THE AMALGAMATED SUGAR COMPANY LLC

50 SOUTH 500 WEST • P.O. BOX 700 • PAUL, ID 83347
PHONE: (208) 438-2115 • FAX: (208) 438-5485

July 1, 2010

Dave Anderson
Regional Manager-Engineering
DEQ Twin Falls Regional Office
1363 Fillmore Street
Twin Falls, Idaho 83301

Re: TASCO-Mini-Cassia LA-000050-02
Wastewater Reuse Permit Renewal Application

Dear Mr. Anderson:

As requested from The Department in a letter dated July 15, 2009, The Amalgamated Sugar Company LLC (TASCO) has reviewed and updated the data to the April 3, 2000 Wastewater Land Application Permit Renewal. Detailed explanations of the evaluation and findings related to this update are presented in the following pages. The data requested is also presented in electronic format.

If you have any questions please call Karen Cummings, Environmental Engineer Manager at 208-438-2115 or Michael Dalton, Corporate Environmental Engineer at 208-383-6500.

Sincerely,

Larry Lloyd

Larry Lloyd
Plant Manager
TASCO – Mini-Cassia Facility

cc Dr. Michael Murray – HDR Inc. w/disk
John McCreedy, Michael Dalton – Boise Corporate
Dean DeLorey, Corporate Engineering – Boise Corporate w/disk
Karen Cummings, Environmental File – Mini-Cassia w/disk

# Permit Renewal Application
# For
# The Amalgamated Sugar Company LLC
# Mini-Cassia Facility

## Wastewater Land Application
## Permit No. LA-000050-02

Prepared by

The Amalgamated Sugar Company LLC
Paul, Idaho

and

HDR

April 3, 2000
Revised May 3, 2000
Updated July 1, 2010

# Technical Report

# Wastewater Land Application Permit Renewal
# for
# Mini-Cassia Facility

Prepared by

The Amalgamated Sugar Company LLC
Paul, Idaho

and

HDR

April 3, 2000
Revised May 3, 2000
Updated July 1, 2010

# Table of Contents


**1.0 Introduction ..... 1**

**1.1 Purpose ..... 1**

**1.2 Regulatory Analysis ..... 1**

Wastewater Land Application Program ..... 1
Idaho Groundwater Quality Plan ..... 2
Idaho Groundwater Quality Rule ..... 4
Idaho DEQ Groundwater Policy ..... 6
Application of Regulatory Standards to the Facility ..... 7

**1.3 Sugar Beet Processing Facility ..... 7**

**1.4 Mini-Cassia Facility ..... 8**

**2.0 Process and Wastewater Systems ..... 11**

**2.1 Process Water Systems ..... 11**

Flume System ..... 11
Lime Water System ..... 11
Scrubber Water System ..... 11
Fly Ash System ..... 11
Condenser System ..... 11
Sanitary Lagoon ..... 12
Non-Contact Cooling Water ..... 12
Mud Pond System ..... 12

**2.2 Wastewater Types and Treatment ..... 14**

Process Wastewater ..... 14
Condensate ..... 14

**2.3 Pond Storage ..... 15**

**2.4 Wastewater Volumes and Quality ..... 15**

**2.5 Land Application Sites ..... 21**

**2.6 System Improvements/Modifications ..... 21**

**3.0 Land Application System Operation and Management ..... 25**

**3.1 Wastewater Land Application Permit ..... 25**

**3.2 Management Plans ..... 28**

Nuisance Odor Management Plan (Attachment 1) ..... 28
TDS Management Plan (Attachment 2) ..... 28
Buffer Zone Management Plans (Attachment 3) ..... 28
Waste Solids Management Plan (Attachment 4) ..... 29
Contingency Plan ..... 29
Well Acceptability Analysis ..... 29

# Table of Contents


**3.3 Historical Loading Rates ..... 29**
Growing Season ..... 40
COD Loading ..... 40
Nutrients ..... 40
Hydraulic Loading ..... 40
Non-Growing Season ..... 41
COD Loading ..... 41
Nutrients ..... 41
Hydraulic Loading ..... 41
NVDS Application Rates ..... 41

**3.4 Crop/Land Management ..... 42**

**4.0 Site Conditions ..... 53**

**4.1 Climate ..... 53**

**4.2 Soils ..... 56**
Soil Survey ..... 56
Soil Storage Capacity ..... 57
Site Soil Analysis ..... 64

**4.3 Hydrogeology ..... 66**
Regional Hydrogeology ..... 66
Site Hydrogeology ..... 66
Shallow Aquifer Parameter Estimates ..... 67
Monitoring Well Construction and Suitability ..... 71
Upgradient and Downgradient Wells ..... 74

**4.4 Groundwater Quality ..... 74**
LOWESS Trend Plots ..... 77
Mixing Zone Analysis ..... 88

**5.0 Land Application System Performance Assessment ..... 92**

**5.1 East Farm (MU-005001) ..... 92**
Dissolved Solids ..... 92
Nitrogen ..... 93

**5.2 South Farm (MU-005002) ..... 96**
Dissolved Solids ..... 96
Nitrogen ..... 96

**5.3 Goitiandia Farm (MU-005004) ..... 99**
Dissolved Solids ..... 99
Nitrogen ..... 102

**5.4 East Gillette Farm (MU-005005) ..... 102**
Dissolved Solids ..... 102

# Table of Contents


Nitrogen ..... 105

**5.5 Seedall Farm (MU-005007) ..... 105**
Dissolved Solids ..... 105
Nitrogen ..... 108

**5.6 South Schow Farm (MU-005009) ..... 108**
Dissolved Solids ..... 108
Nitrogen ..... 109

**5.7 North Schow Farm (MU-005010) ..... 109**
Dissolved Solids ..... 110
Nitrogen ..... 115

**5.8 Offsite Farm ..... 115**
Dissolved Solids ..... 116
Nitrogen ..... 116

**5.9 Facility Ponds/Facility Grounds ..... 119**

**6.0 Proposed Management and System Modifications ..... 121**

**6.1 Land Application System Loading Rates ..... 121**

**6.2 Future System Improvements ..... 125**

**6.3 Monitoring ..... 125**

**6.4 Offsite Impacts ..... 126**

**6.5 Updates to the Wastewater Land Application Permit ..... 126**

**6.6 Process Water Management ..... 127**

**6.7 Future Production ..... 127**

**Works Cited ..... 128**

# Table of Contents

## Appendices


| | |
|---|---|
| Appendix 1 | Permits |
| Appendix 2 | Wastewater Quality Data |
| Appendix 3 | Land Application System Improvements |
| Appendix 4-1 | Soil Data |
| Appendix 4-2 | Groundwater Level Data |
| Appendix 4-3 | Groundwater Quality Data |
| Appendix 4-4 | Groundwater Mixing Zone Analysis |
| Appendix 4-5 | Groundwater Contour Maps—Shallow Aquifer |


## Attachments


| | |
|---|---|
| Attachment 1 | Odor Management Plan |
| Attachment 2 | TDS Management Plan |
| Attachment 3 | Buffer Zone Management Plan |
| Attachment 4 | Waste Solids Management Plan |

# Figures

Figure 1-1 Topography Map ..... 9
Figure 1-2 Land Application Map ..... 10
Figure 2-1 TASCO/Mini-Cassia Wastewater System ..... 13
Figure 2-2 Mini-Cassia Wastewater Production ..... 17
Figure 2-3 Mini-Cassia Wastewater TN and NVDS ..... 19
Figure 2-4 Wastewater Loads ..... 20
Figure 2-5 East Farm Acreage Reduction ..... 24
Figure 4-1. Average Minimum and Maximum Temperature Patterns for Rupert, Idaho ..... 54
Figure 4-2 Average Daily Soil Temperature at 4 Inch Depth for Rupert, Idaho ..... 55
Figure 4-3. Soils ..... 58
Figure 4-4. October 2008 Groundwater Elevation Contours ..... 68
Figure 4-5. April 2009 Groundwater Elevation Contours ..... 69
Figure 5-1 Dissolved Solids Analysis—East Farm ..... 94
Figure 5-2 Nitrate Analysis—East Farm ..... 95
Figure 5-3 Dissolved Solids Analysis—South Farm ..... 97
Figure 5-4 Nitrate Analysis—South Farm ..... 98
Figure 5-5 Dissolved Solids Analysis—Goitiandia Farm ..... 100
Figure 5-6 Nitrate Analysis—Goitiandia Farm ..... 101
Figure 5-7 Dissolved Solids Analysis—East Gillette Farm ..... 103
Figure 5-8 Nitrate Analysis—East Gillette Farm ..... 104
Figure 5-9 Dissolved Solids Analysis—Seedall Farm ..... 106
Figure 5-10 Nitrate Analysis—Seedall Farm ..... 107
Figure 5-11a Dissolved Solids Analysis—Schow Farms ..... 111
Figure 5-11b Dissolved Solids Analysis—Schow Farms ..... 112
Figure 5-12a Nitrate Analysis—Schow Farms ..... 113
Figure 5-12b Nitrate Analysis—Schow Farms ..... 114
Figure 5-13 Dissolved—Offsite Farms ..... 117
Figure 5-14 Nitrogen—Offsite Farms ..... 118
Figure 5-15 Dissolved Solids—Facility Wells ..... 120
Figure 5-16 Nitrate—Facility Wells ..... 120

# Tables

Table 2-1 Estimated Pond Wetting Periods, Surface Areas, and Operating Volumes ..... 16
Table 2-2 Wastewater Land Application and Condensate Recycle, Mini-Cassia ..... 17
Table 2-3 Wastewater Quality Summary, TASCO, Mini-Cassia ..... 18
Table 2-4 Land Application Management Unit Description ..... 23
Table 3-1 Current Permitted Loading Rates ..... 26
Table 3-2 Status of Permit Schedule C Compliance Conditions ..... 27
Table 3-3 Summary of Historical and Current Loadings ..... 30
Table 3-4 Summary of Crop Yields and Crop Nitrogen Removal ..... 43
Table 3-5 Average Nitrogen Crop Removals from 1995 to 1999 ..... 48
Table 4-1. General Climate Data for Paul, Idaho Area from 1/1/1925 to 12/31/2009 ..... 53
Table 4-2.Summary of Rupert, Idaho's Agri-Met Weather Station Measurements ..... 53
Table 4-3. Average precipitation for Rupert, Idaho (1987 to 2009) ..... 54
Table 4-4. Monthly Average Reference Evapotranspiration ($ET_r$) for Agri-Met Rupert Station (based on average 1987 to 2009) ..... 56
Table 4-5. Non-Growing Season Evapotranspiration ($ET_{ngs}$) based on the Agri-Met Rupert Station $ET_r$ data and Using an Evaporation Coefficient of 0.7 ..... 56
Table 4-6. Summary of Soil Characteristics ..... 59
Table 4-7. Proposed HLRngs for TASCO Mini-Cassia ..... 63
Table 4-8. Summary of Soil Data for April 2009 ..... 65
Table 4-9. Shallow Aquifer Parameter Estimates Determined from Site Monitoring Well Data 70
Table 4-10 Monitoring Well Construction Details ..... 72
Table 4-11 Existing Monitoring Well Locations ..... 74
Table 4-12 Summary Statistics and Trend Analysis for Nitrates ..... 76
Table 4-13 Summary Statistics and Trend Analysis for TDS ..... 77
Table 4-14 East Far, (MU-005001) Groundwater Summary ..... 78
Table 4-10. South Farm (MU-005002) Groundwater Summary ..... 79
Table 4-11. Wilkins (MU-005003) Groundwater Summary ..... 80
Table 4-12. Goitiandia (MU-005004) Groundwater Summary ..... 81
Table 4-13. East Gillette (MU-005005) Groundwater Summary ..... 82
Table 4-14. Seedall (MU-005007) Groundwater Summary ..... 83
Table 4-15. South Schow (MU-005009) Groundwater Summary ..... 84
Table 4-16. North Schow (MU-005010) Groundwater Summary For Nitrate-N ..... 85
Table 4-17.North Schow (MU-005010) Groundwater Summary for TDS ..... 86
Table 4-18. Estimated Cmix as a Function of Hydraulic Conductivity for North Schow ..... 90
Table 4-24 Estimated Cmix as a Function of Hydraulic Conductivity for Goitiandia (MU-005004) and East Gillette (MU-005005) ..... 91
Table 6-1 Proposed Loading Rates ..... 122

companion guidelines were finalized in March 1989. Together, the regulations and guidelines helped to establish parameters for workable land application permits designed to protect surface and groundwater quality and meet the treatment needs of the waste generator.

A WLAP Technical Work Group, comprised of agency, industry, municipalities, and technical consultants, was formed in September 1993 to expand the original guidelines on four selected issues of concern. The resulting document, *Handbook for Land Application of Municipal and Industrial Wastewater* (IDEQ, April 1996), includes the newly adopted 1994 Technical Interpretive supplement with supporting information on growing and non-growing season application rates; guidance for determining minimum setback distances to public and private wells; proposed buffer zones between land application sites and the public; and grazing on land application sites. The Handbook was updated in 2007 and the resulting document is the *Guidance for Reclamation and Reuse of Municipal and Industrial Wastewater* (September 2007). The position of the IDEQ is that the 2007 Guidance are recommendations that support and reinforce laws and regulations, but by themselves are not standards or mandates.

The Rules for the Reclamation and Reuse of Municipal and Industrial Wastewater (IDAPA 58.01.17) (the "Land Application Rules") in conjunction with the Idaho Groundwater Quality Plan govern this application. The Land Application Rules define the conditions that IDEQ may place on land application facilities. The rules are very general, and essentially permit IDEQ to establish such conditions as are "necessary for the protection of the environment and the public health . . ." (IDAPA 58.01.17.600.01)

Specific conditions may specify or limit (IDAPA 58.01.17.600.03):

a. Wastewater composition;
b. Method, manner, and frequency of wastewater treatment;
c. Wastewater pretreatment requirements;
d. Physical, chemical, and biological characteristics of a land application facility; and
e. Any other condition the Director finds necessary to protect public health or environment.

Further, IDEQ may specify (IDAPA 58.01.17.600.04 (emphasis added)):

a. Specific steps or actions to be taken by the permittee to achieve compliance with applicable requirements or final permit conditions [and]
b. Dates by which those steps or actions are to be taken . . .

## Idaho Groundwater Quality Plan

The wastewater land application program is focused on protecting groundwater while allowing for treatment of wastewater. The State Legislature adopted the Idaho Groundwater Quality Plan (Groundwater Quality Council, 1992) (the "Groundwater Plan") in 1992 "as a first step in providing comprehensive groundwater protection for Idaho." It is a planning document that includes 22 policies that are intended to describe the State's overall approach to protecting groundwater. However, the Groundwater Plan is more than a planning document, as stated in Idaho Code Section 39-124: "After action by the legislature, the plan shall have the force and effect of law."

