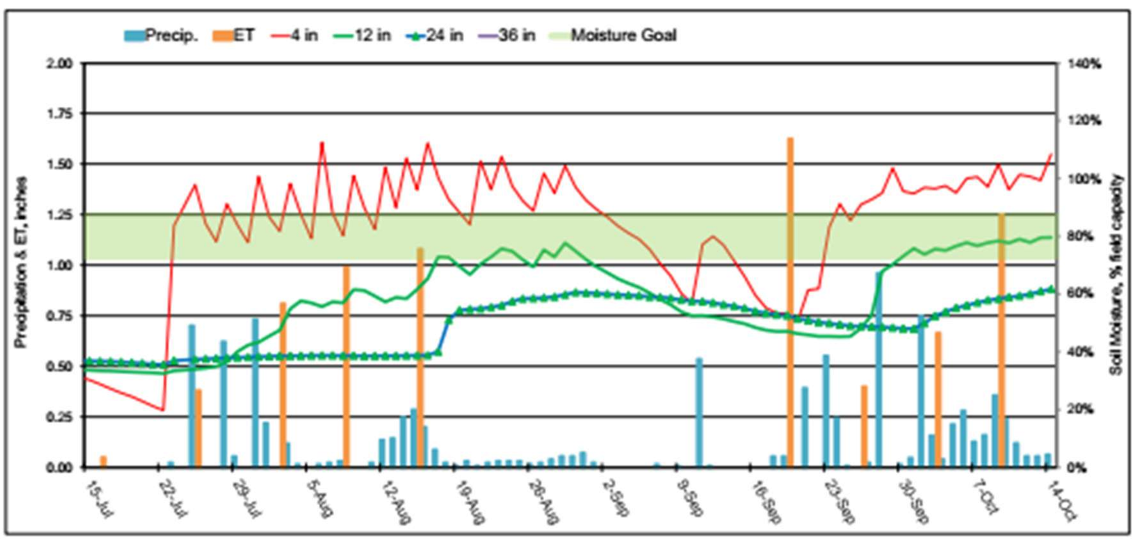
0.90 inches/24 hrs @ 85% Efficiency
6.5 hours @ 100%

Weekly Reporting

DATE	WATER USE, INCHES Last Week	WATER USE, INCHES Next Week	APPLIED INCHES	% of field capacity 4"	% of field capacity 12"	% of field capacity 24"	MOISTURE GOAL	RECOMMENDATION SYSTEM	RECOMMENDATION INCHES	RECOMMENDATION HRS.	RECOMMENDATION REVS	RECOMMENDATION %	Rain Only
14-Oct	0.00	0.00	0.00	108%	80%	62%	80%	9-00	0.20	5	6	732	0.00
CUMLATIVE:	7.51		11.74										
		Rainfall:	2.18										
		Irrigation:	9.56										

2021 Report

Run 4 *sets @* 24 *hrs each* *and* 0 *sets @* 16 *hrs each* *and* -11 *sets@* 8 *hrs each*



2. SOIL FACTORS

The physical and chemical characteristics of the soil determine the suitability of the site for land treatment purposes. Of primary concern is the suitability of the site for crop production. Specific soil properties determine the management strategies to be employed during the land treatment process.

Field 1 of the SVZ, Othello site is well suited for crop production and land treatment uses. The slope is nearly level. The nearest surface water is the Potholes Canal of the Columbia Basin Irrigation District. The shallow lakes of the Potholes area are located approximately one mile north and west of the site. Ground water is not found near enough to the surface to interfere with cropping activities. Soil drainage is good, neither excessive nor poor. No areas of salt accumulation or other undesirable chemical characteristics are naturally found. Soil depth to cobbly substratum is a bit shallow in places for root crops, but adequate for forage and grain crops. Yields of production crops at the site have been near Columbia Basin averages. Although Field 2 has never been used for wastewater treatment, forage crops could be grown. The shallow soil of Field 2 will limit the productive capacity of the field and will also require careful water management to avoid excessive leaching or ponding at the site. The soil of Field 3 is like that of Field 1 only it grades to deeper soil as it progresses northward. Although still too rocky for root crop production, Field 3 has a higher yield potential than Field 1 due to greater soil depths. The discharge permit requests soil monitoring to a depth of 6 feet. Cobbles and large gravel cause auger refusal often at depths of 2 ft in Fields 1 and 3. Occasionally, a site is sampled where the auger passes between stones and can penetrate deeper.

2.1 Infiltration Rates and Water Holding Capacity

The soil at the land treatment site is predominantly Scooteney loam. The water infiltration rate ranges from 0.8 to 2.5 inches per hour. The available water holding capacity of the loam soils at the land treatment site are approximately 2.0 inches of water per foot of topsoil and approximately 1.0 inch per foot for the cobbly and gravelly subsoil.[2] Site investigations have revealed the depth to cobbly subsoil ranges from 12 to 30 inches, with the soil depth greatest at the northeast edge of the area. The irrigations are managed for a depth of 24 inches as that is the maximum average soil depth of the two functioning fields.

2.2 Compaction and Puddling Potential

The soils at the land treatment site have loam and gravelly loam textures. In addition, the soils have low to moderate organic matter and low clay content. Consequently, the soils have a moderately strong soil structure and tend not to compact easily. Compaction can be ameliorated by minimizing traffic, eliminating traffic during wet periods, and by maintaining a perennial crop to maximize root structure.

Generally, sodium becomes problematic when the exchangeable sodium

[2] Soil Survey of Adams County Washington. USDA SCS. 1967.

percentage (ESP) reaches 15%. The soil at the land treatment site contains sufficient clay and has moderate enough slopes that 15% is the appropriate limit. This level of sodium should not be exceeded in the surface soils at the SVZ land application site to avoid possible infiltration problems. Elevated soil salinity can facilitate infiltration when the ESP is greater than 15%; however, excessively high salinity levels can impede crop production. Should sodium approach problematic levels in the surface soils, gypsum (calcium sulfate) can be applied to improve soil structure. Controlled leaching events should be planned to remove excess sodium from the surface horizon of the soil.

2.3 Soil Monitoring

The soils of the treatment fields have been monitored for many years. The permit guidelines require that the fields be sampled to a depth of 6 feet twice each year: once prior to the initiation of crop growth in the spring and again in the fall after the last harvest is completed. Field 2 has not been sampled for several years because equipment has been stored on the site which precluded access to some of the monitoring locations. The site has only been used for equipment storage and no plans exist to grow crops on the site or to apply process wastewater on Field 2; it was decided skip monitoring the soil of the field entirely. In 2007 soil monitoring was initiated on Field 3, which was added to the treatment system. Although the soil column extends to a depth of 6 feet, the rocky and gravelly nature of the soil inhibits auger penetration to that depth most of the time. By happenstance a sampling site will be chosen that allows the auger to slip between the rocks and reach a depth greater than 2 feet. This occurred once in 2017 in Field 1. A sampling depth of 6 feet was achieved at one location in Field 3 only four times since 2007. In 2021, sampling depths of only 2 feet were achieved in Fields 1 and 3.

The soil test reports from 2021 are included in the Appendix. Graphical summaries of all constituents can be found in Figure 3. In addition to the constituents charted in Figure 3, each soil sample is checked for the presence of ferrous iron using a dipyridyl reagent in the field. All soil samples at all sampling events tested negative for the presence of ferrous iron in 2021. No positive test for ferrous iron has been obtained since monitoring began in 2012. A brief discussion of significant soil trends is provided below.

Soil nitrate levels at the surface have been typically cyclical in nature. Field 2 monitoring ended in 2012 when 1-ft soil nitrate was at an all-time high for unknown reasons (this field was never utilized). Nitrate in Field 1 has been low and stable for the last 3 years. Soil nitrate in Field 3 has been low and stable since shortly after it's addition to the treatment system in 2007; however, in 2021, nitrate at 1- and 2- foot depths increased dramatically. Soil nitrate concentration is affected by the addition of fertilizer, irrigation and crop growth. If a crop does not grow well and is not harvested, nitrate will accumulate. No harvests were made in 2020, so an accumulation of soil nitrate would be expected. Field 1 was replanted several times over the years. The minimal crop growth during replanting cannot remove all the nitrogen mineralized from the organic matter and is the likely cause of the spikes in nitrate. The establishment of a stable crop will usually result in minimal residual soil nitrogen. It is anticipated that with the newly planted alfalfa in 2021 and the new irrigation systems in place, normal crop growth and harvests will result in soil nitrate levels remaining low as seen historically in Field 3.

Soil salinity is monitored by measuring the electrical conductivity (EC) of the soil solution. EC levels below approximately 4 mmho/cm will not injure or reduce yields of most crops: until 2020, the EC of all fields were well below this threshold. The EC of only Field 3 spiked in the spring of 2021. It is likely that the lack of irrigation and crop growth in 2020 resulted in salt accumulation. It is unclear why Field 1 did not display similar responses.

Sodium is monitored by extractable sodium and by the exchangeable sodium percentage (ESP, which is the extractable sodium divided by the cation exchange capacity, CEC). ESP is of greatest concern at the surface layer of the soil where it can impact water infiltration. ESP in Fields 1 and 3 have historically exceeded the critical level of 15% at various times and at both depths monitored (Fig. 3): Field 1 has a slightly declining trend for ESP, especially over the last two years. Field 3 has had no real trend but spiked significantly in 2020; most likely due again to insufficient irrigation and lack of harvest in 2020. In 2021, ESP in Field 3 declined from the 2020 highs. Gypsum has been applied periodically to manage ESP and maintain adequate water infiltration rates. A portion of the wastewater has been sent to the City of Othello since 2016. The combination of gypsum applications and declining wastewater loading since 2016 have resulted in the improving ESP and salinity conditions of the soils through 2019. A gypsum application of approximately 1.4 tons/ac are recommended for 2022.

The levels of other cations (Ca, Mg, K) and sulfate-S in the soil show no trends and are found at normal levels. The soil total nitrogen values (also called Total Kjeldahl Nitrogen or TKN) for Fields 1 and 3 demonstrate a slightly increasing trend. Total phosphorus (Total P) in Fields 1 and 3 appears to demonstrate no trend. Soil organic matter (OM) is fairly consistent; the concentration seems to be increasing in Field 3 the last few years. It is desirable to have a high OM level in the soil as it improves structure, water and gas infiltration, microbial activity and acts to store plant nutrients.

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3. CROP WATER MANAGEMENT

A balance sheet approach is used for water management analysis in this report. The inputs are identified and quantified. Losses or consumption are quantified and subtracted from the additions. The water balance is calculated and discussed in relation to leaching requirements and crop health and production.

3.1 Crop Water Use and Irrigation Requirement

Alfalfa hay was seeded into Fields 1 and 3 in the spring of 2021. The 2021 monthly and annual water consumption for alfalfa hay for each of the circles can be found in Table 2. Precipitation is subtracted from ET to calculate the Rainfall Balance. Excess precipitation is carried over into the subsequent month to reflect soil storage. The irrigation requirement is calculated from the rainfall balance using a net system

FIGURE 3: SUMMARY OF SOIL TEST MONITORING

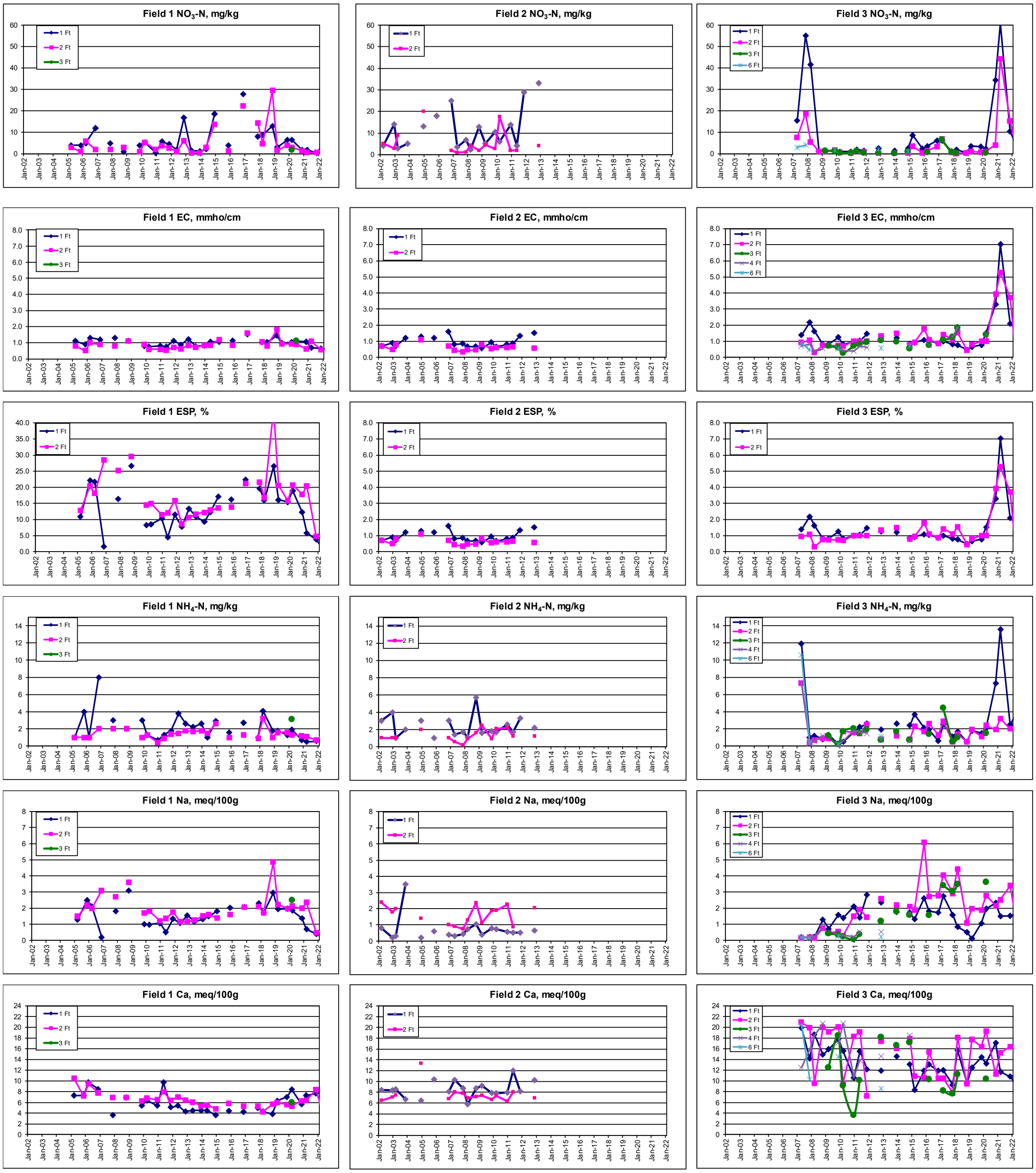


FIGURE 3: SUMMARY OF SOIL TEST MONITORING (CONTINUED)

application efficiency of 85%. This efficiency may adequately cover some of the needed leaching requirements; however, soil test data will be used to determine the need for additional planned leaching events. In a typical season, alfalfa may utilize 42 inches of water and require 50 inches of irrigation water. The summer weather of 2021 was quite hot and dry: total annual rainfall was 4.0 inches; consumptive water use was approximately 42.1 inches. The water requirement was reduced somewhat by the newly seeded alfalfa crop; the irrigation requirement was approximately 48.0 inches. Figures 2A & B demonstrate the irrigation management reports showing the generally dryer condition in Field 3.

3.2 Water Balance

In 2021, the total wastewater flow from the SVZ processing facility to the lagoon was 33.17 MG (Table 1A), very similar to last year. Approximately 27.76 MG of wastewater was pumped from the lagoon and land applied, half again as much as last year. The balance of the wastewater pumped into the lagoon (approximately 4.81 MG) was sent to the City of Othello for treatment (see Figure 4). Flow meter data show that 14.05 MG of fresh water was applied to the fields in 2021, three times that applied last year. Flow meters are placed to measure all water applied to each field, but not each circle. Estimates were made based on acreage covered to split the water sent to Field 1 between Circle1 and Circle 2.

The water balances for each circle are calculated in Table 2. It is estimated in that the alfalfa in Field 1 potentially transpired 42.1 inches of water and that the irrigation requirement was 48.0 inches. Approximately 40.3 inches of water (56% process wastewater) were applied to Circle 1. An additional 4.0 inches of rainfall were received. The water balance indicates that the field was under-irrigated by 7.7 inches (negative balance). The water balance was positive only during the months of April and October. Deficit irrigation was practiced the remaining 6 months of the irrigation season. The hydraulic loading for Circle 2 was 43.4 inches and the ratio of wastewater was 52%, similar to that for Field 1: the irrigation deficit was 4.6 inches for the year. Only April and October had positive water balances.

The hydraulic loading for Circle 3 was 28.7 inches and the ratio of wastewater was 63%. The irrigation deficit was 19.2 inches for the year. October was the only month with a significant positive water balance.