# 1.0 Introduction

The Amalgamated Sugar Company LLC (TASCO) Mini-Cassia facility has operated and managed a wastewater land application treatment system for over 30 years. The Idaho Department of Environmental Quality (IDEQ) has provided oversight on the system since 1975. In 1993, TASCO-Mini-Cassia's wastewater land application permit was renumbered to LA-000050, and renewed in July 1995. TASCO is currently operating according to the requirements of this permit. Detailed permit applications and analyses were prepared by TASCO and submitted to the IDEQ prior to the issuance of each permit.

Historically, wastewaters have resulted in some impacts to groundwater; primarily to secondary non-health based constituents. In accordance with requirements of the previous permits, TASCO has progressively implemented several management strategies and improvement projects to minimize impacts on the environment from the land application system. TASCO has significantly reduced wastewater loadings to the land application sites by reducing wastewater volumes, purchasing additional land for land application, improving treatment, minimizing wastewater application during the non-growing season, and installing process upgrades for source reduction.

## 1.1 Purpose

The Mini-Cassia Facility's most recent land application permit (No. LA-000050-02) expired July 1, 2000 (Appendix 1-1). In April of 2000, prior to the deadline, TASCO submitted an application to renew the permit. This report, prepared as an update in support of the application, addresses operation and management of the land application system, site conditions, and proposed management and system modifications.

## 1.2 Regulatory Analysis

While preparing the permit renewal application, the following relevant regulatory programs and regulations were reviewed:

- Wastewater Land Application Program
- Idaho Groundwater Quality Plan
- Idaho Groundwater Quality Rule
- Idaho DEQ Groundwater Policy

These programs and regulations are discussed below, preceding a final section discussing the application of regulatory standards to the facility.

**<u>Wastewater Land Application Program</u>**

The Wastewater Land Application Program ("WLAP") (now referred to as the Wastewater Reuse Permitting Program) was developed, in part, to ensure that sites used for land application of wastewater are "managed as agronomic units for the efficient treatment and beneficial uses of groundwater." The original program regulations became effective in April 1988, and

**TASCO-Mini-Cassia Facility**

The policies in the Groundwater Plan are designed to reflect that past practices such as farming and food processing which impact groundwater quality are allowable beneficial uses. The Plan covers protection, prevention, and remediation and is followed by a discussion of the rationale and implementation. Summaries of selected policies and rationale are discussed below.

Section I *Categories of Groundwater* states:

I-C. Categorization of Groundwater – The policy of the State of Idaho is to provide differential protection for the State's groundwater resources. A groundwater categorization system should be established for aquifers and portions of aquifers. The categorization system should be based on vulnerability of the groundwater, existing and protected future beneficial uses of the groundwater, existing quality of the groundwater, and social and economic considerations.

The rationale states that the level of protection given groundwater should be consistent with its present water quality, its vulnerability to contamination, its existing and protected future beneficial uses, and social and economic considerations.

Section VI of the Groundwater Plan, *Remediation of Contamination*, states:

VI-A. Remediation – The policy of the State of Idaho is where contamination resulting from human activities produces a significant potential for the impairment of an existing or projected future beneficial use of groundwater, remediation should be conducted when feasible and appropriate. Decisions for when to initiate remediation, the extent of remediation needed, and appropriate remedy should take into consideration site-specific risks to health and the environment, the cost of the remediation, the technological limitations, and the need to maintain or recover beneficial uses of groundwater and interconnected surface water.

The rationale for the above-referenced statement is that "the best interest of the State is met when groundwater contamination that impairs or threatens to impair beneficial uses is remediated whenever it is *feasible and appropriate*.

The Idaho Groundwater Plan states that "in most cases, remediation will not completely restore groundwater to its precontaminated state, and in some situations groundwater restoration may not be practicable at all…."

The Plan does not give specific contamination levels. Instead it requires agencies to analyze the risk to human health or the environment and to consider what is feasible and appropriate after this analysis has been performed.

Section VI-B *Liability for Costs of remediation* states:

The policy of the State of Idaho is that costs for remediation be apportioned between responsible parties (to be defined by the Idaho Legislature) and the general public through a variety of funding mechanisms. The apportionment of costs should take into account the cause of the contamination, whether the person(s) causing the contamination are identifiable and able to conduct the remediation, and whether the contamination results from past or current practices and other appropriate factors.

The rationale is that "Much of the groundwater contamination existing today results from past practices that often were either commonly accepted practices of the day or even authorized under a permit system. Also, part of identifying responsible parties includes providing a defense for an innocent landowner in certain circumstances. In view of the complexity of the many contamination situations that can occur, it is virtually impossible to establish a single set of rules to determine who is liable for the costs of remediation." (Idaho Groundwater Quality Plan, June 1992 Page 47)

## Idaho Groundwater Quality Rule

The Idaho Groundwater Rule (IDAPA Chapter 58.01.11) (the "Groundwater Rule") defines and limits in part the obligations of a land application discharger to protect human health and the environment.

Numerical and narrative standards defined in the Groundwater Rule are established in part based on the federal drinking water standards. Most of the groundwater constituents associated with the land application system are secondary contaminants that are generally based on non health related aesthetic qualities. These include TDS, iron, manganese, and chlorides.

The Groundwater Rule identifies two numerical standards of primary interest in this application:

| Constituent | Max. Concentration (mg/L) | Primary or Secondary Standard |
|---|---|---|
| Nitrate | 10 | Primary |
| Total Dissolved Solids ("TDS") | 500 | Secondary |

IDAPA 58.01.11.200.01.a (Table II - Nitrate); 58.01.11.200.01.b (Table III - Total Dissolved Solids)

The numeric standards apply to setting permit limits (IDAPA 58.01.11.150.01.b). The type of permit limits depends on the aquifer categorization described in Section 150.02. By default, the facility falls within the General Resource category, although, as discussed below, it may be appropriate for this aquifer to be redesignated as an "Other Resource" aquifer to reflect actual conditions. The protection level in General Resource aquifers is defined as follows (IDAPA 58.01.11.150.02):

| Table I. Level of Protection and Application of Standards to Aquifer Categories | | |
|---|---|---|
| **Category** | **Level of Protection** | **Application of Standards** |
| General Resource | Apply best management practices and best practical methods. | Apply numerical and narrative standards in Section 200. |

Rule 301.02 reinforces this point: "Activities with the potential to degrade General Resource aquifers shall be managed in a manner which maintains or improves existing groundwater quality through the use of best management practices and best practical methods to the maximum extent practical." (IDAPA 58.01.11.301.02.a)

The effect of this table and Rule 301.02 is that the numerical limits require the facility to implement of best management practices ("BMPs") and best practical methods ("BPMs"). The Groundwater Rule defines "Best Management Practice" as (IDAPA 58.01.11.007.05):

A practice or combination of practices determined to be the most effective and practical means of preventing or reducing contamination to groundwater and interconnected surface water from nonpoint and point sources to achieve water quality goals and protect the beneficial uses of the water.

"Best Practical Method" is defined as (IDAPA 58.01.11.007.06.):

Any system, process, or method that is established and in routine use which could be used to minimize the impact of point or non-point sources of contamination on groundwater quality.

The touchstones these definitions offer are that BMPs must be both "effective and practical" and BPMs must be "established and in routine use." In tandem, these definitions prohibit IDEQ from imposing permit conditions that are not practical, established or routine. In this application, TASCO offers compliance assurance measures that both protect water quality and meet the reasonable touchstones established by the Groundwater Rule.

The Groundwater Rule also addresses situations where existing groundwater quality exceeds water quality standards, such as is the case in certain wells surrounding the facility. Rule 400.03 states as follows (IDAPA 58.01.11.400.03 (emphasis added)):

Contamination Exceeding a Groundwater Quality Standard. The discovery of any contamination exceeding a groundwater standard **that poses a threat to existing or projected beneficial uses of groundwater** shall require appropriate actions, as determined by the Department, to prevent further contamination. These actions may consist of investigation and evaluation, or enforcement actions if necessary to stop further contamination or clean up existing contamination, as required under the Environmental Protection and Health Act, Section 39-108, Idaho Code.

The Groundwater Rule therefore establishes the touchstone that the discovery of contamination above water quality standards requires "appropriate actions" only when the levels discovered pose "a threat to existing or projected future beneficial uses of groundwater". TASCO believes this provision is particularly applicable to exceedances of secondary water quality standards, including TDS, the primary bases for which are "aesthetic qualities" (IDAPA 58.01.11.200.01.b). TASCO does not downgrade the importance of maintaining the aesthetic qualities of drinking water. However, TASCO believes the rule requires IDEQ to assess whether it is "appropriate" to place a lower priority on aesthetic issues, especially where the costs of remedial actions are significant and the problem is regional in extent, such is the case at the facility. The lower emphasis on aesthetic values also applies to whether proposed actions are "practical," "routine," or are in "established use."

The Groundwater Rule also permits IDEQ the flexibility to redesignate an aquifer if it is not appropriate for designated uses, including potable water supply. Section 400.05 states as follows:

400.05: Site-Specific Groundwater Quality levels. The Department may allow site-specific groundwater quality levels, for any aquifer category, that vary from a standard(s) in Section 200 or 300, based on consideration of effects to human health and the environment, for:

a. Remediation conducted under the Department's oversight;
b. Permits issued by the Department;
c. Situations where the site background level varies from the groundwater quality standard; or
d. Other situations authorized by the Department in writing.

Idaho Code §39-102 requires that groundwater be restored and protected where feasible and appropriate to support beneficial uses and that all groundwater be protected against unreasonable contamination. This legislation therefore recognizes permitted past practices as reasonable.

## Idaho DEQ Groundwater Policy

On March 1, 2000, IDEQ adopted a policy, entitled "Policy for Addressing Degraded Groundwater Quality Areas" (the "Groundwater Policy") regarding how IDEQ will address areas that have degraded groundwater. The Groundwater Policy outlines reasonable steps for IDEQ to address degraded groundwater, including, in quick summary:

- IDEQ may designate areas that have significantly degraded groundwater;
- IDEQ then will establish a state-wide priority list of such areas;
- Consistent with the priority list, IDEQ will develop groundwater management strategies including the following:

  a. Collection of additional data and studies;
  b. Executing local agreements;
  c. Applying voluntary and/or regulatory control measures;
  d. Determining if the contamination is the result of historical practices or natural causes; and
  e. Applying remediation techniques.

- Effectiveness review;
- Recategorization of aquifers; and
- Removal of degraded groundwater quality areas from the priority list.

TASCO believes the Groundwater Policy outlines the appropriate steps for IDEQ to follow to address existing groundwater conditions. TASCO does not believe it is appropriate for IDEQ to require remediation of existing groundwater conditions in the context of addressing a wastewater land application permit application.

**Application of Regulatory Standards to the Facility**

In this application, TASCO proposes to continue implementing BMPs and BPMs for its wastewater land application operations in compliance with Idaho law, the Groundwater Rule and the Groundwater Policy. TASCO's historical track record is to apply BMPs and BPMs in conjunction with IDEQ and to improve its operations continuously. This application is consistent with law and IDEQ regulations.

On a large scale, there are known groundwater quality issues in the area around the facility. TASCO proposes to work with IDEQ to address the regional groundwater concerns consistent with the approach outlined in the Groundwater Rule and the Policy for Addressing Degraded Waters. TASCO will continue its policy of addressing neighbors' complaints about groundwater quality on a case-by-case basis. TASCO also believes IDEQ should consider whether the beneficial uses of the aquifer(s) surrounding the facility should be reviewed in light of the legacy groundwater issues in the area.

## 1.3 Sugar Beet Processing Facility

Sugar beets are harvested annually from September until early November and stored either onsite or offsite. Processing of the sugar beets typically begins in mid-September and continues until early March. This period is referred to as the "beet campaign." Yearly crop and weather variations can significantly affect the beet campaign's length.

During the beet campaign, the sugar beets are transported to the factory by truck from the storage piles. Initially, the sugar beets are cleaned by a wet handling system. After entering the factory, they are sliced and transferred to a diffuser where sugars and non-sugars are extracted from the beets using hot water. This liquid, known as raw juice, is pumped to the juice purification phase of the factory where hydrated lime and carbon dioxide are added to remove non-sugars. The juice is then filtered to create thin juice. Using evaporators, water is removed from the thin juice to create thick juice. The thick juice is either sent to the sugar end of the factory, where both wet sugar and molasses are produced, or to juice storage tanks. The wet sugar is conveyed to granulators for drying and cooling prior to being sent to storage silos. Granulated sugar is either packaged or transferred to railcars for shipment. The molasses is transferred to storage tanks for further processing. During the beet campaign, pulp material from the sugar beets is pressed and/or dried. It is then sold primarily as animal feed.

Following the beet campaign, the stored thick juice is processed in the sugar end of the factory for processing. This is known as the "juice run", which lasts approximately 110 days. The factory is shut down between campaigns for maintenance and repair work.

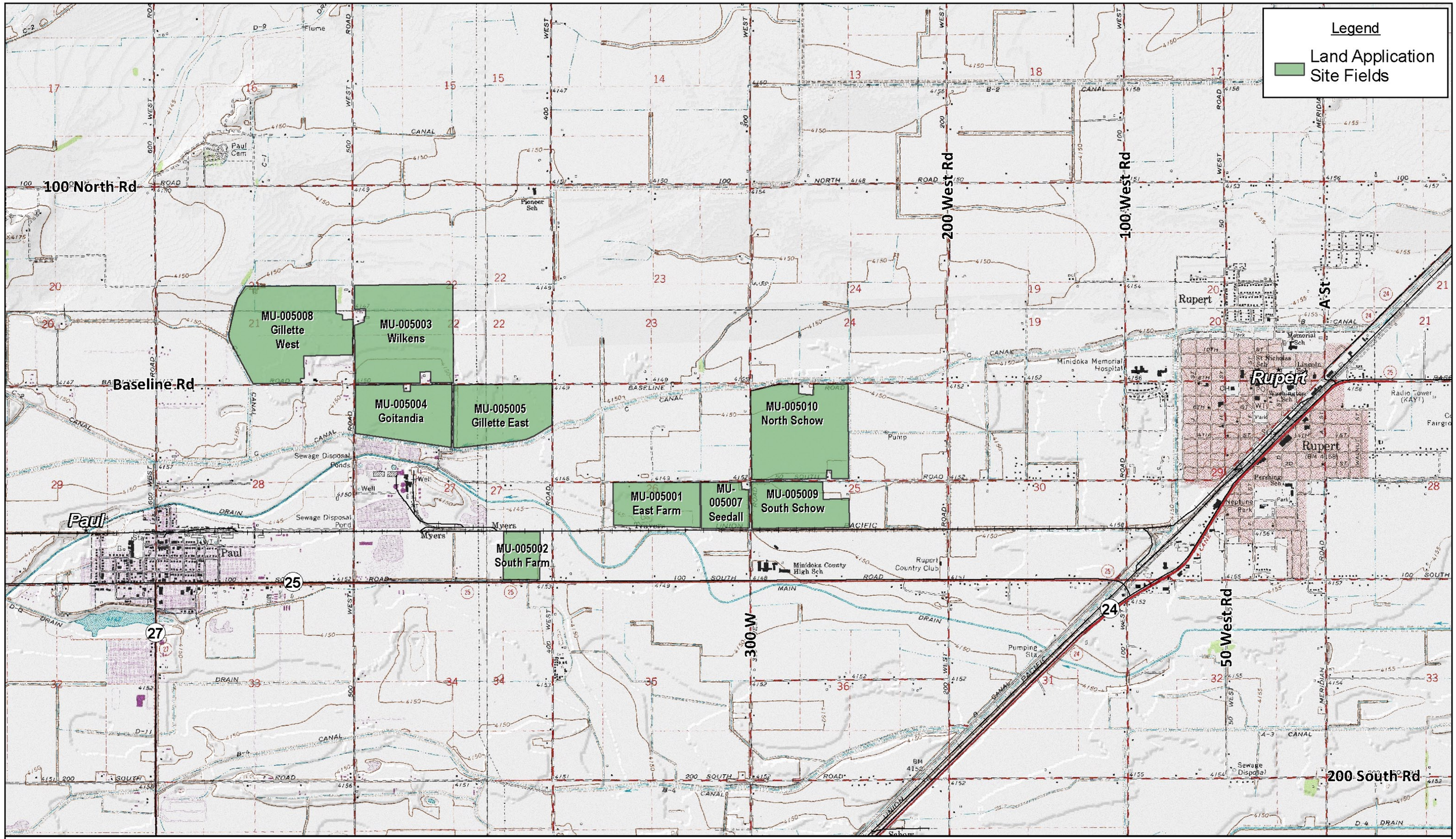
## 1.4 Mini-Cassia Facility

The TASCO Mini-Cassia Facility, which began operation October 28, 1917, is located in an agricultural area approximately two miles east of the town of Paul, Idaho (Figures 1-1 and 1-2). The processing facility is located in Township 9 South, Range 23 East more specifically within Sections 27 with onsite wastewater land application fields in sections 25 and 26. Additional offsite acreage is available in Sections 21 and 22. Both the Minidoka Canal and the Main Drain flow through the facility property. The topography of the area is very flat with slopes listed by the Natural Resources Conservation Service as less than 2 percent.

TASCO property encompasses approximately 975 acres. The processing facility and associated material handling sites cover approximately 400 acres with 27 acres of processing ponds (i.e. mud ponds, flume treatment pond and the sanitation pond).

In addition TASCO owns and manages 518 acres of agricultural land dedicated and permitted for the application of industrial wastewater. The facility also has approximately 57 acres of lined wastewater storage (process and condensate) used in combination with the processing facility and the wastewater land application system.

The current wastewater land application permit lists an additional 395 acres available as offsite management units for the application of condensate.




# Site Map

**The Amalgamated Sugar Company**
**Mini-Cassia Facility, Paul, Idaho**

Map Date: 06/16/10
Q:\TASCO\Paul\map_docs\PaulFigures.mxd

DRG Source: Inside Idaho
Other Data Sources:US Censue Bureau

HDR | ONE COMPANY *Many Solutions*℠

**Figure 1-1**

N

0 1,000 2,000 3,000 Feet

# Land Application Map

The Amalgamated Sugar Company
Mini-Cassia Facility, Paul, Idaho

Map Date: 06/16/10
Q:\TASCO\Paul\map_docs\PaulFigures.mxd

Imagery: 2009 1 meter resolution NAIP
Source: NRCS Digital Gateway
Other Data Sources:US Censue Bureau

HDR | ONE COMPANY Many Solutions℠

**Figure 1-2**

# 2.0 Process and Wastewater Systems

The wastewater land application system consists of many interconnected systems. Figure 2-1 provides a simplified schematic of the process and wastewater systems at the facility. Wastewater generated by the facility originates primarily from the processed sugar beets, which contain 75 percent water.

## 2.1 Process Water Systems

The following provides a description of each of the process water systems at the Mini-Cassia facility. These systems may include storage ponds, tanks, concrete basins, pumps, and associated piping.

**Flume System**

In 2008, the facility upgraded the flume water system for more effective removal of solids. The flume water system is a closed-loop system used to clean and transport beets into the factory. The flume water conveys the beets through a series of washers and rock catchers before the sugar beets are sliced. The flume water is then transferred to rotary screens to remove beet chips and then to vibratory screens to remove small organic matter (tailings). The water then flows into the primary clarifier for solids removal. The overflow of the clarifier is recirculated back to the beet washer. Underflow from the clarifier is pumped to the hydroclones and belt presses. The spray wash water from the belt presses is transported to the mud pond to remove remaining solids. Clarified water from the mud pond is then returned to the flume system. Make up water to the flume system is provided by the flume excess pond or condensate water.

**Lime Water System**

In 2007, a dry lime handling system was installed eliminating the previous wet handling of the juice purification process residuals.

**Scrubber Water System**

A flue gas desulphurization (FGD) system (dual-alkali) was installed in 2004 as a prerequisite for the dry lime handling system. Water from the scrubber is pumped to a sedimentation tank to remove fly ash solids. The scrubber water is then pumped to the FGD system for treatment and then recycled back to the boiler and dryer scrubbers. This is a closed loop system. The water is stored and reused each year.

**Fly Ash System**

Bottom ash and multiclone fly ash from the two coal-fired boilers is slurried and settled in the boiler ash system. Clarified water is recirculated back to the boilers. Makeup water for this closed system is provided by the flume excess pond or condensate water.

**Condenser System**

Non-contact cooling water for the barometric condensers on the evaporators and vacuum pans is provided by three cooling towers. Cooled water is recirculated from the cooling towers to the barometric condensers. There are no ponds associated with this system. Makeup water is provided by well water or condensate water.

## Sanitary Lagoon

Domestic waste is discharged to the sanitary lagoon for storage and treatment. The sanitary lagoon is an evaporative lagoon; there are no return flows required for this system.

## Non-Contact Cooling Water

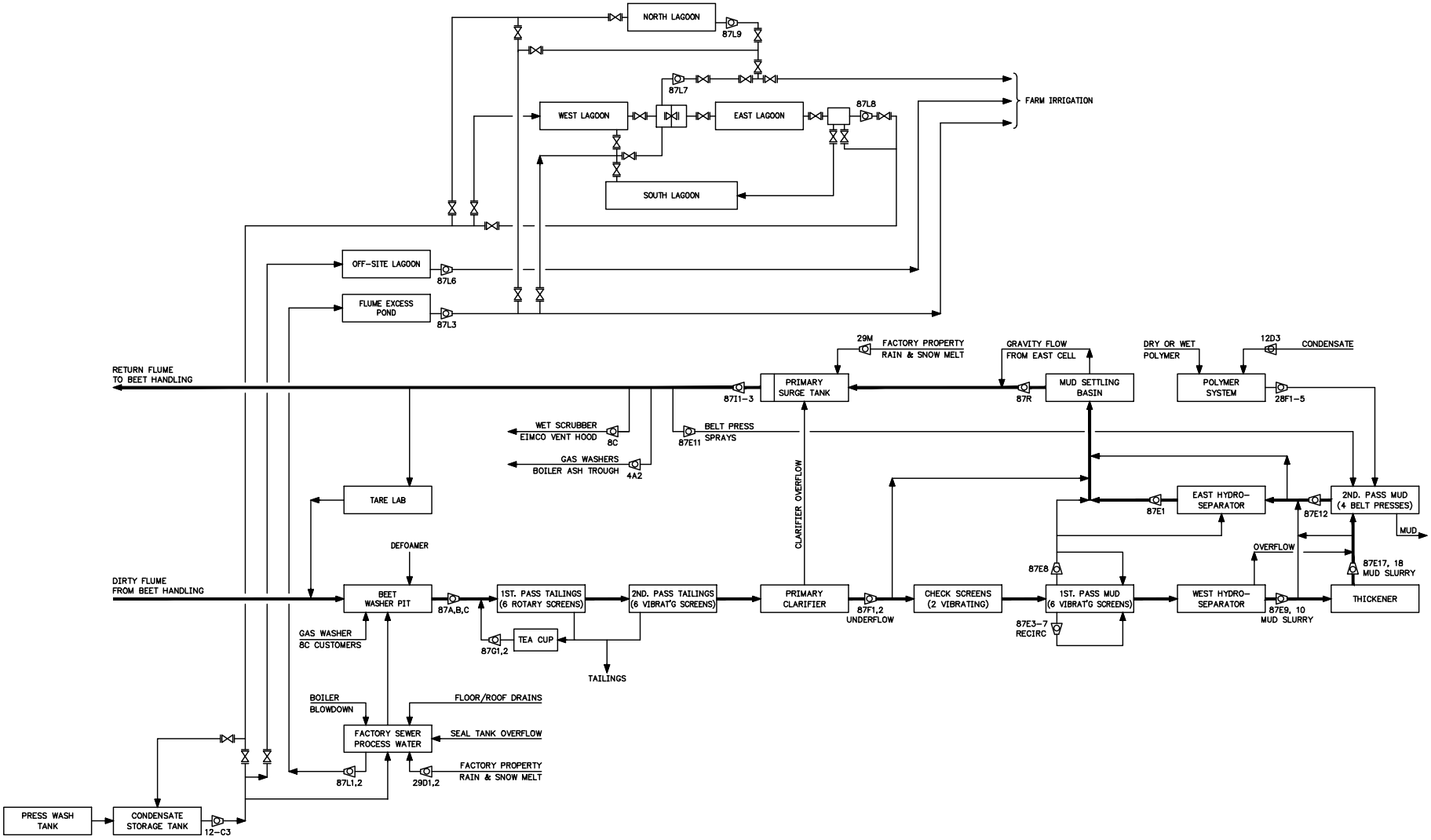
The non-contact cooling water system has been eliminated and the NPDES permit associated with the non-contact cooling water system has been terminated. This cooling system was replaced by a cooling tower located north of the Main Drain.

## Mud Pond System

The facility uses a set of three interconnected mud settling basins to aid in the removal of soil and silt from the flume water system. The mud settling systems are occasionally excavated and the mud solids are transferred to bare land to the east (called the Manning property) for further conditioning prior to final disposal. After each excavation, the basins are relined with bentonite clay and seepage tested.

In 2008 TASCO tested mechanical mud solids separation systems and in 2009, started up a refined system that removes mud solids from the flume system drastically reducing the solids load to the mud settling basins. This solids separation system includes clarification, hydroclones, polymer addition and belt filter presses to produce a filter cake that is further conditioned on the Manning property for ultimate disposal. The conditioned soil is offered to the public for land fill or land reclamation.

FIGURE 2-1 WASTEWATER SYSTEM



## 2.2 Wastewater Types and Treatment

There are two separate sources of wastewater that are land-applied at the Mini-Cassia facility, process water and condensate. Process wastewater originates from many sources and is mechanically aerated to facilitate biological treatment prior to land applying. Condensate consists of condensed vapor from the evaporators. All efforts are made to keep the process water and condensate separated. The following is a discussion of the process water and condensate systems.

**Process Wastewater**

Process wastewater is generated daily from the factory and also from the recycled systems described above. During the beet and juice processing periods, process wastewater is generated from floor washing, roof drains, tank overflows, and other miscellaneous sources. This water enters the main factory drain. The water can be pumped to either the flume excess pond and/or west treatment lagoon for treatment. At the end of the beet processing campaign, water from the recycled flume system, mud pond, and fly ash system is pumped into the flume excess pond and/or west treatment lagoon.

Treatment in either the flume excess or the west treatment lagoon is accomplished by aeration and the goal is to achieve a reduction in chemical oxygen demand (COD). The flume excess pond contains a total of 810 hp of aeration, ten (10) 75 hp and three (3) 20 hp aerators. The west treatment lagoon contains a total of 350 hp of aeration, seven (7) 50 hp aerators. All aerators at the facility are splash-type aerators. Aeration of the process water typically begins in late March following the end of the beet processing campaign. Initial COD and total dissolved solids (TDS) concentrations are approximately 30,000 mg/L and 15,000 mg/L, respectively. The process water is treated for approximately five months prior to land applying. Following aeration, average COD and TDS concentrations of the treated water are 1,080 mg/L and 1,700 mg/L, respectively.

Treated process water from the west lagoons and flume excess pond is applied to onsite farms. Additionally, treated process water from the flume excess pond is used to fill the recycled flume, mud pond, and ash systems prior to the start of each beet processing campaign.

**Condensate**

Condensate originates from the water contained within the sugar beets. This water is produced from the evaporators, which are used to concentrate sugar juices. Condensate is relatively clean with very low TDS and only small amounts of COD and ammonia.

During the beet processing campaign, condensate is either stored or land-applied. Condensate is stored in one of four lined lagoons, the offsite, north, east or south lagoons. Following the beet processing campaign, the stored condensate is reused during the juice run. The condensate is reused in the evaporation process and reduces the need for softened well water. This significantly reduces softener regeneration salt waste to the process water system and ultimately reduces TDS loadings to the land application system.

Condensate is applied to both onsite and offsite acreage (permitted wastewater land application fields not owned by TASCO). Only condensate is made available for application to the offsite management units. This water is excellent for crops, since it provides a source of ammonia nitrogen.

## 2.3 Pond Storage

As previously discussed, ponds are utilized for storage, treatment, and reuse of wastewater. Surface areas and operating volumes of the storage ponds are described in Table 2-1. The ponds at the plant site cover a total area of approximately 73 acres. Operating volumes and days of operation for each pond vary throughout the year. All process ponds are in operation during the beet campaign and are typically maintained at approximately 70-90 percent of maximum capacity when in use. Condensate ponds are operated on an as needed basis and the volume will grow as the beet processing campaign proceeds. Prior to the start of a new campaign, most ponds are empty.

As required in Schedule C of TASCO's existing permit, a seepage test was conducted for each pond. All ponds tested met the permitted seepage criteria (0.25 in/d for existing ponds and 0.125 in/d for newly constructed ponds).

## 2.4 Wastewater Volumes and Quality

Wastewater production rates from the 1995-96 campaign through 2009 are provided in Table 2-2 and shown on Figure 2-2 (also see Appendix 2-1). More condensate water is produced because of increase in beet slice. This has increased the amount of wastewater applied to approximately 105 million gallons (MG) per annum. Of this, approximately 30% is process wastewater and approximately 70% is condensate.

A summary of the quality of the treated process wastewater and condensate that was land-applied during the term of the current permit is provided in Table 2-3. Wastewater concentrations (nitrogen and non volatile dissolved solids-NVDS) and loads (nitrogen, NVDS and TDS) are plotted on Figures 2-3 and 2-4. No process water was applied to the WLAP system in 2006 but was held over the next campaign and applied in 2007. This is reflected in the increase in TDS/NVDS load from process water in 2007. Discounting the 2005-06 to 2006-07 time periods, the TDS, NVDS load has remained relatively stable over the period of the permit.