The leaching requirement is estimated to be 6% as calculated from the water quality parameters in Tables 1A and 1B and an average mix of 57% wastewater. The leaching requirement is the same for both fields as they receive water from the same sources at nearly the same ratios; further, they are planted to the same crop and the soil is substantially consistent across both fields. The maximum desirable saturated paste EC for both fields was set at 3.5 mmho/cm for the calculation. As the EC of neither the supplemental water nor the wastewater is measured, it was estimated using a commonly used general relationship: EC=TDS/640. Since we generally are concerned with FDS in vegetable wastewater, the same formula was applied using FDS rather than TDS. As indicated in Table 2, wastewater made up 64% of the water applied to each field on average. The weighted average EC for all the rain and irrigation water applied to the field is then 1.0 mmho/cm. The Leaching Requirement is

FIGURE 4: SVZ WASTEWATER PRODUCTION

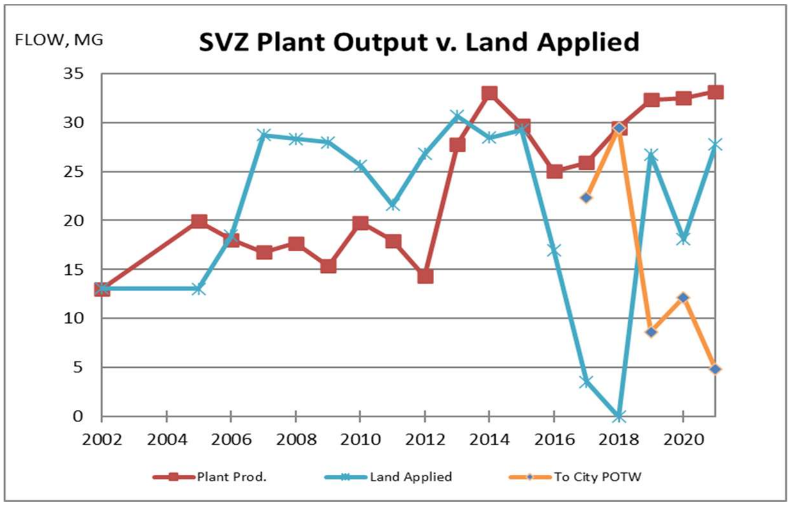


TABLE 1A: WASTEWATER PRODUCTION AND LAND APPLICATION TOTALS

	PLANT PROCESS WATER PRODUCTION		IRRIGATION WASTEWATER								
			AVERAGE MONTHLY ANALYSES, mg/L							LAND-APPLIED	
MONTH	MG	Ac-Ft	TKN	BOD	COD	sBOD	FDS	Na	NH4-N	MG	Ac-Ft
JAN	1.848	5.671								0.000	0.00
FEB	2.103	6.455								0.000	0.00
MAR	2.620	8.040	24	606	1,335	507	1,105		0.6	0.479	1.47
APR	2.533	7.773	21	735	1,400	615	1,270		3.2	8.533	26.19
MAY	3.120	9.574	29	531	1,056	414	1,227		2.4	3.120	9.57
JUN	4.037	12.388	38	327	713	213	1,185	386	1.5	4.037	12.39
JUL	3.014	9.249	36	78	295	77	1,299		17.6	3.014	9.25
AUG	2.889	8.867	25	78	297	75	1,216		9.1	2.889	8.87
SEP	2.898	8.893	14	77	299	72	1,133		0.6	2.898	8.89
OCT	2.795	8.577	8	77	328	42	1,050	305	0.4	2.795	8.58
NOV	3.096	9.500								0.000	0.00
DEC	2.222	6.818								0.000	0.00
AVG	2.764	8.484	24	313	715	252	1,186	345	4.4	2.314	7.100
			TOTAL LAND APPLIED, LBS								
TOTAL	33.173	101.81	5,660	86,998	185,871	70,147	280,406	80,387	1,027	27.764	85.204

Notes: Plant wastewater was used for irrigation all season; in addition, supplemental irrigation district water was also applied.

Potential Evaporation Loss	
3.157	Mgal

TABLE 1B: SUPPLEMENTAL WATER TOTALS

	units	result	MGal Applied		Total Pounds Applied
NITRATE-N	mg/L	**0.04**			
TKN	mg/L	**0.30**			
NITROGEN	mg/L	**0.3**	**14.05**	**Nitrogen**	**39.8**
TDS (salts)	mg/L	**117**		**TDS**	**13712**
Sodium (Na)	mg/L	**0.1**		**Sodium**	**12**

TABLE 2: HYDRAULIC LOADING SUMMARY

CIRCLE 1 (S)

MONTH	Consump-tive Use ac-in/ac	Precip-itation ac-in/ac	Rainfall Balance ac-in/ac	Irrigation Req't at 85% Efficiency ac-in/ac	Irrigation Process ac-in/ac	Irrigation Fresh ac-in/ac	Irrigation Total ac-in/ac	Balance w/Precip. ac-in/ac
JAN	0.19	0.97	0.8	0.0	0.0	0.0	0.0	-1.0
FEB	0.40	0.17	-0.2	0.0	0.0	0.0	0.0	-0.2
MAR	0.81	0.08	-0.7	1.0	0.4	0.4	0.7	-0.3
APR	1.99	0.03	-2.0	2.3	8.9	1.8	10.7	8.3
MAY	5.57	0.00	-5.6	6.5	2.4	2.2	4.6	-1.9
JUN	8.96	0.05	-8.9	10.5	2.8	3.5	6.3	-4.3
JUL	8.96	0.00	-9.0	10.5	2.1	2.6	4.7	-5.8
AUG	7.08	0.00	-7.1	8.3	2.0	2.5	4.5	-3.9
SEP	5.26	0.41	-4.8	6.2	2.1	2.3	4.4	-2.2
OCT	2.17	0.68	-1.5	2.5	1.9	2.5	4.4	1.2
NOV	0.43	1.38	1.0	0.0	0.0	0.0	0.0	-1.4
DEC	0.28	0.21	-0.1	0.0	0.0	0.0	0.0	-0.2
YEAR	**42.08**	**3.98**	**-38.1**	**48.0**	**22.6**	**17.7**	**40.3**	**-7.7**

Total Hydraulic Load, in.	**40.3**	**2019 Load**	**42.0**	**18.0" wastewater in plan from 2020**
Hydraulic Load Limit, in.	**30.0**	**% Change**	**-4%**	**30% over planned**
% of Limit ac-ft/ac	**134%**		**Process, % of Total**	**56%**
% of Irrig Reqirement	**84%**		**Leaching Fraction as-applied**	**-16.1%**
			Calculated Leaching Requirement	**6.1%**

CIRCLE 2 (Mid)

MONTH	Consump-tive Use ac-in/ac	Precip-itation ac-in/ac	Rainfall Balance ac-in/ac	Irrigation Req't at 85% ac-in/ac	Irrigation Process ac-in/ac	Water Fresh ac-in/ac	Loading Total ac-in/ac	Balance ac-in/ac
JAN	0.19	0.97	0.8	0.0	0.0	0.0	0.0	-1.0
FEB	0.40	0.17	-0.2	0.0	0.0	0.0	0.0	-0.2
MAR	0.81	0.08	-0.7	1.0	0.4	0.4	0.8	-0.2
APR	1.99	0.03	-2.0	2.3	8.9	2.1	11.0	8.6
MAY	5.57	0.00	-5.6	6.5	2.4	2.6	5.0	-1.5
JUN	8.96	0.05	-8.9	10.5	2.8	4.1	6.9	-3.7
JUL	8.96	0.00	-9.0	10.5	2.1	3.1	5.2	-5.4
AUG	7.08	0.00	-7.1	8.3	2.0	2.9	4.9	-3.4
SEP	5.26	0.41	-4.8	6.2	2.1	2.7	4.8	-1.8
OCT	2.17	0.68	-1.5	2.5	1.9	2.9	4.8	1.6
NOV	0.43	1.38	1.0	0.0	0.0	0.0	0.0	-1.4
DEC	0.28	0.21	-0.1	0.0	0.0	0.0	0.0	-0.2
YEAR	**42.08**	**3.98**	**-38.1**	**48.0**	**22.6**	**20.8**	**43.4**	**-4.6**

Total Hydraulic Load	**43.4**	**2019 Load**	**31.9**	**18.0" wastewater in plan from 2020**
Hydraulic Load Limit	**30.0**	**% Change**	**36%**	**12% over planned**
% of Limit ac-ft/ac	**145%**		**Process, % of Total**	**52%**
% of Irrig Reqirement	**90%**		**Leaching Fraction as-applied**	**-9.5%**
			Calculated Leaching Requirement	**6.1%**