## Table 2-1 Estimated Pond Wetting Periods, Surface Areas, and Operating Volumes TASCO, Mini-Cassia

| Pond | Seepage Test | | Days Wetted | Surface Area | Operating Volume (MG) | |
|---|---|---|---|---|---|---|
| | Year | (in/day) | per year | (acres) | Minimum | Maximum |
| Fly Ash | 1995 | 0.1260 | 268 | 3 | 0 | 2 |
| Flume Excess | 1995 | 0.0600 | 365 | 9 | 10 | 22 |
| Mud | 2007 | 0.1730 | 200 - 365 | 15 | 0 | 4 |
| West Lagoon | 1995 | 0.0100 | 120 - 365 | 5.2 | 0 | 20 |
| East Lagoon | 2005 | 0.1250 | 0 - 200 | 5.2 | 0 | 22 |
| South Lagoon | 2002 | 0.0725 | 0 - 200 | 13.25 | 0 | 66* |
| North Lagoon | 2007 | 0.0520 | 300 - 365 | 19 | 0 | 81 |
| Sanitary Lagoon | 1997 | 0.0580 | 365 | 2 | 2 | 3 |
| Condensate Surge Pond (Hot-tub) | 1995 | 0.0100 | 300 - 365 | 1 | 0 | 2 |
| Lime Pond - Abandoned | 1996 | 0.0540 | 0 | 18 | | |
| Scrubber A - Abandoned | 1996 | 0.0290 | 0 | 2 | | |
| Scrubber B - Abandoned | 1996 | 0.0100 | 0 | 1 | | |
| Farm Surge Pond - Abandoned | | | | | | |

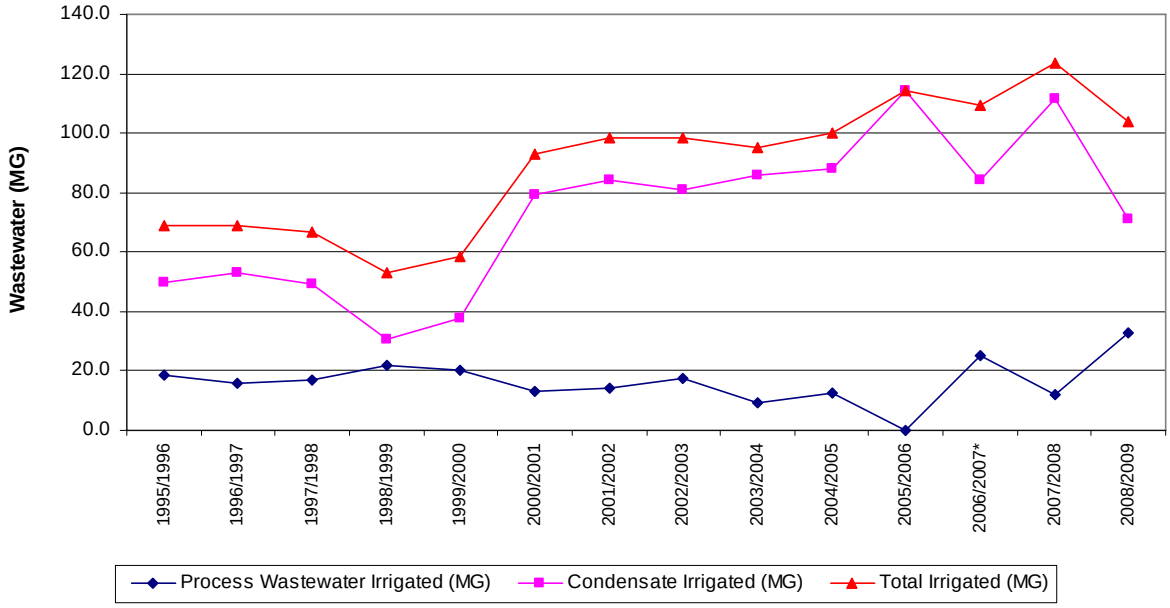
*South Lagoon prior to expansion in 2003 was 42 (MG)

**Table 2-2 Volume of Wastewater Land Applied**
**TASCO, Mini-Cassia**

| Campaign | Process Wastewater Irrigated (MG) | Condensate Irrigated (MG) | Total Irrigated (MG) | Process Wastewater Irrigated Onsite (MG) | Condensate Irrigated Onsite (MG) | Condensate Irrigated Offsite (MG) |
|---|---|---|---|---|---|---|
| 1995/1996 | 18.8 | 50.0 | 68.8 | 18.8 | 0.0 | 50.0 |
| 1996/1997 | 15.9 | 53.3 | 69.1 | 15.9 | 0.0 | 53.3 |
| 1997/1998 | 17.1 | 49.5 | 66.6 | 17.1 | 0.0 | 49.5 |
| 1998/1999 | 22.1 | 30.7 | 52.8 | 22.0 | 0.0 | 30.7 |
| 1999/2000 | 20.4 | 37.9 | 58.3 | 20.4 | 20.4 | 17.4 |
| 2000/2001 | 13.3 | 79.5 | 92.8 | 13.3 | 58.0 | 21.5 |
| 2001/2002 | 14.2 | 84.4 | 98.6 | 14.2 | 44.1 | 40.3 |
| 2002/2003 | 17.5 | 81.0 | 98.6 | 17.5 | 48.7 | 32.3 |
| 2003/2004 | 9.2 | 85.7 | 94.9 | 9.2 | 41.2 | 44.5 |
| 2004/2005 | 12.4 | 87.8 | 100.2 | 12.5 | 47.9 | 39.9 |
| 2005/2006 | 0.0 | 114.5 | 114.5 | 0.0 | 75.8 | 38.7 |
| 2006/2007* | 25.0 | 84.2 | 109.2 | 25.0 | 65.8 | 18.4 |
| 2007/2008 | 12.1 | 111.6 | 123.8 | 12.1 | 102.9 | 8.8 |
| 2008/2009 | 32.98 | 70.88 | 103.9 | 32.98 | 66.37 | 4.5 |

*Goitiandia and East Gillette Farms were incorporated into the onsite farms Fall 2006.

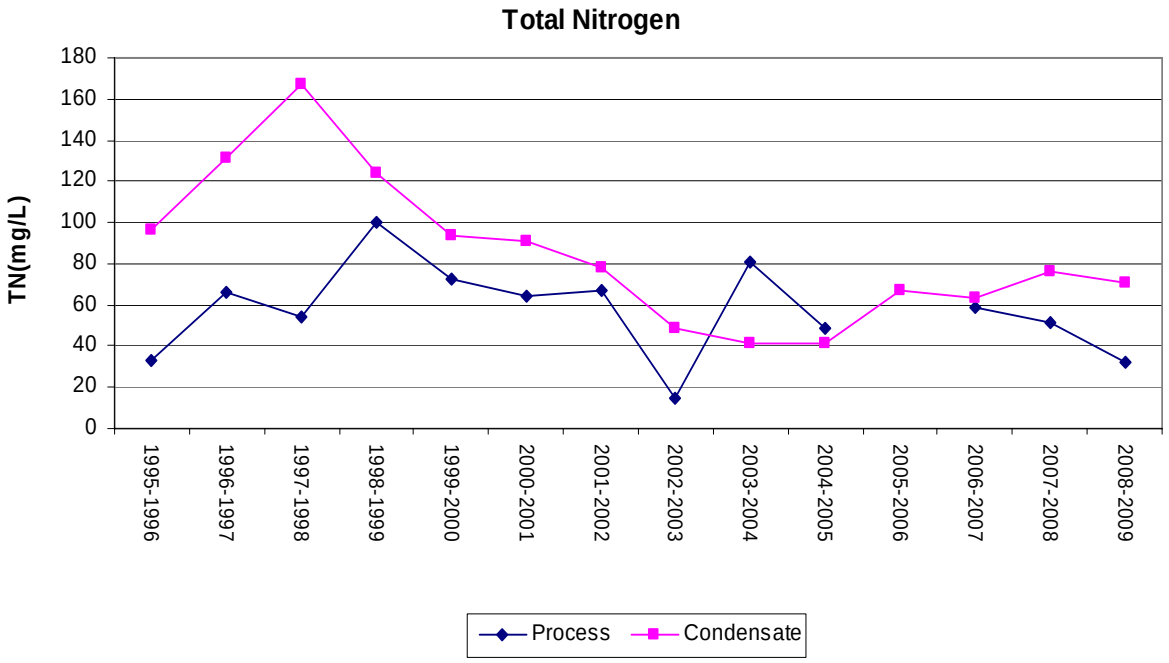
**Figure 2-2 Mini-Cassia Wastewater Production**
**TASCO, Mini-Cassia**