CIRCLE 3 (N)

MONTH	Consump-tive Use ac-in/ac	Precip-itation ac-in/ac	Rainfall Balance ac-in/ac	Irrigation Req't at 85% ac-in/ac	Irrigation Process ac-in/ac	Water Fresh ac-in/ac	Loading Total ac-in/ac	Balance ac-in/ac
JAN	0.19	0.97	0.8	0.0	0.0	0.0	0.0	-1.0
FEB	0.40	0.17	-0.2	0.0	0.0	0.0	0.0	-0.2
MAR	0.81	0.08	-0.7	1.0	0.4	0.0	0.4	-0.7
APR	1.99	0.03	-2.0	2.3	1.8	0.6	2.4	0.1
MAY	5.57	0.00	-5.6	6.5	2.2	0.4	2.7	-3.9
JUN	8.96	0.05	-8.9	10.5	3.6	5.2	8.8	-1.8
JUL	8.96	0.00	-9.0	10.5	2.7	1.5	4.2	-6.3
AUG	7.08	0.00	-7.1	8.3	2.5	0.8	3.3	-5.0
SEP	5.26	0.41	-4.8	6.2	2.4	0.0	2.4	-4.2
OCT	2.17	0.68	-1.5	2.5	2.6	2.0	4.6	1.3
NOV	0.43	1.38	1.0	0.0	0.0	0.0	0.0	-1.4
DEC	0.28	0.21	-0.1	0.0	0.0	0.0	0.0	-0.2
YEAR	**42.08**	**3.98**	**-38.1**	**48.0**	**18.2**	**10.5**	**28.7**	**-19.2**

Total Hydraulic Load	**28.7**	**2019 Load**	**31.9**	**18.0" wastewater in plan from 2020**
Hydraulic Load Limit	**30.0**	**% Change**	**-10%**	**12% over planned**
% of Limit ac-ft/ac	**96%**		**Process, % of Total**	**63%**
% of Irrig Reqirement	**60%**		**Leaching Fraction as-applied**	**-40.1%**
			Calculated Leaching Requirement	**6.1%**

(ET and Precip. data from AgWeatherNet Othello) calculated by the following relationship:

LR= ECw / [(5xECw) – ECe], where LR is Leaching Requirement; ECw is the EC of the average water applied; ECe is the maximum allowable EC of the soil solution. Inserting the values calculated above, yields a LR of 6.1%.

The 2021 leaching requirement is somewhat more than 2019 because more wastewater was used for irrigated in 2021.

4. NUTRIENT MANAGEMENT

A balance sheet approach is used for nutrient management analysis in this report, like the method used for water management. The inputs are identified and quantified. Losses and removals are also identified, quantified and compared to projections from last year. Finally, a balance is calculated and discussed in comparison to soil test results.

4.1 Constituent Additions

Significant amounts of wastewater were applied to both of the treatment fields (all three circles) in 2021 (Table 2); thus, the nutrients and salts included in the wastewater were also applied (Table 1A). The nitrogen and salts contained in the supplemental fresh water added little to the loadings (Table 1B). No commercial fertilizer applications were made.

Gross nitrogen additions from wastewater were 245 lbs-N/ac to Circle 1, 245 lbs-N/ac to Circle 2, and 105 lbs-N/ac to Circle 3. The N loading to Circles 1 and 2 exceeded the design N loading of 165 lbs-N/ac. Fresh water nitrogen additions were negligible at approximately 1 lbs-N/ac. Salt additions from wastewater were 12,153 lbs/ac (35 lbs/ac-day) to Circles 1 and 2, and 5,220 lbs/ac (15 lbs/ac-day) to Circle 3. all values were exceeded the 4,000 lbs/ac-yr or 11 lbs/ac-day design maximum. Salt loading from supplemental water was approximately 500 lbs/ac. Negligible sodium loading was derived from the supplemental water; however, wastewater added 3,484 lbs-Na/ac to Circles 1 and 2, and 1,496 lbs/ac to Field 3. Circles 1 and 2 received 3,771 lbs/ac (15 lbs/ac-day) of BOD from wastewater and Circle 3 received 1,620 lbs/ac (7 lbs/ac-day). All BOD loading values are well below the 100 lbs/ac-day design maximum. Loading trends are plotted in Figure 5.

4.2 Constituent Losses and Harvest Removals

Nitrogen loss from denitrification and volatilization can result in relatively low uptake efficiencies under fertigation with wastewater containing high BOD. No losses are deducted in Table 1A or 1B, but in calculating the total loading in Table 4 the sums were adjusted by the following nitrogen use efficiencies: 75% of the wastewater-N and 85% of the fresh water-N and fertilizer-N were carried into the total (Allison, F.E. 1965. *Evaluation of Incoming and Outgoing Processes That Affect Soil Nitrogen*, in Soil Nitrogen. Agronomy Monograph 10, Bartholomew, W.V. & Clark, Francis E. eds. American Society of Agronomy, Madison, WI).

Table 3 summarizes the harvest removal of selected constituents in the harvested portion of the crop. Only the year-end total harvest data were available. No hay samples were obtained for testing. Therefore, an average hay analysis from an alfalfa field to which vegetable processing wastewater is applied were used to calculate constituent removal.

FIGURE 5: WASTEWATER CONSTITUENTS LAND APPLIED

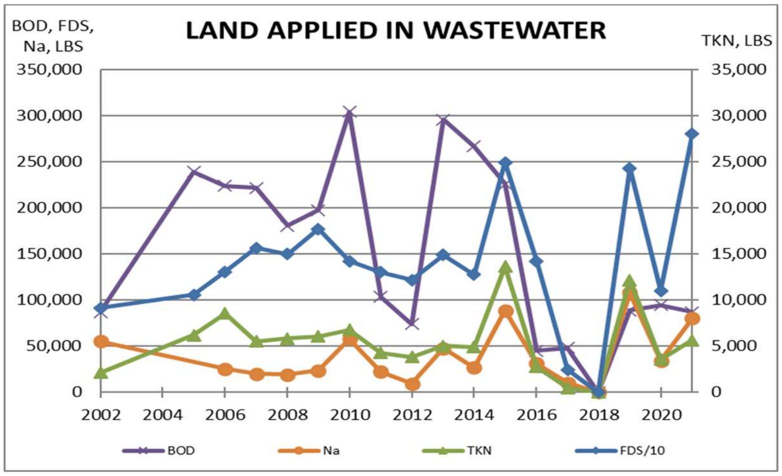


TABLE 3: HARVEST REMOVAL TOTALS

FIELD / DATE	CROP	YIELD, lbs	DM	N	P	Na	Ca	Mg	K	Cl	Ash
			------ %, TOTAL ANALYSIS ------								
CIRCLE 1	8.6 acres										
1st Cutting	Alfalfa										
2nd Cutting	Alfalfa										
3rd Cutting	Alfalfa										
4th Cutting	Alfalfa										
Total	lbs	69,328	92.7%	2.91%	0.40%	0.10%	1.11%	0.26%	2.82%	0.05%	12.5%
	t/ac	4.03									
Net Removal	**lbs/ac**		**7,473**	**218**	**30**	**7**	**83**	**19**	**211**	**3.7**	**934**
CIRCLE 2	7.3 acres										
1st Cutting	Alfalfa										
2nd Cutting	Alfalfa										
3rd Cutting	Alfalfa										
4th Cutting	Alfalfa										
Total	lbs	58,848	92.7%	2.91%	0.40%	0.10%	1.11%	0.26%	2.82%	0.05%	12.5%
	t/ac	4.03									
Net Removal	**lbs/ac**		**7,473**	**218**	**30**	**7**	**83**	**19**	**211**	**3.7**	**934**
CIRCLE 3	16.7 acres										
1st Cutting	Alfalfa										
2nd Cutting	Alfalfa										
3rd Cutting	Alfalfa										
4th Cutting	Alfalfa										
Total	lbs	134,625	92.7%	2.91%	0.40%	0.10%	1.11%	0.26%	2.82%	0.05%	12.5%
	t/ac	4.03									
Net Removal	**lbs/ac**		**7,473**	**218**	**30**	**7**	**83**	**19**	**211**	**3.7**	**934**

Note: Yield data and analyses for individual harvests were not available. Total yield used with analysis from an alfalfa field receiving vegetable processing wastewater used to calculate removal amounts.