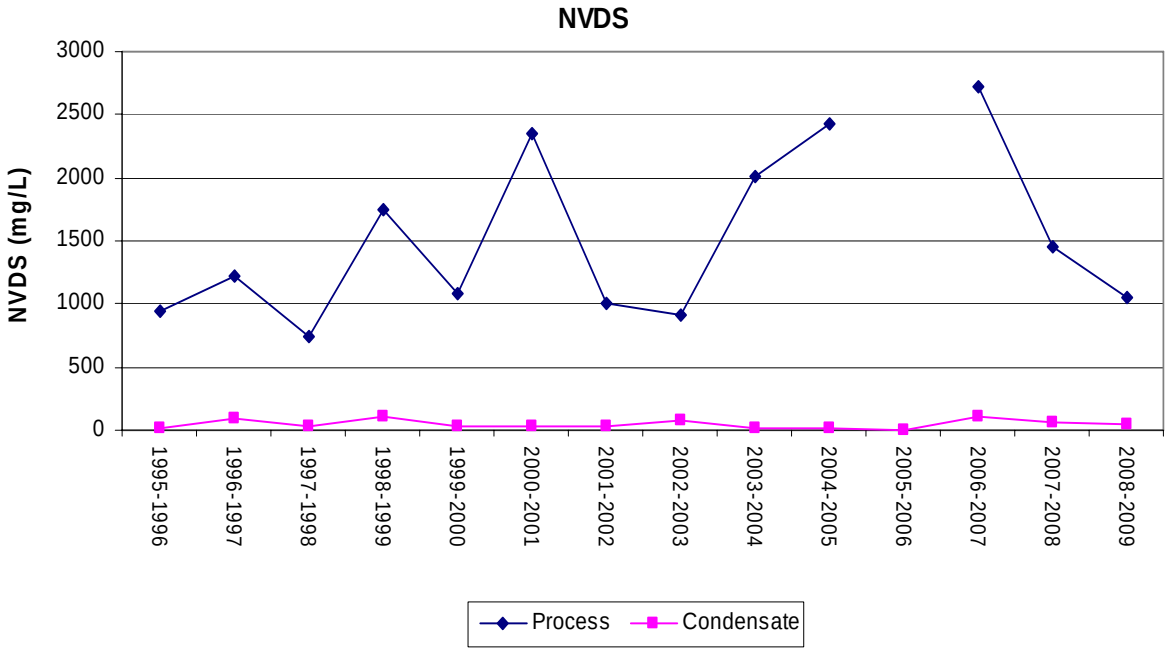


## Table 2-3 Wastewater Quality Summary
## TASCO-Mini-Cassia

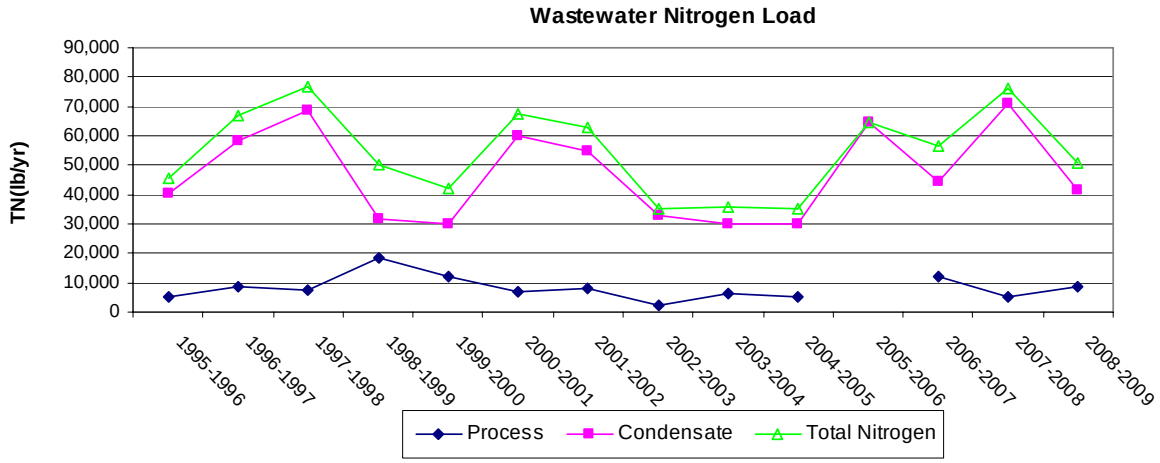
| Sample Location | Campaign Year | Calcium (mg/L) | COD (mg/L) | Chloride (mg/L) | Ammonia (mg/L) | Kjeldahl (mg/L) | Nitrate (mg/L) | Total Phos. (mg/L) | TDS (mg/L) | VDS (mg/L) | E.C. (uhmos/cm) | Total Coli (count) | Sulfate (mg/L) | Sodium (mg/L) | Magnesium (mg/L) | Potassium (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Condensate Water | 1995-1996 | 13.00 | 198 | 0.42 | 101.00 | 107.30 | -1.00 | -0.50 | 50 | 25 | 447 | 6 | 1.13 | 0.30 | 0.00 | 0.43 |
| | 1996-1997 | 1.00 | 232 | 1.80 | 128.70 | 142.20 | -1.00 | -0.20 | 168 | 76 | 495 | 43 | 3.10 | 3.18 | 0.21 | 11.74 |
| | 1997-1998 | 3.40 | 188 | 1.36 | 125.30 | 152.80 | -1.00 | 0.13 | 104 | 43 | 537 | 440 | 4.80 | 0.80 | 0.54 | 1.05 |
| | 1998-1999 | 16.00 | 104 | 4.63 | 79.90 | 92.40 | -1.00 | 0.40 | 133 | 20 | 494 | 1239 | 7.80 | 4.20 | 0.90 | 2.02 |
| | 1999-2000 | 15.74 | 109 | 6.89 | 64.02 | 68.01 | -0.07 | 0.05 | 98 | 28 | 496 | 73 | 13.73 | 6.37 | 4.75 | 1.61 |
| | 2000-2001 | 2.73 | 339 | 3.23 | 72.22 | 90.86 | 1.32 | 0.11 | 42 | 8 | 492 | 449 | 0.00 | 0.81 | 0.64 | 1.40 |
| | 2001-2002 | 1.45 | 217 | 1.10 | 69.11 | 77.05 | -0.06 | 0.14 | 45 | 5 | 350 | 9101 | 3.05 | 0.61 | 0.47 | 1.09 |
| | 2002-2003 | 23.57 | 269 | 10.89 | 32.57 | 43.18 | 0.25 | 0.85 | 161 | 66 | 325 | 21166 | 28.81 | 7.35 | 5.96 | 14.97 |
| | 2003-2004 | 16.28 | 252 | 4.17 | 42.99 | 52.08 | 0.10 | 0.33 | 154 | 76 | 369 | 13026 | 22.01 | 6.57 | 1.87 | 6.98 |
| | 2004-2005 | 4.11 | 107 | 0.48 | 36.13 | 43.96 | -0.02 | 0.60 | 39 | 23 | 212 | 6559 | 1.27 | 0.03 | 0.23 | 0.15 |
| | 2005-2006 | 3.03 | 218 | 0.42 | 47.77 | 58.85 | 0.19 | 0.20 | 30 | 23 | 257 | 9801 | 1.02 | 0.02 | 0.19 | 0.30 |
| | 2006-2007 | 6.93 | 184 | 3.31 | 53.5 | 62.83 | -0.04 | 0.92 | 194 | 116 | 430 | 23262 | 2.42 | 7.51 | 1.18 | 3.65 |
| | 2007-2008 | 5.38 | 165 | -1.96 | 59.31 | 73.23 | -0.24 | 0.39 | 67 | 18 | 521 | 2249 | -2.13 | 1.71 | 1.36 | 0.59 |
| | 2008-2009 | 13.68 | 276 | 1.54 | 47.99 | 65.44 | -0.30 | 0.66 | 133 | 83 | 546 | 140072 | 6.38 | 2.98 | 1.61 | 3.89 |
| Process Water | 1995-1996 | 57.10 | 494 | 201.00 | 3.50 | 28.50 | 0.20 | 1.91 | 1183 | 252 | 1513 | 18337 | 214.00 | 164.00 | 16.15 | 138.00 |
| | 1996-1997 | 60.10 | 408 | 193.00 | 41.20 | 66.75 | -1.00 | 1.42 | 1520 | 165 | 2170 | 101000 | 344.00 | 181.50 | 45.50 | 229.00 |
| | 1997-1998 | 57.40 | 657 | 191.00 | 1.08 | 24.80 | 10.50 | 1.21 | 1640 | 358 | 2085 | 200000 | 438.00 | 170.00 | 61.30 | 256.00 |
| | 1998-1999 | 206.50 | 4630 | 240.00 | 15.20 | 125.00 | -1.00 | 7.80 | 4880 | 2560 | 3790 | 1500 | 240.00 | 222.00 | 210.90 | 394.00 |
| | 1999-2000 | 128.25 | 1026 | 105.70 | 46.01 | 82.38 | 8.63 | 2.29 | 1770 | 683 | 2090 | 1419810 | 403.15 | 114.45 | 62.68 | 201.93 |
| | 2000-2001 | 221.07 | 1454 | 258.67 | 12.33 | 68.87 | -0.03 | 1.72 | 3283 | 1057 | 2401 | 14200 | 0.00 | 194.67 | 148.73 | 393.67 |
| | 2001-2002 | 137.50 | 753 | 89.63 | 40.73 | 66.10 | -0.10 | 0.93 | 1430 | 432 | 1803 | 7803 | 338.33 | 85.53 | 44.73 | 126.80 |
| | 2002-2003 | 99.80 | 1210 | 120.00 | 11.00 | 0.36 | 7.59 | 11.50 | 1790 | 330 | 2240 | 21420 | 1140.00 | 128.00 | 103.00 | 220.00 |
| | 2003-2004 | 138.00 | 640 | 409.00 | 10.50 | 65.40 | 46.40 | 3.11 | 5248 | 930 | 6580 | 22000 | 1814.00 | 449.00 | 30.90 | 870.00 |
| | 2004-2005 | 60.67 | 562 | 286.67 | 29.70 | 48.47 | 0.01 | 1.94 | 3263 | 830 | 4510 | 1413333 | 180.30 | 365.33 | 259.33 | 630.00 |
| | 2005-2006* | * No Process irrigated | | | | | | | | | | | | | | |
| | 2006-2007 | 97.63 | 477 | 289.08 | 12.505 | 48.35 | 9.09 | 3.17 | 3176 | 701 | 5150 | 579025 | 445.83 | 575.50 | 134.93 | 730.00 |
| | 2007-2008 | 64.10 | 268 | 179.00 | 3.84 | 29.8 | 22.00 | 1.94 | 1790 | 340 | 2520 | 141000 | 325.00 | 309.00 | 42.20 | 356.00 |
| | 2008-2009 | 40.05 | 457 | 157.00 | 9.75 | 27.93 | 0.74 | 2.44 | 1745 | 350 | 2469 | 782495 | 351.75 | 786.25 | 45.85 | 1038.90 |

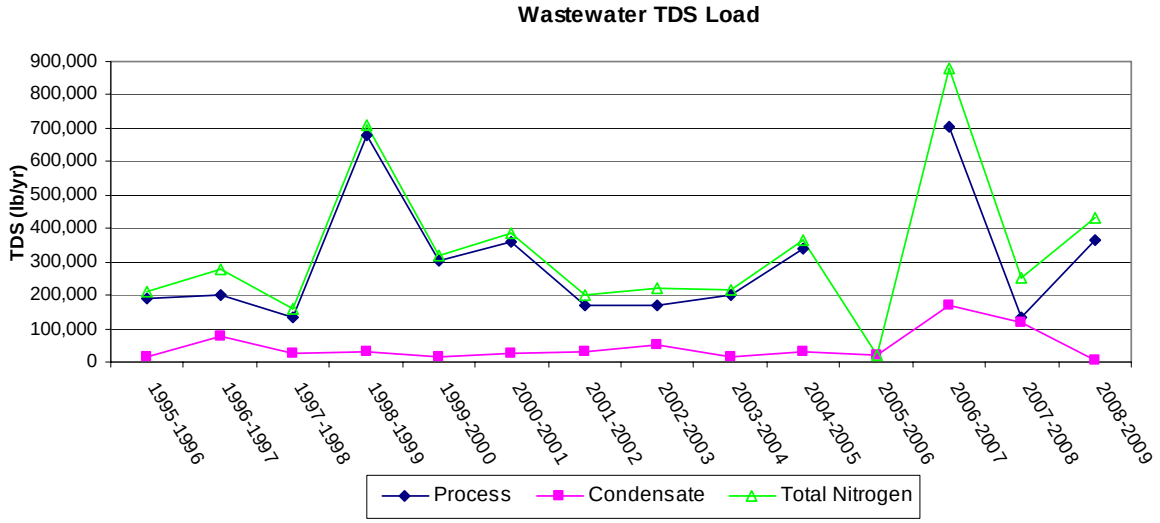
**Figure 2-3 Wastewater TN and NVDS**
**TASCO, Mini-Cassia**

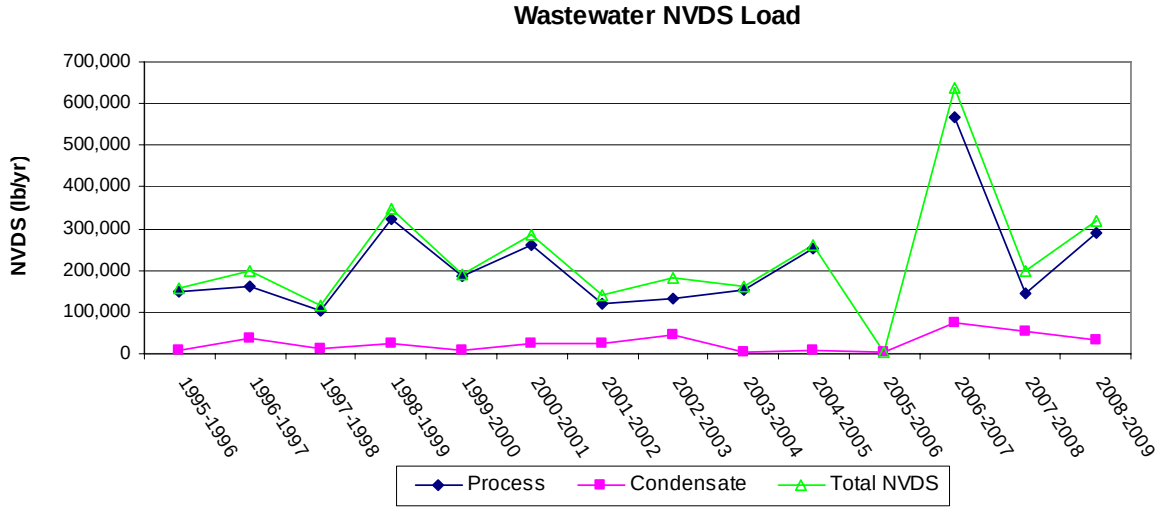


## Figure 2-4 Wastewater Loads
## TASCO, Mini-Cassia




** Wastewater is the sum of the process and condensate wastewater

## 2.5 Land Application Sites

Sites for applying wastewater are divided into onsite and offsite fields (Figure 1-2). In accordance with IDEQ procedures, each field has been designated as a management unit for monitoring wastewater loading rates and other data. Table 2-4 includes a summary of the land application sites, including onsite and offsite fields.

The onsite fields (known as the East, South, Seedall, North Schow and South Schow Farms) are owned and fully managed by TASCO. In February of 2003 and in January of 2004, TASCO notified the Department of the purchase of the East Gillette (MU-005005) and the Goitiandia (MU-005004) respectively. In Fall of 2006, TASCO requested a modification to the permit reflecting the Goitiandia and East Gillette (GnG) Management Units (MU) be transferred from offsite to onsite and on November 30$^{th}$, 2006 IDEQ granted that request. Process water and condensate is applied to the onsite acreage.

The offsite acreage is owned by individual farmers. TASCO has an agreement with the local farmers to apply only the high-quality condensate. This water is beneficial to the farmers due to the ammonia, which provides a source of fertilizer for the crops. Wastewater is sprinkler-irrigated by either a pivot, hand lines or wheel lines.

## 2.6 System Improvements/Modifications

Improvements to the land application system at the Mini-Cassia facility have focused on purchasing or leasing additional land, water reuse and conservation activities, storage, and process improvements. A detailed discussion of the improvements since the 1995 permit was issued and is included in Appendix 2-2. Significant improvements implemented over this period include:

1. Nov. 1996: The West Gillette (MU-005008)155 acres added to the WLAP program.

2. Feb. 2000: An additional 220 acres of land purchased at a cost of over $1 million.
   a. South Schow (MU-005009) 65 acres added to the WLAP program.
   b. North Schow (MU-005010) 155 acres added to the WLAP program.

3. Feb 2003 – January 2004: Two management units previously permitted as offsite MUs now owned and under direct control by TASCO. Nov. 2006 both units are permitted as onsite MUs.
   a. East Gillette (MU-005004) 89 acres under direct control of TASCO.
   b. Goitiandia (MU-005005) 87 acres under direct control of TASCO.

4. Summers of 1993 and 1998: Approximately 85 MG of storage and/or treatment lagoons installed at a cost of approximately $3 million.
   a. West Lagoon – Process Wastewater treatment –20 MG.
   b. East Lagoon- Condensate Storage – 22 MG.
   c. South Lagoon-Process / Condensate Wastewater –42 MG.

d. In 2002 the height of the walls of the South Lagoon were modified to increase the lagoons capacity to 66 MG)

e. March 2007: An additional 81 million gallons of poly-lined condensate storage was installed (North Lagoon).

Annually, approximately 56 MG of condensate is recycled during the juice run to significantly reduce the need for soft water

As a result of the construction of the east, west and south lagoons, part of the onsite East Farm (MU-005001) was taken out of service. The east and west lagoon system was constructed during 1993. In 1998 the south lagoon was added. Approximately 28 acres of topsoil were required for building the dikes. During the 1998-1999 beet campaign, this area was used to compost dirt/material recovered from the dry beet handling system. The composted dirt and mud pond dirt were used to replace the top soil. This reduced the area of the East Farm to approximately 40 acres. Since it was anticipated that the nutrient and electrical conductivity (EC) levels would be elevated, wastewater was not applied to the western section of the East Farm allowing for natural attenuation of the mentioned constituents. Recently, soils analyses have shown a reduction to reasonable levels and wastewater application has resumed. The total acreage available for wastewater application on the East farm has been reduced from the original 80 acres to the current 60 acres (see Figure 2-5).

To replace the onsite acreage lost for the construction of the South Lagoon, TASCO purchased a 65-acre parcel, known as the South Schow Farm, in 1998. TASCO notified the IDEQ for de minimis application on October 23, 1998. In 1999, TASCO purchased a 155-acre parcel known as the North Schow Farm. On February 11$^{th}$, 2000 the IDEQ modified Mini-Cassia's Wastewater Land Application Permit to allow for non-growing season (NGS) application of condensate on South and North Schow through March 31, 2000 (Allred, February 11, 2000). On November 6$^{th}$, 2000, IDEQ granted permission to apply condensate water during the NGS for the 2000-2001 campaign. On January 9$^{th}$, 2002, IDEQ granted permission to apply condensate during the NGS for the 2001-02 campaign. On April 22$^{nd}$ 2002, IDEQ granted permission to apply condensate for the month of April, 2002. On September 20$^{th}$, 2002, IDEQ granted a modification to the permit to allow non-growing season applications to the North and South Schow Farms. This final modification was not limited to a specific year and TASCO has continued to managing the non-growing season applications to the Schow Farms in accordance with this permit modification (Dave Anderson, September 20, 2002).

## Table 2-4 Land Application - Management Unit Description
## TASCO, Mini-Cassia

| System/Field | Management Unit | Size (acres) | Initial Date of Application | Wastewater Method of Application | Wastewater Schedule of Application |
|---|---|---|---|---|---|
| **Onsite System** | | | | | |
| East* | MU-01 | 60 | Late 1970s | Hand/Wheel Lines | GS and NGS |
| South | MU-02 | 27 | Late 1970s | Hand/Wheel Lines | GS and NGS |
| Goitiandia** | MU-04 | 87 | Fall 2006 | Hand/Wheel Lines | GS and NGS |
| East Gillette** | MU-05 | 89 | Fall 2006 | Hand/Wheel Lines | GS and NGS |
| Seedall | MU-07 | 35 | Summer 1995 | Hand/Wheel Lines | GS and NGS |
| South Schow | MU-09 | 65 | August 1999 | Hand/Wheel Lines | GS and NGS |
| North Schow | MU-10 | 155 | February 2000 | Hand/Wheel Lines | GS and NGS |
| Subtotal | | 518 | | | |
| **Offsite System** | | | | | |
| Wilkins | MU-03 | 160 | November 1992 | Hand/Wheel Lines | GS and NGS |
| Goitiandia** | MU-04 | ~~87~~ | Oct. 1992 - 2006 | Hand/Wheel Lines | GS and NGS |
| East Gillette** | MU-05 | ~~89~~ | Fall 1994 - 2006 | Hand/Wheel Lines | GS and NGS |
| Fisk-Blacker | MU-06 | 80 | Fall 1995 | Wheel Lines | GS and NGS |
| West Gillette | MU-08 | 155 | November 1996 | Pivot/Hand/Wheel lines | GS and NGS |
| Subtotal | | 395 | | | |
| **Total** | | **913** | | | |

* The East Farm was reduced in size from the original 80 acres to the current 60 acres. See drawing 2-5 below.
** These farms were offsite farms until the fall of 2006 when they were permitted as onsite farms.

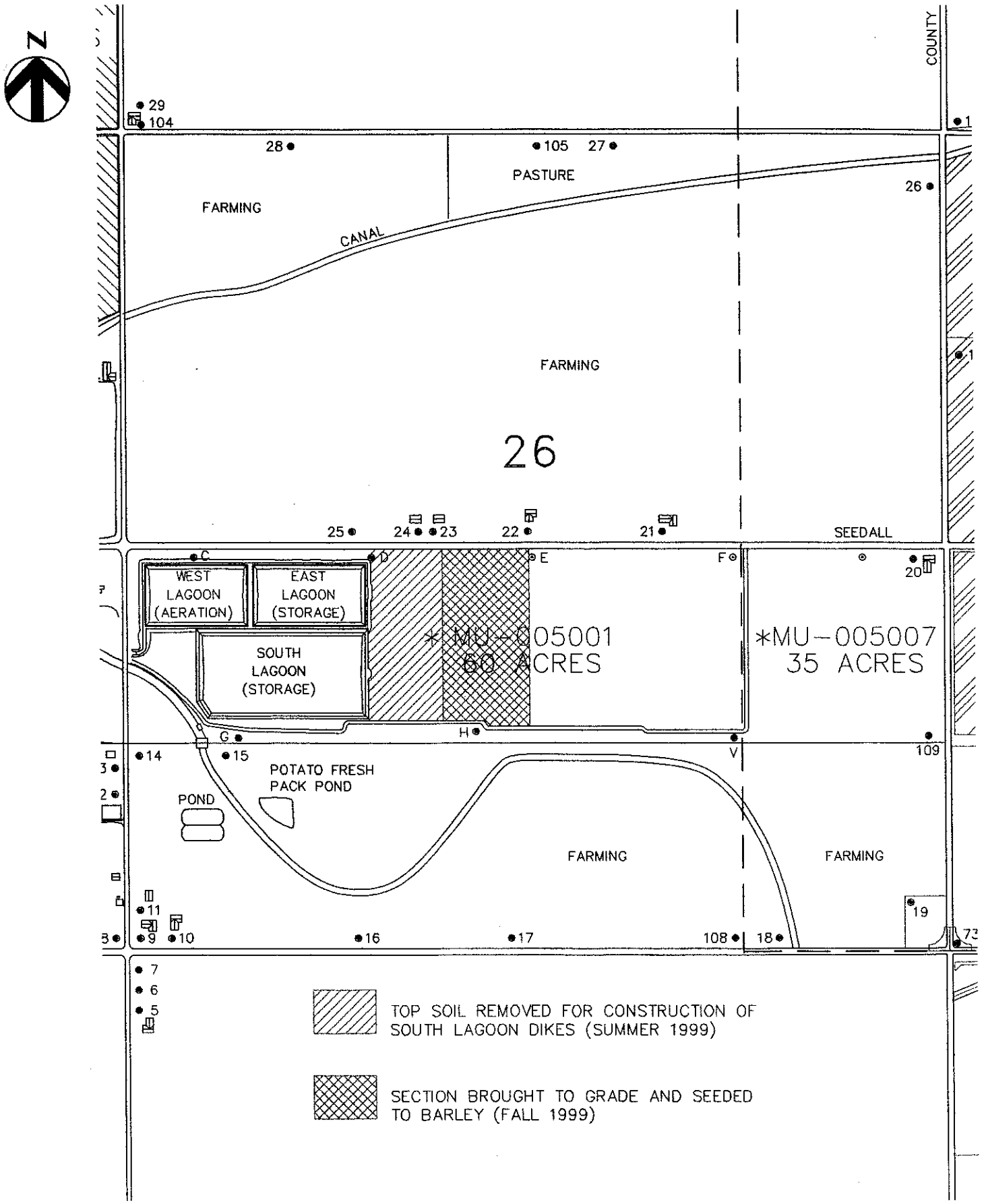



FIGURE 2-5 - EAST FARM ACREAGE REDUCTION

# 3.0 *Land Application System Operation and Management*

The land application system at the Mini-Cassia facility is managed and operated by applying wastewater to crops for beneficial reuse in accordance with IDEQ-approved loading rates. The effectiveness of the land application system is continually evaluated using environmental monitoring data. The current Wastewater Land Application Permit (No. LA-000050-02) issued by the IDEQ includes hydraulic and constituent loading limitations and other requirements, including the development of management plans. The land application system is operated and managed in accordance with the permit requirements.

## 3.1 Wastewater Land Application Permit

The permit that is being renewed was originally issued on July 5, 1995, and expires on July 1, 2000. The following modifications have been approved by the IDEQ:

| Date | Modification |
|---|---|
| November 27, 1996 | 155 acres of offsite land (West Gillette) were added to the permit. De minimis criteria were also added to the permit to enable adding land to the facility without technical review or modifying the permit. |
| April 14, 1997 | Facility name change to The Amalgamated Sugar Co. LLC |
| February 11, 2000 | 220 acres of onsite land (N. & S. Schow) were added to the permit to apply condensate during the 1999-2000 growing season. |
| October 30, 2006 | Memorandum for 2nd Draft Permit Modification eliminated the total hydraulic loading limit. |
| November 30, 2006 | Management Units 005004 and 005005 (Goitiandia and East Gillette) were transferred from offsite to onsite management units. Permit wide hydraulic loading limits were dropped from the full permit at this time. |

A summary of the hydraulic and constituent loading rates for each management unit as specified in Schedule A of the permit is included in Table 3-1. In general, loading rates are based on IDEQ's *Handbook for Land Application of Municipal and Industrial Wastewater* and its most recent replacement, *Guidance for Reclamation and Reuse of Municipal and Industrial Wastewater (2007)*. Hydraulic and nutrient loading limits are included for both the growing season and non-growing season. Growing season nutrient loading rates are set at levels that provide necessary nutrients for plant growth while hydraulic loading limits are set at the Irrigation Water Requirement. Non-growing season and offsite acreage hydraulic loading limits are very low and set at levels based on average soil water holding capacities.

Schedule B of the current WWLAP permit outlines the monitoring and reporting requirements for the land application system. Monitoring data for the land application is submitted annually to the IDEQ in a Wastewater Land Application Site Performance Report.

Schedule C of the permit outlines permit compliance conditions and schedules for completion. Table 3-2 summarizes the status of each condition in Schedule C.

## Table 3-1 Current Permitted Loading Rates
## TASCO Mini-Cassia

| Acreage/Site Loading Limits | Onsite Acreage MU-005001 & MU-005002 | Onsite Acreage Goitiandia & East Gillette MU-005004 & MU-005005 | Offsite Acreage | Seedall Acreage MU-005007 | South Schow MU-005009 | North Schow MU-005010 |
|---|---|---|---|---|---|---|
| | Permit | Permit | Permit | Permit | Permit | Permit |
| Acres | 87 | 176 | 395 | 35 | 65 | 155 |
| WW Loading Total in. | Crop Consumptive Use Divided by Irrigation | Crop Consumptive Use Divided by Irrigation | 9.5 | Crop Consumptive Use Divided by Irrigation | Crop Consumptive Use Divided by Irrigation | Crop Consumptive Use Divided by Irrigation |
| WW Loading NGS in. | 7 | 9.5 | 9.5 | 7 | 5.8 | 7.5 |
| WW NVDS Loading lbs/ac/yr | 7600 | 4000 (Total)<br>642 (NGS) | 642 | 2500 | 4000 (Total)<br>642 (NGS) | 4000 (Total)<br>642 (NGS) |
| GS COD Loading lb/ac/day | 50 | 50 | 50 | 50 | 50 | 50 |
| NGS COD Loading lb/ac/day | 25 | 25 | 25 | 25 | 25 | 25 |
| Nitrogen Loading lbs/ac/yr (Includes fertilizer application and WW nitrogen loadings) | 150% of crop uptake or 300 lbs/ac/yr | 150% of crop uptake | 150% of crop uptake or 300 lbs/ac/yr | 150% of crop uptake or 300 lbs/ac/yr | 250 (Total)<br>150 (NGS) | 250 (Total)<br>150 (NGS) |
| Phosphorus Loading lbs/ac/yr (Includes fertilizer application and WW phosphorus loadings) | 150% of crop uptake | 150% of crop uptake | 150% of crop uptake | 150% of crop uptake | 150% of crop uptake | 150% of crop uptake |

## Table 3-2 Status of Permit Schedule C Compliance Conditions

| Item # | Condition or Schedule Description | Status |
|---|---|---|
| 1 | Conduct seepage test | Complete as per DEQ correspondence of December 23, 1996 and August 13, 2004. |
| 2 | Repair, replace or abandon structures that do not meet seepage test | Schedule dated November 1, 1996 submitted to DEQ (letter to Michael Cook) for the farm surge and mud ponds. Farm surge pond abandonment plan, was submitted to DEQ, on June 29, 1998; the abandonment was finalized by September 1, 1999. The results of the north lagoon test in February 2007 and the mud pond seepage test in September 2007 met the permit requirements. The mud pond was not dredged in 2009 therefore, no seepage testing was performed. The South Lagoon liner was repaired fall 2009 and revetment protection on the liner will be performed summer 2010. A seepage test will be performed after the completion of the project. |
| 3 | Documentation on earthen conveyance structures | Complete as of September 1996. The cooling tower overflow pond was replaced with a gravity flow piping system. |
| 4 | Abandonment of Sanitary Lagoon | TASCO has requested that this requirement be removed from the permit and allow continued operation of the sanitary lagoon (Letter to Lance Nielsen of Oct. 14, 1997). A seepage test of the sanitary lagoon in June 1997 demonstrates that the lagoon is in compliance with Schedule C Item 1. |
| 5 | TDS Management Plan | Completed. TDS Management Plan was submitted to DEQ on June 27, 1997. |
| 6 | Construction of three new monitoring wells (C, M, Seedall) | Complete as per letter to IDEQ dated January 3, 1996 |
| 7 | Well Acceptability Analysis | Completed. The Well Acceptability Analysis was submitted to DEQ on May 1, 1997. An update to the Plan was presented in the April 2000, Permit Renewal Application. TASCO submitted a Well-by-Well Analysis July 15, 2002 at the request of IDEQ. IDEQ and TASCO are currently in discussions regarding the analysis. |
| 8 | Buffer Zone Plan | Completed. Buffer Zones Plan was submitted to DEQ on May 1, 1997. An update to the Plan was presented in the April 2000, Permit Renewal Application. |
| 9 | Nuisance Odor Management Plan | Completed. Odor Management Plan approved by DEQ letter dated March 11, 1996. An update to the Plan was presented in the April 2000, Permit Renewal Application. On August 6, 2003 IDEQ approved an updated Odor Management Plan. |
| 10 | Waste Solids Management Plan | Completed. A Waste Solids Management Plan was submitted on January 2, 1996 and approved in a letter by DEQ dated March 11, 1996. An update to the Plan was presented in the April 2000, Permit Renewal Application. |
| 11 | Reduce/Minimize TDS, iron, manganese impacts in groundwater | Several improvements have been implemented including reuse of condensate and the purchase of additional farm ground. |
| 12 | NVDS current loading determination | Submitted calculations in letter to Michael Cook dated August 1, 1996. An update to the NVDS evaluation was presented in the April 2000, Permit Renewal Application. |
| 13 | Evaluation of current groundwater well monitoring network. | As per condition 13 of the modified Schedule C of the November 30, 2006 permit modification, an evaluation of the monitoring well network was performed (May 2007) and as recommended by the IDEQ (December 4, 2007) two monitoring wells were installed downgradient of the Goitiandia and East Gillette properties. |

## 3.2 Management Plans

In accordance with the permit, TASCO has previously prepared plans for managing odors, total dissolved solids, buffer zones, and solid waste and submitted them to the IDEQ. These plans, which are included as Attachments 1 through 4, are summarized below:

**Nuisance Odor Management Plan (Attachment 1)**

This plan describes TASCO's pro-active approach for reducing and minimizing nuisance odors from wastewater. The plan includes preventative measures, testing procedures, and treatment methods. Nuisance odors associated with wastewater are controlled through the use of chemicals, mechanical aeration, and if necessary, masking agents. TASCO has worked with an odor control expert and chemical suppliers to reduce or eliminate odors. Since the original plan was submitted, 375 hp of additional aerator capacity has been installed in the flume excess pond.

**TDS Management Plan (Attachment 2)**

TASCO is pro-active in terms of installing new and modified systems for reducing TDS in wastewater streams and land application sites. TASCO has developed innovative solutions for reducing TDS at the source. The primary sources of TDS are the beet flume water system and process wastewater. Projects implemented to reduce wastewater TDS levels include:

1. Elimination of the Quentin process;
2. Water Conservation measures;
3. Separation of condensate from process wastewater;
4. Recycle of condensate during juice runs to eliminate the need for softened water;
5. Installation of beet screens to remove dirt and beet parts;
6. Installation of high performance vacuum drum filters and Putsch filters for dry lime handling;
7. Purchase or leasing of additional land;
8. Purchase and installation of hydroclones, polymer addition and belt presses to reduce the amount of solids sent to the mud ponds and ultimately the TDS load to the groundwater.

Overall, TDS loadings to the land application sites have been reduced substantially. With the recent installation of the dry lime handling system and the mud filter presses, TDS loads to the reuse system should be reflected by reduced TDS concentrations in the groundwater.

**Buffer Zone Management Plans (Attachment 3)**

A buffer zone plan has been prepared by TASCO to determine whether a buffer zone between the land application sites and inhabited dwellings or areas accessible to the public is necessary. An evaluation of the potential impacts to the public was conducted for condensate and process water. Based on this analysis, no buffer zones are required. Condensate, which originates from the sugar beets, is of high quality and when discharged to the storage lagoons prior to application, is essentially free of any bacteria. Additionally, an analysis of the wind drift of the wastewater, which is sprinkler irrigated, was conducted by the University of Idaho Research Extension Center. The amount of wastewater drift that can potentially leave the site is negligible. Many adjacent homes have vegetative barriers surrounding the sites.