4.3 Constituent Balances

The nutrient balances are calculated for all 3 circles in Table 4. In these calculations, it was assumed that 100% of all constituents, except nitrogen as explained above, passed through the conveyance and application system and entered the soil. Positive values in the balance rows in Table 4 indicate an accumulation of constituent in the soil of the land treatment field. Balances in 2021 were much different than 2020 due to the application of more irrigation wastewater this year and no harvest removals last year. Although the N loading rate to Circles 1 and 2 exceeded the design value, the alfalfa crop removed more nitrogen than applied and left a net balance of -32 lbs-N/ac. Similarly, Circle 3 had a balance of -138 lbs-N/ac due to the high removal by the alfalfa crop. Circles 1 and 2 received a net loading of 11,788 lbs/ac of salts and Circle 3 received a net load of 4,565 lbs/ac of salts. More sodium was also applied than removed in harvests: Circles 1 and 2 had a 3,477 lbs/ac balance of sodium and Circle 3 had a 1,489 lbs/ac balance.

Historical nitrogen and salt removals and balances are summarized in Figure 6. Loading in 2021 was up significantly from 2020. Approximately 84% of all wastewater produced in 2021 was land applied. The 2020 management plan recommended applying 14.3 inches of wastewater to the fields in 2021. Wastewater loading to Field 1 was approximately 30% over the 2019 plan and wastewater loading to Field 2 was 12% over that planned.

FIGURE 6: NITROGEN AND SALT REMOVAL & NET APPLICATION

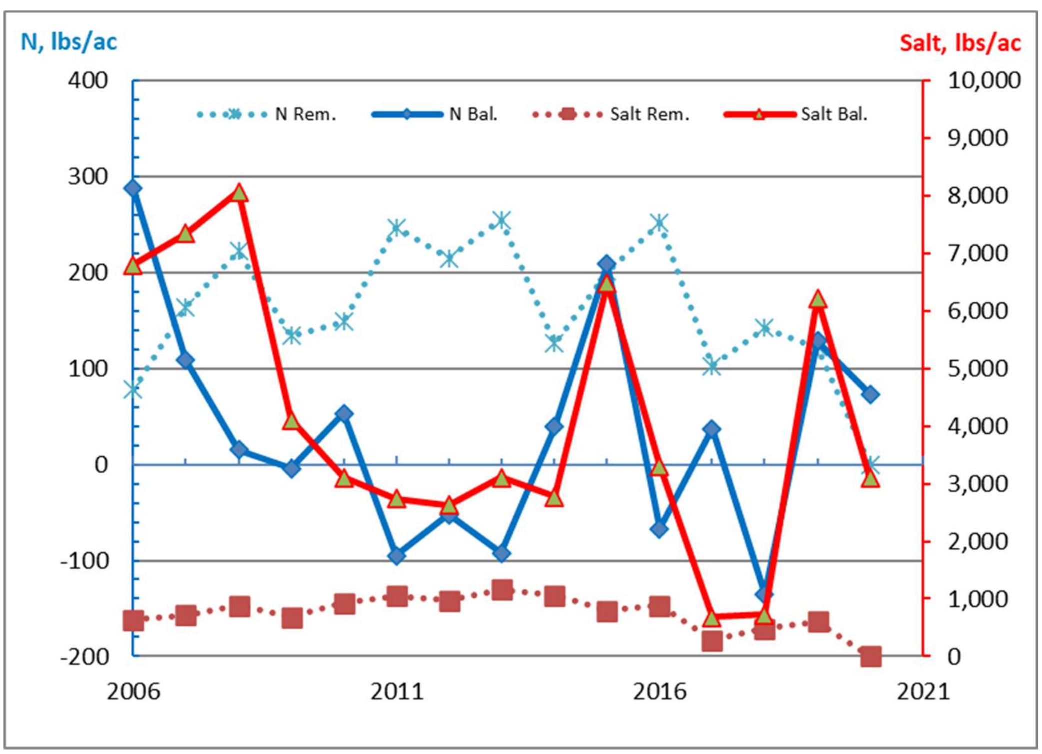


TABLE 4: BALANCE OF CONSTITUENTS LAND APPLIED

CIRCLE 1	8.6 acres							
	N, lbs/ac		Sodium, lbs/ac		FDS or Salt, lbs/ac		BOD, lbs/ac	
Source	2021	2020	2021	2020	2021	2020	2021	2020
Wastewater	245	109	3,484	1,057	12,153	3,372	3,771	2,902
Freshwater	1.7	0.6	0.5	0.1	569	93	0	0
Fertilizer	0	0	0	0	0	0	0	0
SUM^	**185**	83	**3,485**	1,057	**12,722**	3,466	**3,771**	2,902
% difference from last year		**125%**		**230%**		**267%**		**30%**
					35	lbs/ac/day*	**15**	**lbs/ac/day***
Permit Design	**165**	lbs/yr	**N/A**	**N/A**	**11**	lbs/ac/day	**100**	**lbs/ac/day**
% of Design	**112%**	50%	**N/A**	**N/A**	**317%**		**15%**	
Harvested, lbs/ac	**218**	0	**7**	0	**934**	0	**N/A**	**N/A**
Balance, lbs/ac	**-32**	83	**3,477**	1,057	**11,788**	3,466	**N/A**	**N/A**
CIRCLE 2	**7.3 acres**							
Wastewater	245	109	3,484	1,057	12,153	3,372	3,771	2,902
Freshwater	1.7	0.6	0.5	0.1	569	93	0	0
Fertilizer	0	0	0	0	0	0	0	0
SUM^	**185**	83	**3,485**	1,057	**12,722**	3,466	**3,771**	2,902
% difference from last year	**124.5%**			**229.6%**		**267.1%**		**30%**
					35	lbs/ac/day*	**15**	**lbs/ac/day***
Permit Design	**165**	lbs/yr	**N/A**	**N/A**	**11**	lbs/ac/day	**100**	**lbs/ac/day**
% of Design	**112%**	50%	**N/A**	**N/A**	**317%**		**15%**	
Harvested, lbs/ac	**218**	0	**7**	0	**934**	0	**N/A**	**N/A**
Balance, lbs/ac	**-32**	83	**3,477**	1,057	**11,788**	3,466	**N/A**	**N/A**
CIRCLE 3	**16.7 acres**							
Wastewater	105	86	1,496	830	5,220	2,646	1,620	2,277
Freshwater	0.8	0.5	0.2	0.1	279	79	0	0
Fertilizer	0	0	0	0	0	0	0	0
SUM^	**80**	65	**1,497**	830	**5,499**	2,725	**1,620**	2,277
% difference from last year		**22.8%**		**80.3%**		**101.8%**		**-29%**
					15	lbs/ac/day*	**7**	lbs/ac/day*
Permit Design	**165**	lbs/yr	**N/A**	**N/A**	**11**	lbs/ac/day	**100**	**lbs/ac/day**
% of Design	**48%**	39%	**N/A**	**N/A**	**137%**		**7%**	
Harvested, lbs/ac	**218**	0	**7**	0	**934**	0	**N/A**	**N/A**
Balance, lbs/ac	**-138**	65	**1,489**	830	**4,565**	2,725	**N/A**	**N/A**

Notes: ^Sum of Nitrogen was calculated assuming 75% use efficiency of wastewater N and 85% use efficiency of commercial fertilizer N.
* FDS, pounds/acre/day was calculated over 365 days in a year; BOD pounds/ac/day was calculated using the 245 day irrigation season.

5. GROUNDWATER MONITORING

Eight monitor wells have been installed at the land treatment site; the location of each is indicated in Figure 1. Monitor wells 1 through 5 were installed prior to the date SVZ assumed operations of the site. Wells 6 through 8 were installed in the spring of 2008 in preparation for adding Field 3 to the treatment site. Wells 1 and 2 were damaged during fall field work in 2013. These wells were abandoned along with monitor wells 3 and 4 in 2014 when two new wells, 2R and 3R, were installed. The wells are monitored monthly for water level and various physical and chemical parameters as required by permit.

Historical data for nitrate and TDS is reported in Figure 5. The data for the new wells 2R and 3R is appended to that of the original wells 2 and 3 in Figure 5 as they are in approximately the same locations. In the 2012 Fact Sheet Update for State Waste Discharge Permit ST-8077 the background values for groundwater nitrate and TDS for well 2R were modified to 5.62 and 507 mg/L, respectively. The background values for well 8 as determined in the same Fact Sheet were 18.1 mg/l for nitrate-N and 916 mg/l for TDS. The background lines and data trend lines for these two parameters are included in Figure 5.