**Waste Solids Management Plan (Attachment 4)**

There are primarily four types of waste solids generated at the facility: dirt, lime, FGD solids and ash. The management of waste solids is shifting from onsite storage to source reduction and reutilization. Since the initial solids management plan was submitted, TASCO implemented the following improvements:

- Installation of dry beet handling equipment;
- Installation of high-performance vacuum drum filters for handling a portion of the lime dry.
- Installation of a dry lime handling system and the elimination of the Lime Pond.
- Installation of improved tailing screenings to more effectively eliminate beets tops and parts from flume system.
- Installation of hydroclones and belt filter presses to reduce the solids load on the Mud ponds.

**Contingency Plan**

The water and wastewater system has numerous connections with options to divert waters to different ponds. If the wastewater irrigation system fails, the wastewater (process or condensate) can be diverted to any of the storage and treatment ponds (i.e. offsite, west, east, north or south lagoons and the flume excess pond). The storage capacity of these ponds will allow ample time for repairs to the wastewater irrigation system.

During times of extremely low temperatures, wastewater irrigation can be terminated. If this occurs, the wastewater will be diverted to the storage ponds until more favorable weather conditions allow startup of the irrigation system.

If one of the wastewater transport systems fail (i.e. process water or condensate pump and/or piping), backup systems are available to transport the water to the ponds.

**Well Acceptability Analysis**

A well acceptability analysis was completed for the Mini-Cassia factory May 1, 1997, to fulfill one of TASCO's land application permit conditions. A subsequent Well Acceptability Analysis was prepared for the North and South Schow Sites. An update to the plan was presented in the April 2000 Permit Renewal Application. TASCO submitted a Well-by-Well Analysis on June 15, 2002 at the request of IDEQ.

## 3.3 Historical Loading Rates

The Mini-Cassia WLAP includes limits on nitrogen, phosphorous and NVDS. Historical wastewater loading rates for each management unit from the 1995-96 campaign through the most recent campaign (2008-09) are presented in Table 3-3. Hydraulic application is measured by a flow meter at the discharge pump, while nitrogen and non-volatile dissolved solids (NVDS) loading is based on monthly samples collected (ppm) multiplied by the hydraulic application (MG) multiplied by 8.34.

## Table 3-3 Summary of Historical and Current Waste Water Loadings to the Management Units TASCO Mini-Cassia

| | Season | Campaign | Hydraulic Applied | COD Applied | NVDS Applied | Total Nitrogen | |
|---|---|---|---|---|---|---|---|
| | | | | | | Wastewater | Fertilizer |
| | | | (in/ac/yr) | (lb/ac/day) | (lb/ac/yr) | (lb/ac/yr) | (lb/ac/yr) |
| MU-005001 | Growing | 1995-1996 | 4.10 | 1.4 | 932.0 | 30.0 | |
| East Farm | Number of Days | 1996-1997 | 5.45 | 2.7 | 1522.0 | 83.0 | |
| | 215 | 1997-1998 | 4.88 | 0.9 | 695.0 | 66.0 | |
| | | 1998-1999 | 5.84 | 16 | 1935.0 | 142.0 | |
| | | 1999-2000 | 0.24 | 0.2 | 32.0 | 5.0 | |
| | | 2000-2001 | 6.09 | 0.7 | 77.0 | 118.4 | |
| | | 2001-2002 | 3.74 | 2.2 | 1038.9 | 61.9 | |
| | | 2002-2003 | 5.09 | 2.5 | 643.5 | 11.8 | |
| | | 2003-2004 | 3.31 | 0.4 | 20.9 | 17.6 | |
| | | 2004-2005 | 7.39 | 2.1 | 1490.0 | 52.3 | |
| | | 2005-2006 | 4.09 | 0.2 | 23.6 | 16.0 | |
| | | 2006-2007 | 5.76 | 1.8 | 2158.3 | 47.0 | |
| | | 2007-2008 | 7.61 | 1.5 | 1414.4 | 87.6 | |
| | | 2008-2009 | 8.40 | 3.5 | 1661.2 | 44.4 | |
| | | | | | | | |
| | Non-Growing | 1995-1996 | 0.00 | 0.0 | 0.0 | 0.0 | |
| | Number of Days | 1996-1997 | 0.00 | 0.0 | 0.0 | 0.0 | |
| | 150 | 1997-1998 | 0.00 | 0.0 | 0.0 | 0.0 | |
| | | 1998-1999 | 3.31 | 17.0 | 1059.0 | 49.0 | |
| | | 1999-2000 | 6.76 | 4.7 | 193.0 | 150.0 | |
| | | 2000-2001 | 4.69 | 2.2 | 20.9 | 100.2 | |
| | | 2001-2002 | 5.75 | 1.0 | 147.2 | 101.7 | |
| | | 2002-2003 | 3.25 | 1.3 | 47.3 | 47.4 | |
| | | 2003-2004 | 2.20 | 0.4 | 0.5 | 23.4 | |
| | | 2004-2005 | 0.00 | 0.0 | 0.0 | 0.0 | |
| | | 2005-2006 | 3.75 | 0.8 | 0.9 | 47.2 | |
| | | 2006-2007 | 0.00 | 0.0 | 0.0 | 0.0 | |
| | | 2007-2008 | 0.00 | 0.0 | 0.0 | 0.0 | |
| | | 2008-2009 | 1.55 | 0.1 | 10.5 | 23.2 | |
| | | | | | | | |
| | Total | 1995-1996 | 4.10 | 0.8 | 932.0 | 30.0 | 111 |
| | Number of Days | 1996-1997 | 5.45 | 1.6 | 1522.0 | 83.0 | 6 |
| | 365 | 1997-1998 | 4.88 | 0.5 | 695.0 | 66.0 | 6 |
| | | 1998-1999 | 9.15 | 16.4 | 2994.0 | 191.0 | 6 |
| | | 1999-2000 | 7.00 | 2.1 | 225.0 | 155.0 | 0 |
| | | 2000-2001 | 10.78 | 1.3 | 97.9 | 218.6 | 50 |
| | | 2001-2002 | 9.49 | 1.7 | 1186.1 | 163.6 | 0 |
| | | 2002-2003 | 8.34 | 2.0 | 690.8 | 59.2 | 0 |
| | | 2003-2004 | 5.51 | 0.4 | 21.4 | 41.0 | 37 |
| | | 2004-2005 | 7.39 | 1.2 | 1490.0 | 52.3 | 0 |
| | | 2005-2006 | 7.84 | 0.4 | 24.5 | 63.2 | 14.93 |
| | | 2006-2007 | 5.76 | 1.1 | 2158.3 | 47.0 | 36 |
| | | 2007-2008 | 7.61 | 0.9 | 1414.4 | 87.6 | 85 |
| | | 2008-2009 | 9.95 | 2.09 | 1671.7 | 67.6 | 72 |

## Table 3-3 Summary of Historical and Current Waste Water Loadings to the Management Units

| | Season | Campaign | Hydraulic Applied | COD Applied | NVDS Applied | Total Nitrogen | |
|---|---|---|---|---|---|---|---|
| | | | | | | Wastewater | Fertilizer |
| | | | (in/ac/yr) | (lb/ac/day) | (lb/ac/yr) | (lb/ac/yr) | (lb/ac/yr) |
| MU-005002 | Growing | 1995-1996 | 4.10 | 1.7 | 940.0 | 28.0 | |
| South Farm | Number of Days | 1996-1997** | | | | | |
| | 215 | 1997-1998 | 4.05 | 1.8 | 1180.0 | 23.0 | |
| | | 1998-1999 | 4.63 | 19.0 | 2184.0 | 134.0 | |
| | | 1999-2000 | 3.40 | 1.8 | 1697.0 | 32.0 | |
| | | 2000-2001 | 7.34 | 4.8 | 766.4 | 139.6 | |
| | | 2001-2002 | 6.56 | 2.0 | 800.5 | 104.3 | |
| | | 2002-2003 | 10.15 | 5.8 | 1336.2 | 55.0 | |
| | | 2003-2004 | 6.65 | 4.0 | 4283.1 | 135.8 | |
| | | 2004-2005 | 12.55 | 4.3 | 3388.2 | 92.5 | |
| | | 2005-2006 | 6.43 | 0.3 | 37.2 | 25.3 | |
| | | 2006-2007 | 8.17 | 4.9 | 5476.0 | 77.3 | |
| | | 2007-2008 | 0.00 | 0.0 | 0.0 | 0.0 | |
| | | 2008-2009 | 13.87 | 9.1 | 2307.6 | 122.4 | |
| | | | | | | | |
| | Non-Growing | 1995-1996 | 0.00 | 0.0 | 0.0 | 0.0 | |
| | Number of Days | 1996-1997** | | | | | |
| | 150 | 1997-1998 | 0.00 | 0.0 | 0.0 | 0.0 | |
| | | 1998-1999 | 4.32 | 22.0 | 1382.0 | 64.0 | |
| | | 1999-2000 | 6.12 | 5.4 | 229.0 | 139.0 | |
| | | 2000-2001 | 4.58 | 1.6 | 15.6 | 96.9 | |
| | | 2001-2002 | 0.87 | 0.2 | 22.3 | 15.4 | |
| | | 2002-2003 | 3.10 | 2.2 | 154.7 | 21.1 | |
| | | 2003-2004 | 0.00 | 0.0 | 0.0 | 0.0 | |
| | | 2004-2005 | 0.00 | 0.0 | 0.0 | 0.0 | |
| | | 2005-2006 | 5.46 | 1.1 | 1.2 | 60.1 | |
| | | 2006-2007 | 0.00 | 0.0 | 0.0 | 0.0 | |
| | | 2007-2008 | 8.03 | 2.0 | 109.1 | 148.4 | |
| | | 2008-2009 | 0.00 | 0.0 | 0.0 | 0.0 | |
| | | | | | | | |
| | Total | 1995-1996 | 4.10 | 1.0 | 940.0 | 28.0 | 124 |
| | Number of Days | 1996-1997** | | | | | 310 |
| | 365 | 1997-1998 | 4.05 | 1.1 | 1180.0 | 23.0 | 6 |
| | | 1998-1999 | 8.95 | 20.2 | 3566.0 | 198.0 | 6 |
| | | 1999-2000 | 9.52 | 3.3 | 1926.0 | 171.0 | 22 |
| | | 2000-2001 | 11.92 | 3.5 | 782.0 | 236.6 | 0 |
| | | 2001-2002 | 7.43 | 1.3 | 822.8 | 119.7 | 0 |
| | | 2002-2003 | 13.25 | 4.3 | 1490.9 | 76.1 | 0 |
| | | 2003-2004 | 6.65 | 2.4 | 4283.1 | 135.8 | 133 |
| | | 2004-2005 | 12.55 | 2.5 | 3388.2 | 92.5 | 0 |
| | | 2005-2006 | 11.89 | 0.6 | 38.4 | 85.4 | 17 |
| | | 2006-2007 | 8.17 | 2.9 | 5476.0 | 77.3 | 0 |
| | | 2007-2008 | 8.03 | 0.8 | 109.1 | 148.4 | 61 |
| | | 2008-2009 | 13.87 | 5.36 | 2307.6 | 122.4 | 0 |
| | | | | | | | |

## Table 3-3 Summary of Historical and Current Waste Water Loadings to the Management Units

| | Season | Campaign | Hydraulic Applied | COD Applied | NVDS Applied | Total Nitrogen | |
|---|---|---|---|---|---|---|---|
| | | | | | | Wastewater | Fertilizer |
| | | | (in/ac/yr) | (lb/ac/day) | (lb/ac/yr) | (lb/ac/yr) | (lb/ac/yr) |
| MU-005003 | Growing | 1995-1996 | 0.00 | 0 | 0.0 | 0.0 | |
| Wilkins | Number of Days | 1996-1997 | 0.00 | 0 | 0.0 | 0.0 | |
| | 215 | 1997-1998** | | | | | |
| | | 1998-1999 | 1.86 | 0.3 | 36.0 | 39.0 | |
| | | 1999-2000** | | | | | |
| | | 2000-2001** | | | | | |
| | | 2001-2002 | 0.00 | 0.0 | 0.0 | 0.0 | |
| | | 2002-2003** | | | | | |
| | | 2003-2004 | 1.49 | 0.1 | 0.3 | 20.6 | |
| | | 2004-2005 | 0.00 | 0.0 | 0.0 | 0.0 | |
| | | 2005-2006** | | | | | |
| | | 2006-2007** | | | | | |
| | | 2007-2008** | | | | | |
| | | 2008-2009** | | | | | |
| | | | | | | | |
| | Non-Growing | 1995-1996 | 3.39 | 1.9 | 39.0 | 105.0 | |
| | Number of Days | 1996-1997 | 5.30 | 1.3 | 62.0 | 141.0 | |
| | 150 | 1997-1998** | | | | | |
| | | 1998-1999 | 3.30 | 0.7 | 84.0 | 102.0 | |
| | | 1999-2000** | | | | | |
| | | 2000-2001** | | | | | |
| | | 2001-2002 | 2.23 | 0.4 | 12.6 | 45.5 | |
| | | 2002-2003** | | | | | |
| | | 2003-2004 | 0.00 | 0.0 | 0.0 | 0.0 | |
| | | 2004-2005 | 1.40 | 0.3 | 4.9 | 16.6 | |
| | | 2005-2006** | | | | | |
| | | 2006-2007** | | | | | |
| | | 2007-2008** | | | | | |
| | | 2008-2009** | | | | | |
| | | | | | | | |
| | Total | 1995-1996 | 3.39 | 0.8 | 39.0 | 105.0 | 118 |
| | Number of Days | 1996-1997 | 5.30 | 0.5 | 62.0 | 141.0 | 66 |
| | 365 | 1997-1998** | | | | | |
| | | 1998-1999 | 5.16 | 0.5 | 120.0 | 141.0 | 110 |
| | | 1999-2000** | | | | | |
| | | 2000-2001** | | | | | 122 |
| | | 2001-2002 | 2.23 | 0.2 | 12.6 | 45.5 | 106 |
| | | 2002-2003** | | | | | 114 |
| | | 2003-2004 | 1.49 | 0.1 | 0.3 | 20.6 | 95 |
| | | 2004-2005 | 1.40 | 0.1 | 4.9 | 16.6 | 57.6 |
| | | 2005-2006** | | | | | 98.8 |
| | | 2006-2007** | | | | | 19 |
| | | 2007-2008** | | | | | 58 |
| | | 2008-2009** | | | | | 96.2 |
| | | | | | | | |