The Field 1 up-gradient well, MW2/2R demonstrates variations in TDS of approximately 200 mg/l. No overall long-term trend is apparent. TDS levels in MW2/2R have exceeded background levels at various times throughout the record; however, the long-term trend line falls just slightly below the background line. Up-gradient well MW8 in Field 3 demonstrated a steady increase of approximately 300 mg/l from its installation in 2008 until 2012, then decreasing to below original levels by the end of 2017. Since 2017, the trend has been flat and below the 2012 background level.

The down-gradient wells are mixed in their responses over time. TDS in Well 3/3R (down-gradient of Field 1) demonstrates a downward trend but remained approximately 200 mg/L above background in 2021. Well 5 demonstrates no trend and remains approximately 250 mg/L above background with considerable short and long-term variations. Wells 6 and 7 both exhibit long-term increasing TDS over the monitoring period but TDS in both wells has levelled off over the last 3 years. Both wells had near but just below background TDS levels in 2021.

The nitrate levels in Field 1 up-gradient well, MW2, is well above background and exhibits an increasing long-term trend with considerable annual variations. Some very high values were recorded in the winters of 2016, 2017, 2018 and again in 2021. The nitrate level in the Field 3 up-gradient well, MW8, has trended downward but levelled out and begun to increase since 2018. Nitrate levels in 2021 were approximately 10 mg/L below the background level established in 2012.

The nitrate level in the Field 1 down-gradient wells, MW3/3R and MW5, remain above background levels and demonstrate variably increasing trends with wide variations. MW5 had relatively low levels of nitrate in 2018-2020, then jumped to an all-time high of 33 mg/L in July 2021. The reason for these large variations are unclear. . MW3/3R has varied from zero to nearly 30 mg/l at various times with a resultant increasing trend. MW3/3R experienced low nitrate levels in 2018-2020 with a subsequent increase in 2021 similar to MW5 but less dramatic.

The nitrate levels in Field 3 down-gradient wells, MW6 and MW7, demonstrate an overall flat trend but have been increasing the last three years. The nitrate levels in MW6 have stayed below the 2012 background level but nitrate in MW7 exceeded the background level at times in 2021.

FIGURE 5: SUMMARY OF SVZ WELL MONITORING (Field 1 Wells)

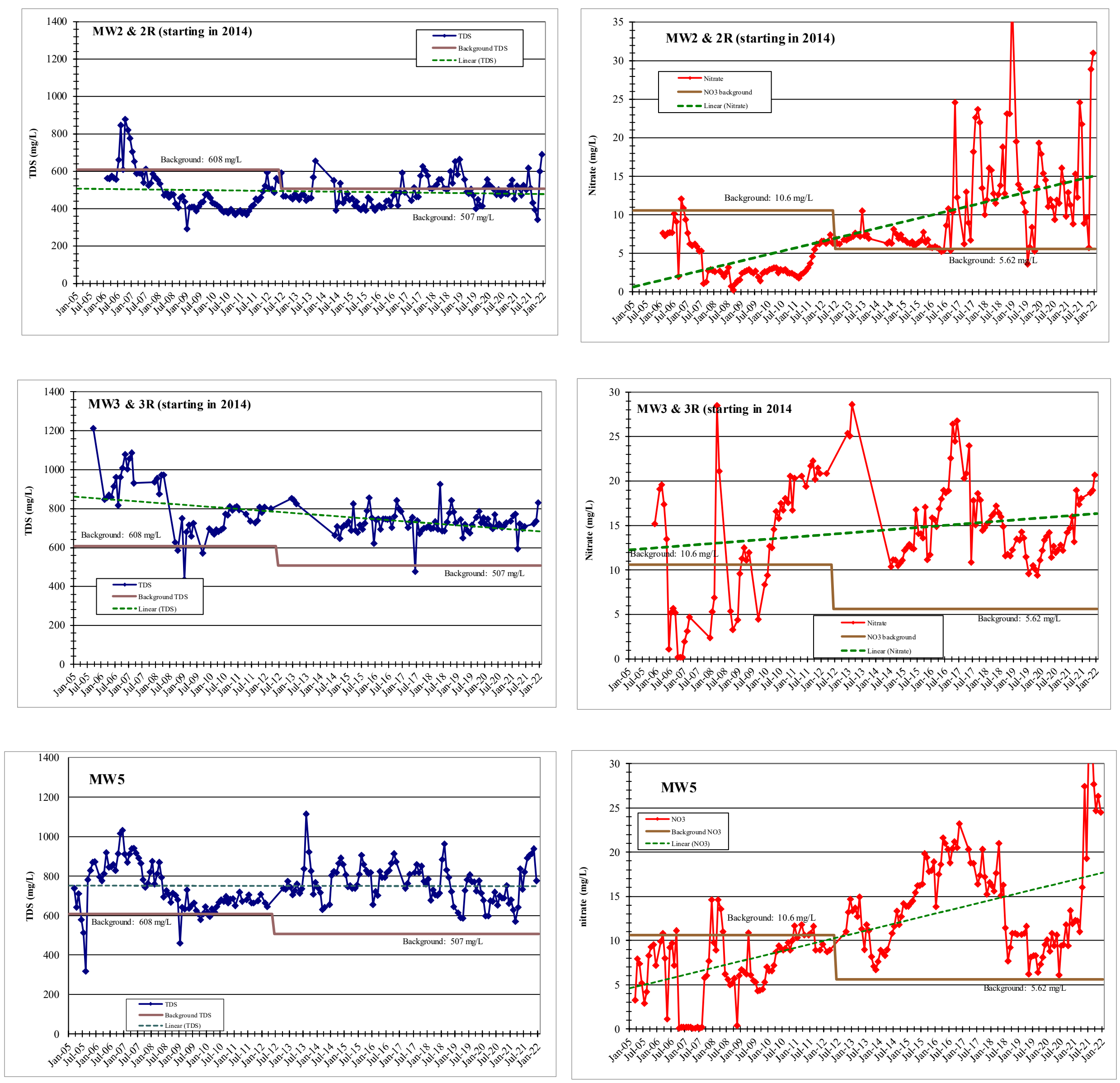
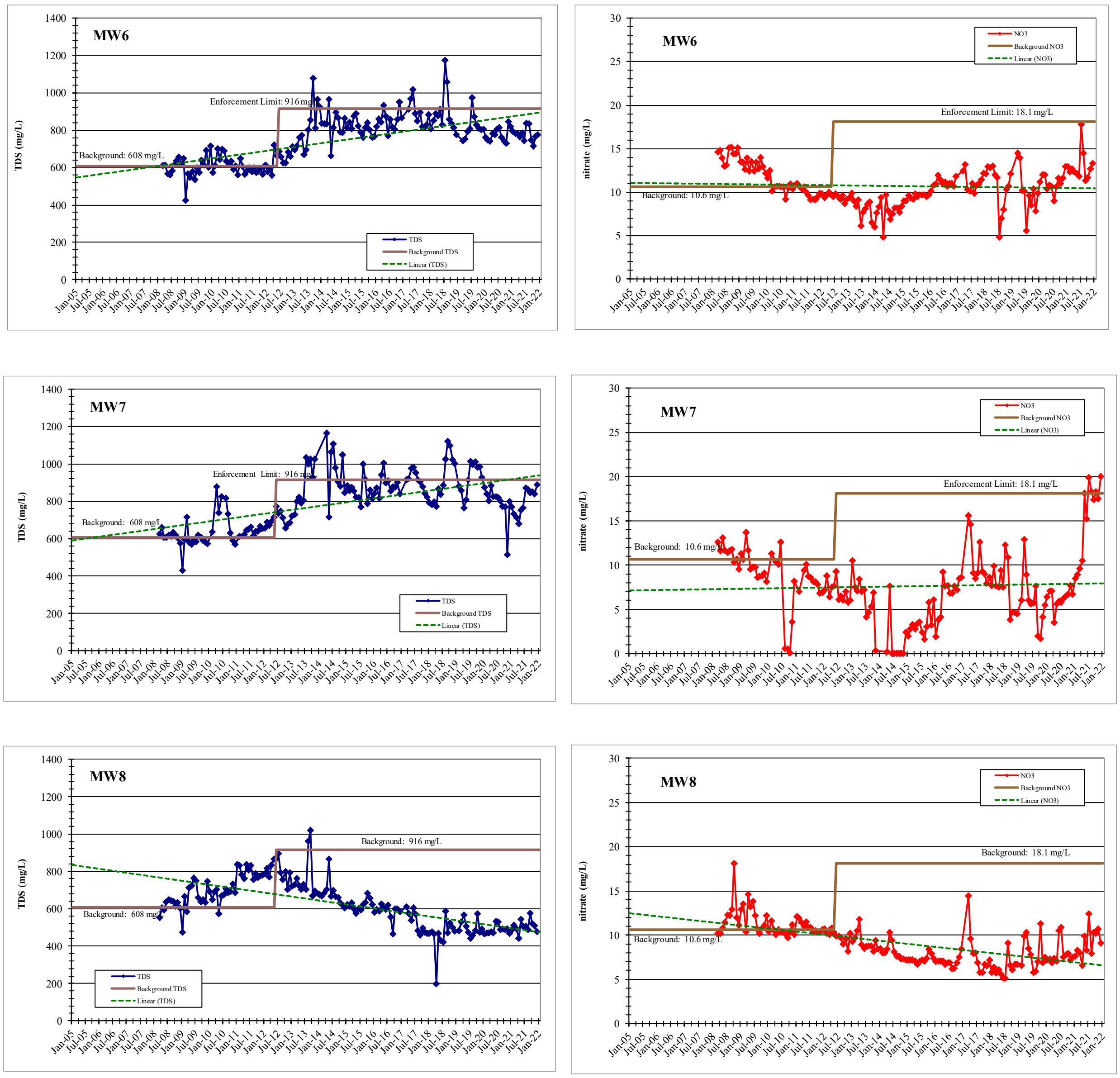


FIGURE 5: SUMMARY OF SVZ WELL MONITORING (Field 3 Wells)



6. 2022 CROP PLAN

In the early spring of 2021, SVZ removed the wheel-line irrigation systems from Fields 1 and 3 and replaced them with 3 small center pivot half-circle systems. As the old Field 2 has no plans for use, the naming system in future reports will be modified to match that used by SVZ. Field 1 will continue to be the name for the south field which will be irrigated with two half-circle center pivot systems, Pivot 1 to the south and Pivot 2 to the north. The north field will continue to be called Field 3 and will be irrigated with a single half-circle system, Pivot 3. All three pivots were seeded to alfalfa in the spring of 2021. The total acres under irrigation are approximately 4 acres less than that when irrigated by wheel-lines.

6.1 Soil Monitoring

The DOE land treatment permit requires that soil samples be collected in the spring and fall: this will continue to be accomplished in 2022. The purpose of soil testing is to monitor salt and nutrient concentrations over time and act as a back-up to the nutrient balance calculations. Modifications in management will be triggered by significant changes in soil test values. Soil samples will be collected and analyzed from Fields 1 and 3 to monitor chemical changes and salt conditions. The monitoring sites may need to be modified due to the change to center pivot irrigation systems but will be maintained as close to the original sites as practical. No sampling will occur on the old Field 2 as SVZ has no plans to utilize it for treatment or crop production.

6.2 Cropping Pattern and Wastewater Applications

After the new center pivot irrigation systems were installed, Fields 1 and 2 were seeded to alfalfa hay for the 2021 season. Alfalfa is anticipated to remain the treatment crop and for at least three more years. The Projected Management Plan for 2022 (Table 5) was developed with the following assumptions and goals:

1) The weather, ET and precipitation, for 2022 will not vary substantially from the 2017 to 2021 average.
2) Wastewater analyses will not diverge greatly from those observed in 2021.
3) Wastewater applications will be limited such that gross salt loading to the fields will remain below 4,000 lbs/ac **and** net nitrogen loading to the fields will remain below 165 lbs/ac.
4) Crop yields in 2022 will be near those experienced in previous years.

With these considerations in mind, it is recommended that no fertilizer nitrogen be applied to the alfalfa crop (Table 5). An application of 2 lbs/ac of boron may be beneficial to alfalfa production; no other nutrients are recommended based on the fall 2021 soil test results. Sodium levels in the soils suggest an application of approximately 2,500 lbs/ac of gypsum would be helpful to ensure that sodium does not damage the soil structure and the water infiltration rate remains sufficient.

For 2022, it has been determined that salts are the limiting factor for wastewater application to the fields. No more than 12.7 MG of wastewater should be applied to the 3 pivots in order to keep the salt loading below 4,000 lbs/ac for the year. This will apply approximately 14.4 inches of wastewater if distributed evenly over all pivots. This application amount will result in a nitrogen loading from wastewater of approximately 80 lbs/ac, well below the 165 lbs/ac limit. All wastewater generated by the plant in excess of 12.7 MG should be sent to the City of Othello for treatment. Additional irrigation requirements will need to be met with supplemental water, as approximated in Table 5.

The nitrogen requirement in any given year depends on the crop, growing conditions/weather, water and nutrient management and disease/pest pressure. Most of these factors can only be estimated ahead of time from historical values or experience; the result is called the agronomic rate. The crop nitrogen requirement can be met by nitrogen from four main sources, soil residual, wastewater, fresh water, and fertilizer. Not all the nitrogen applied from any of these sources remains available for crop use. Volatilization and denitrification result in nitrogen loss from the system and each of these sources has an efficiency of use that needs to be included in the balance equation. If planning suggests that nitrogen availability from one of these sources is anticipated to be higher, then nitrogen from one or more of the other sources should be reduced. Alfalfa is a legume crop. Using a symbiotic relationship with Rhizobium bacteria, alfalfa can fix its own nitrogen and thus, requires no nitrogen fertilizer. However, alfalfa has the ability to utilize mineral nitrogen from the soil, if it is available, in place of that fixed by the bacteria. A well-managed alfalfa crop in the Columbia Basin can remove in excess of 400 lbs/ac of nitrogen from the soil in a single season. It will also remove significant amounts of potassium and other salts. These capabilities make alfalfa an ideal crop for treatment of wastewater containing variable amounts of nitrogen.

TABLE 5: PROJECTED PLAN FOR 2022

			Anticipated Water Use less Anticipated in-season Rain		Irrigation Plan				Anticipated Wastewater Gross Loading			Soil Rescual	Estimated Fertilizer Nitrogen	Gypsum
	Treated				Wastewater		Fresh Water		N	Salts	BOD	N*	Needed	Require-ment
Field I.D.	Acres	Crop	inches	MG	inches	MG	inches	MG	lbs/ac	lbs/ac	lbs/ac-day	lbs/ac	lbs/ac	lbs/ac
CIRCLE 1 (S)	8.6	New	38.9	9.1	14.4	3.4	24.5	5.7	80	3,946	5	110	0	2800
CIRCLE 2 (Mid)	7.3	Seeding	38.9	7.7	14.4	2.9	24.5	4.9	80	3,946	5	110	0	2750
CIRCLE 3 (N)	16.7	Alfalfa	38.9	17.6	14.4	6.5	24.5	11.1	80	3,946	5	143	0	2700
					total MG	12.7	total MG	21.69						
	32.6			WW limits**	18	15.93			165	4,000	100			

* Soil residual N is calculated from the sum of tested nitrogen from the previous fall soil test.
**Wastewater irrigation is adjusted to keep total nitrogen load below 165 lbs-N/ac and wastewater hydraulic loading below 18 inches/ac (15.9 MG total), and salt loading below 4,000 lbs/ac per design criteria.

7. Summary and Recommendations

Wastewater production in 2021 (33.17 MG) was the highest recorded, slightly exceeding the previous high in 2016 (33.04 MG). The volume land applied was high (27.76 MG) but not as high as experienced in some previous years (Figure 4). Wastewater comprised approximately 57% of the irrigation water applied. This volume of wastewater resulted in the land application of nitrogen and salt (FDS) in excess of permit maxima.

The land application system was modified with the change to 3 center-pivot irrigation systems replacing the wheel line systems. The center-pivot systems allowed easier and better management of the water applications. Although the irrigations were better managed, all circles were irrigated with less water than used by the crop (deficit irrigation). Circle 3 received less wastewater and fresh water than the other two circles with a deficit irrigation of 19 inches. The treatment crops must be managed to produce well to help maintain soil health and a favorable field N balance. Proper water management is the first and most important step. Wastewater application should not exceed the planned amount in order to not overload salts, especially sodium. Adequate supplemental water must be applied to optimize crop growth and provide the required leaching fraction. SVZ upgraded the soil moisture monitoring equipment in 2015 making real-time visualization of the field conditions available to SVZ and the farm manager. Proper utilization of such information will assist the manager in matching irrigations to crop water requirements.

Alfalfa as the treatment crop was planted in the spring and grew well under the new irrigation systems, producing approximately 4 t/ac of hay. The alfalfa crops removed more nitrogen than was applied even though the applications to Circles 1 and 2 exceeded the permit maximum of 165 lbs/ac by 60 lbs/ac. A nitrogen balance of -32 lbs/ac were realized on these two circles. Circle 3 received less wastewater and consequently less nitrogen: 105 lbs/ac were applied with a balance of -138 lbs/ac.