## Table 3-3 Summary of Historical and Current Waste Water Loadings to the Management Units

| | Season | Campaign | Hydraulic Applied | COD Applied | NVDS Applied | Total Nitrogen | |
|---|---|---|---|---|---|---|---|
| | | | | | | Wastewater | Fertilizer |
| | | | (in/ac/yr) | (lb/ac/day) | (lb/ac/yr) | (lb/ac/yr) | (lb/ac/yr) |
| MU-005004 | Growing | 1995-1996 | 3.00 | 0.4 | 7.0 | 73.0 | |
| Goitiandia | Number of Days | 1996-1997 | 2.96 | 0.8 | 86.0 | 118.0 | |
| | 215 | 1997-1998 | 2.64 | 0.3 | 17.0 | 85.0 | |
| | | 1998-1999 | 3.63 | 0.5 | 73.0 | 81.0 | |
| | | 1999-2000 | 3.84 | 0.53 | 14.0 | 100.0 | |
| | | 2000-2001 | 3.98 | 0.47 | 49.6 | 77.2 | |
| | | 2001-2002 | 6.88 | 0.88 | 101.7 | 125.8 | |
| | | 2002-2003 | 5.01 | 0.70 | 71.6 | 70.1 | |
| | | 2003-2004 | 5.00 | 0.50 | 10.8 | 77.6 | |
| | | 2004-2005 | 5.80 | 0.40 | 61.4 | 61.6 | |
| | | 2005-2006 | 2.68 | 0.20 | 0.6 | 46.2 | |
| | | 2006-2007†† | 5.70 | 0.90 | 24.4 | 81.1 | |
| | | 2007-2008 | 5.11 | 0.70 | 11.6 | 84.4 | |
| | | 2008-2009 | 4.83 | 0.79 | 105.6 | 72.5 | |
| | | | | | | | |
| | Non-Growing | 1995-1996 | 1.29 | 0.30 | 7.0 | 40.0 | |
| | Number of Days | 1996-1997 | 0.00 | 0.00 | 0.0 | 0.0 | |
| | 150 | 1997-1998 | 1.04 | 0.20 | 8.0 | 40.0 | |
| | | 1998-1999 | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | 1999-2000 | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | 2000-2001 | 0.40 | 0.15 | 2.8 | 8.7 | |
| | | 2001-2002 | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | 2002-2003 | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | 2003-2004 | 1.84 | 0.60 | 11.2 | 7.7 | |
| | | 2004-2005 | 3.43 | 0.80 | 0.8 | 46.6 | |
| | | 2005-2006 | 4.74 | 2.80 | 4.0 | 74.5 | |
| | | 2006-2007†† | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | 2007-2008 | 2.73 | 1.10 | 35.1 | 59.3 | |
| | | 2008-2009 | 4.63 | 1.37 | 21.0 | 89.0 | |
| | | | | | | | |
| | Total | 1995-1996 | 4.29 | 0.4 | 14.0 | 113.0 | 82 |
| | Number of Days | 1996-1997 | 2.96 | 0.5 | 86.0 | 118.0 | 120 |
| | 365 | 1997-1998 | 3.68 | 0.3 | 25.0 | 125.0 | 134 |
| | | 1998-1999 | 3.63 | 0.3 | 73.0 | 81.0 | 224 |
| | | 1999-2000 | 3.84 | 0.3 | 14.0 | 100.0 | 93 |
| | | 2000-2001 | 4.38 | 0.3 | 52.4 | 85.9 | 65 |
| | | 2001-2002 | 6.88 | 0.5 | 101.7 | 125.8 | 84 |
| | | 2002-2003 | 5.01 | 0.4 | 71.6 | 70.1 | 9 |
| | | 2003-2004 | 6.84 | 0.5 | 22.0 | 85.3 | 57 |
| | | 2004-2005 | 9.23 | 0.6 | 62.2 | 108.2 | 39.2 |
| | | 2005-2006 | 7.42 | 1.3 | 4.6 | 120.7 | 70.4 |
| | | 2006-2007†† | 5.70 | 0.5 | 24.4 | 81.1 | 0 |
| | | 2007-2008 | 7.84 | 0.9 | 46.7 | 143.7 | 0 |
| | | 2008-2009 | 9.46 | 1.0 | 126.6 | 161.5 | 0 |
| | | | | | | | |

## Table 3-3 Summary of Historical and Current Waste Water Loadings to the Management Units

| | Season | Campaign | Hydraulic Applied | COD Applied | NVDS Applied | Total Nitrogen | |
|---|---|---|---|---|---|---|---|
| | | | | | | Wastewater | Fertilizer |
| | | | (in/ac/yr) | (lb/ac/day) | (lb/ac/yr) | (lb/ac/yr) | (lb/ac/yr) |
| MU-005005 | Growing | 1995-1996 | 5.30 | 1.00 | 49.0 | 122.0 | |
| | Number of Days | 1996-1997 | 0.00 | 0.00 | 0.0 | 0.0 | |
| | 215 | 1997-1998 | 3.57 | 0.70 | 10.0 | 102.0 | |
| | | 1998-1999 | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | 1999-2000** | | | | | |
| | | 2000-2001** | | | | | |
| | | 2001-2002 | 2.35 | 0.31 | 31.9 | 40.4 | |
| | | 2002-2003 | 5.16 | 0.70 | 59.8 | 66.0 | |
| | | 2003-2004 | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | 2004-2005 | 4.96 | 0.30 | 35.7 | 48.2 | |
| | | 2005-2006 | 1.63 | 0.10 | 0.4 | 28.1 | |
| | | 2006-2007†† | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | 2007-2008 | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | 2008-2009 | 2.59 | 0.42 | 93.9 | 41.7 | |
| | | | | | | | |
| | Non-Growing | 1995-1996 | 0.00 | 0.00 | 0.0 | 0.0 | |
| | Number of Days | 1996-1997 | 5.40 | 1.40 | 173.0 | 318.0 | |
| | 150 | 1997-1998 | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | 1998-1999 | 7.96 | 1.40 | 203.0 | 246.0 | |
| | | 1999-2000** | | | | | |
| | | 2000-2001** | | | | | |
| | | 2001-2002 | 3.59 | 1.07 | 22.9 | 63.0 | |
| East Gillette | | 2002-2003 | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | 2003-2004 | 4.70 | 1.90 | 11.3 | 60.3 | |
| | | 2004-2005 | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | 2005-2006 | 7.12 | 4.60 | 1.6 | 118.5 | |
| | | 2006-2007†† | 6.31 | 2.20 | 237.4 | 107.2 | |
| | | 2007-2008 | 8.70 | 2.20 | 51.1 | 221.0 | |
| | | 2008-2009 | 3.14 | 0.93 | 14.2 | 60.3 | |
| | | | | | | | |
| | Total | 1995-1996 | 5.30 | 0.6 | 49.0 | 122.0 | 220 |
| | Number of Days | 1996-1997 | 5.40 | 0.6 | 173.0 | 318.0 | 160 |
| | 365 | 1997-1998 | 3.57 | 0.4 | 10.0 | 102.0 | 123 |
| | | 1998-1999 | 7.96 | 0.6 | 203.0 | 246.0 | 0 |
| | | 1999-2000** | | | | | 255 |
| | | 2000-2001** | | | | | 37 |
| | | 2001-2002 | 5.94 | 0.6 | 54.8 | 103.4 | 220 |
| | | 2002-2003 | 5.16 | 0.4 | 59.8 | 66.0 | 9 |
| | | 2003-2004 | 4.70 | 0.8 | 11.3 | 60.3 | 175 |
| | | 2004-2005 | 4.96 | 0.2 | 35.7 | 48.2 | 0 |
| | | 2005-2006 | 8.75 | 1.9 | 2.0 | 146.6 | 10 |
| | | 2006-2007†† | 6.31 | 0.9 | 237.4 | 107.2 | 13 |
| | | 2007-2008 | 8.70 | 0.9 | 51.1 | 221.0 | 38 |
| | | 2008-2009 | 5.73 | 0.6 | 108.1 | 102.0 | 10 |
| | | | | | | | |

## Table 3-3 Summary of Historical and Current Waste Water Loadings to the Management Units

| | Season | Campaign | Hydraulic Applied | COD Applied | NVDS Applied | Total Nitrogen | |
|---|---|---|---|---|---|---|---|
| | | | | | | Wastewater | Fertilizer |
| | | | (in/ac/yr) | (lb/ac/day) | (lb/ac/yr) | (lb/ac/yr) | (lb/ac/yr) |
| MU-005006 | Growing | 1995-1996 | 0.00 | 0.0 | 0.0 | 0.0 | |
| Fisk/Blacker | Number of Days | 1996-1997 | 0.00 | 0.0 | 0.0 | 0.0 | |
| | 215 | 1997-1998 | 0.00 | 0.0 | 0.0 | 0.0 | |
| | | 1998-1999** | 0.00 | 0.0 | 0.0 | 0.0 | |
| | | 1999-2000** | 0.00 | 0.0 | 0.0 | 0.0 | |
| | | 2000-2001** | 0.00 | 0.0 | 0.0 | 0.0 | |
| | | 2001-2002** | 0.00 | 0.0 | | | |
| | | 2002-2003** | 0.00 | 0.0 | | | |
| | | 2003-2004** | 0.00 | 0.0 | | | |
| | | 2004-2005** | 0.00 | 0.0 | | | |
| | | 2005-2006** | 0.00 | 0.0 | | | |
| | | 2006-2007** | 0.00 | 0.0 | | | |
| | | 2007-2008** | 0.00 | 0.0 | | | |
| | | 2008-2009** | 0.00 | 0.0 | | | |
| | | | | | | | |
| | Non-Growing | 1995-1996 | 5.66 | 2.1 | 6.0 | 145.0 | |
| | Number of Days | 1996-1997 | 6.20 | 1.7 | 78.0 | 166.0 | |
| | 150 | 1997-1998 | 4.67 | 2.1 | 28.0 | 243.0 | |
| | | 1998-1999** | 0.00 | 0.0 | 0.0 | 0.0 | |
| | | 1999-2000** | 0.00 | 0.0 | 0.0 | 0.0 | |
| | | 2000-2001** | 0.00 | 0.0 | 0.0 | 0.0 | |
| | | 2001-2002** | 0.00 | 0.0 | | | |
| | | 2002-2003** | 0.00 | 0.0 | | | |
| | | 2003-2004** | 0.00 | 0.0 | | | |
| | | 2004-2005** | 0.00 | 0.0 | | | |
| | | 2005-2006** | 0.00 | 0.0 | | | |
| | | 2006-2007** | 0.00 | 0.0 | | | |
| | | 2007-2008** | 0.00 | 0.0 | | | |
| | | 2008-2009** | 0.00 | 0.0 | | | |
| | | | | | | | |
| | Total | 1995-1996 | 5.66 | 0.9 | 6.0 | 145.0 | 165 |
| | Number of Days | 1996-1997 | 6.20 | 0.7 | 78.0 | 166.0 | 70 |
| | 365 | 1997-1998 | 4.67 | 0.9 | 28.0 | 243.0 | 0 |
| | | 1998-1999** | | | | | ND |
| | | 1999-2000** | | | | | ND |
| | | 2000-2001** | | | | | 0 |
| | | 2001-2002** | | | | | ND |
| | | 2002-2003** | | | | | 52 |
| | | 2003-2004** | | | | | 282 |
| | | 2004-2005** | | | | | 50 |
| | | 2005-2006** | | | | | 51.5 |
| | | 2006-2007** | | | | | 100 |
| | | 2007-2008** | | | | | 9.9 |
| | | 2008-2009** | | | | | 75 |
| | | | | | | | |

**Table 3-3 Summary of Historical and Current Waste Water Loadings to the Management Units**

| | Season | Campaign | Hydraulic Applied | COD Applied | NVDS Applied | Total Nitrogen | |
|---|---|---|---|---|---|---|---|
| | | | | | | Wastewater | Fertilizer |
| | | | (in/ac/yr) | (lb/ac/day) | (lb/ac/yr) | (lb/ac/yr) | (lb/ac/yr) |
| MU-005007 | Growing | 1995-1996 | 7.20 | 2.4 | 1383.0 | 59.0 | |
| | Number of Days | 1996-1997 | 4.00 | 1.6 | 1123.0 | 61.0 | |
| | 215 | 1997-1998 | 3.70 | 0.8 | 489.0 | 51.0 | |
| | | 1998-1999 | 5.51 | 17.0 | 1960.0 | 142.0 | |
| | | 1999-2000 | 5.92 | 4.1 | 2180.0 | 79.0 | |
| | | 2000-2001 | 8.07 | 7.2 | 1266.8 | 141.6 | |
| | | 2001-2002 | 5.07 | 3.6 | 1231.2 | 79.5 | |
| | | 2002-2003 | 8.82 | 0.8 | 191.7 | 47.9 | |
| | | 2003-2004 | 5.13 | 3.5 | 424.6 | 88.2 | |
| | | 2004-2005 | 6.92 | 2.6 | 2156.6 | 53.4 | |
| | | 2005-2006 | 0.00 | 0.0 | 0.0 | 0.0 | |
| | | 2006-2007 | 6.38 | 1.2 | 2226.2 | 68.8 | |
| | | 2007-2008 | 8.82 | 1.5 | 1589.9 | 114.6 | |
| | | 2008-2009 | 4.24 | 0.9 | 795.6 | 44.2 | |
| | | | | | | | |
| | Non-Growing | 1995-1996 | 0.00 | 0.0 | 0.0 | 0.0 | |
| | Number of Days | 1996-1997 | 0.00 | 0.0 | 0.0 | 0.0 | |
| | 150 | 1997-1998 | 0.00 | 0.0 | 0.0 | 0.0 | |
| | | 1998-1999 | 1.13 | 5.0 | 408.0 | 15.0 | |
| | | 1999-2000 | 5.45 | 5.2 | 230.0 | 125.0 | |
| | | 2000-2001 | 3.59 | 1.3 | 569.2 | 76.0 | |
| | | 2001-2002 | 4.81 | 0.8 | 123.0 | 85.0 | |
| Seedall | | 2002-2003 | 0.20 | 0.1 | 3.0 | 2.9 | |
| | | 2003-2004 | 0.00 | 0.0 | 0.0 | 0.0 | |
| | | 2004-2005 | 0.00 | 0.0 | 0.0 | 0.0 | |
| | | 2005-2006 | 5.47 | 2.5 | 1.2 | 138.8 | |
| | | 2006-2007 | 4.18 | 1.5 | 90.4 | 59.0 | |
| | | 2007-2008 | 6.23 | 1.5 | 84.6 | 115.2 | |
| | | 2008-2009 | 3.18 | 0.3 | 21.7 | 47.8 | |
| | | | | | | | |
| | Total | 1995-1996 | 7.20 | 1.4 | 1383.0 | 59.0 | 83 |
| | Number of Days | 1996-1997 | 4.00 | 0.4 | 1123.0 | 61.0 | 6 |
| | 365 | 1997-1998 | 3.70 | 0.5 | 489.0 | 51.0 | 6 |
| | | 1998-1999 | 6.64 | 12.1 | 2368.0 | 157.0 | 6 |
| | | 1999-2000 | 11.37 | 4.6 | 2410.0 | 204.0 | 22 |
| | | 2000-2001 | 11.66 | 4.8 | 1836.0 | 217.6 | 0 |
| | | 2001-2002 | 9.88 | 2.5 | 1354.2 | 164.5 | 0 |
| | | 2002-2003 | 9.02 | 0.5 | 194.7 | 50.9 | 0 |
| | | 2003-2004 | 5.13 | 2.