Mineral salt loadings (FDS) in 2021 were the highest recorded (Figure 5). After accounting for salt removal by the harvested crop, Circles 1 & 2 had a net loading of nearly 11,800 lbs-salt/ac; Circle 3 had a net loading of nearly 4,600 lbs-salt/ac. Sodium, which is included in the FDS measurement, was applied at a net addition of nearly 3,500 lbs/ac to Circles 1 & 2 and nearly 1,500 lbs/ac to Circle 3. Salt build-up in the soil is prevented by incorporating the leaching fraction in the irrigation scheduling. Sodium accumulation is controlled by the addition of gypsum (calcium sulfate) in conjunction with the required leaching fraction. Irrigations the last couple years have not provided the necessary leaching fractions. Thus, salts and sodium have increased. It is recommended that 2,500 lbs/ac of gypsum be applied in 2022. Application of adequate fresh water to achieve the desired leaching fraction of approximately 6% will prevent salt accumulation at the surface. Adequate water will also increase hay yield, thus, improving the treatment capacity of the site. SVZ recognized that drainage from parking and outside work and storage areas was collected into the lagoons. Ice-melt applied for safety purposes in the winter was contributing to the salt load. Plans are in place to modify the drainage from the surface areas so they do not enter the lagoon and impact the loadings sent to either the land or the City of Othello.

Pesticides will be used only as needed. It is anticipated that some herbicide may be applied to the fields for weed control. Need for chemical and fertilizer applications will be determined by a certified crop advisor or similar professional. All pesticide applications will be made in accordance with label directions by licensed applicators.

The flow meters worked well in 2021 which allowed accurate evaluation of the hydraulic balances in the fields. It would be advisable to check the calibration of each flow meter at least annually and provide the dates of calibration for inclusion in this report.

APPENDIX

2021

DMR REPORTS FOR

Washington State DOE Discharge Permit No. ST8077

CAN BE VIEWED AT THE FOLLOWING LINK:

https://fortress.wa.gov/ecy/paris/ComplianceAndViolations/ViewDMRData.aspx

HARVEST REPORTS

(none)

DOE SOIL TESTING RESULTS

soiltest farm consultants, inc.
2925 Driggs Dr., Moses Lake, Wa 98837 - www.soiltestlab.com
Office: (509)765-1622 - Fax:(509)765-0314 - (800)764-1622

SVZ-USA
P.O. BOX 715
OTHELLO, WA 99344

DATE RECEIVED 3/22/2021
DATE REPORTED 3/30/2021
INVOICE # 4161

NORTH

							----NH40AC----			
SAMPLE I.D.	LAB NO	NO3-N mg/Kg	NH4-N mg/Kg	TKN mg/Kg	TOTAL P mg/Kg	OLSEN P mg/Kg	K mg/Kg	Ca meq/100g	Mg meq/100g	Na meq/100g
1FT	S21-4161	60.8	13.6	1497	932	26	489	11.7	3	1.5
2FT	S21-4162	44.4	3.2	710	919		239	15.2	3.3	2.52

		---- DTPA EXT ----					Est Sat Paste			
SAMPLE I.D.	LAB NO	SULFUR mg/Kg	B mg/Kg	Zn mg/Kg	CEC meq/100g	ESP %	SOL SALTS mmhos/cm	pH 1:1	OM %	Fe2+ field test
1FT	S21-4161	49	0.78	3.4	12.5	12.0	7.03	7.7	2.1	NEG
2FT	S21-4162	39			9.9	25.5	5.27	8.8	1.1	NEG

REVIEWED BY_____________ AO

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OTHELLO, WA 99344

DATE RECEIVED	3/22/2021
DATE REPORTED	3/30/2021
INVOICE #	4163

SOUTH

							NH40AC			
SAMPLE I.D.	LAB NO	NO3-N mg/Kg	NH4-N mg/Kg	TKN mg/Kg	TOTAL P mg/Kg	OLSEN P mg/Kg	K mg/Kg	Ca meq/100g	Mg meq/100g	Na meq/100g
1FT	S21-4163	50.4	6.4	1643	1093	38	628	8.3	3	2.04
2FT	S21-4164	61.6	2.3	725	1051		757	7.6	4.5	1.19

		DTPA EXT					Est Sat Paste			
SAMPLE I.D.	LAB NO	SULFUR mg/Kg	B mg/Kg	Zn mg/Kg	CEC meq/100g	ESP %	SOL SALTS mmhos/cm	pH 1:1	OM %	Fe2+ field test
1FT	S21-4163	39	0.48	2.4	11.9	17.1	5.34	8.1	2.5	NEG
2FT	S21-4164	39			11.1	10.7	5.54	7.9	0.8	NEG

REVIEWED BY____________ **AO**

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OTHELLO, WA 99344

DATE RECEIVED 11/29/2021
DATE REPORTED 12/1/2021
INVOICE # S21-27808

FIELD 3 (north wheelline)

							NH40AC			
SAMPLE I.D.	LAB NO	NO3-N mg/Kg	NH4-N mg/Kg	TKN mg/Kg	TOTAL P mg/Kg	OLSEN P mg/Kg	K mg/Kg	Ca meq/100g	Mg meq/100g	Na meq/100g
1FT	S21-27808	10.4	2.5	1216	840	26	496	10.8	2.1	1.51
2FT	S21-27809	15.4	2	563	675		184	16.4	2.5	3.39
3FT	AUGER REFUSAL									

			DTPA EXT				Est Sat Paste			
SAMPLE I.D.	LAB NO	SULFUR mg/Kg	B mg/Kg	Zn mg/Kg	CEC meq/100g	ESP %	SOL SALTS mmhos/cm	pH 1:1	OM %	Fe2+ field test
1FT	S21-27808	13	0.47	2.8	10.8	14.0	2.10	8.2	2.3	NEG
2FT	S21-27809	19.7			10.6	32.0	3.72	8.9	0.9	NEG
3FT	AUGER REFUSAL									

REVIEWED BY_______KEB________________

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SVZ-USA
P.O. BOX 715
OTHELLO, WA 99344

DATE RECEIVED 11/29/2021
DATE REPORTED 12/1/2021
INVOICE # S21-27808

FIELD 1 (south wheelline)

							NH40AC			
SAMPLE I.D.	LAB NO	NO3-N mg/Kg	NH4-N mg/Kg	TKN mg/Kg	TOTAL P mg/Kg	OLSEN P mg/Kg	K mg/Kg	Ca meq/100g	Mg meq/100g	Na meq/100g
1FT	S21-27810	9.4	2.3	1069	821	32	570	7.6	2.5	1.51
2FT	S21-27811	5.9	2.6	610	839		603	5.8	3.4	1.66
3FT	AUGER REFUSAL									

		DTPA EXT					Est Sat Paste			
SAMPLE I.D.	LAB NO	SULFUR mg/Kg	B mg/Kg	Zn mg/Kg	CEC meq/100g	ESP %	SOL SALTS mmhos/cm	pH 1:1	OM %	Fe2+ field test
1FT	S21-27810	9.9	0.37	2	10.3	14.7	1.76	8.1	1.9	NEG
2FT	S21-27811	10.3			9	18.4	1.83	7.9	0.9	NEG
3FT	AUGER REFUSAL									

REVIEWED BY__________KEB__________

LABORATOTRY & CONSULTANT

CERTIFICATIONS

The State of Washington
Department of Ecology

Soiltest Farm Consultants, Inc. Laboratory
Moses Lake, WA

has complied with provisions set forth in Chapter 173-50 WAC and is hereby recognized by the Department of Ecology as an ACCREDITED LABORATORY for the analytical parameters listed on the accompanying Scope of Accreditation. This certificate is effective September 8, 2021 and shall expire September 7, 2022.

Witnessed under my hand on October 14, 2021

Rebecca Wood
Lab Accreditation Unit Supervisor

Laboratory ID
C605

The Soil Science Society of America
Soils Certification Board

has conferred upon

Daniel P. Nelson, PhD

the designation of

Certified Professional Soil Scientist

By successfully fulfilling the requirements, passing a rigorous examination,
subscribing to the Certified Professional Soil Scientist
Code of Ethics and committing to ongoing professional development.

Certification effective from
1/1/2021 to **12/31/2022**

Certification Number: **03231**

CPSS
Certified Professional
Soil Scientist

SSSA President

Soils Certification Board Chair

IMPORTANT INFORMATION

Important Information

About Your Environmental Report

IMPORTANT INFORMATION

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors that were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events and should be consulted to determine if additional tests are necessary.

IMPORTANT INFORMATION

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for

IMPORTANT INFORMATION

another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland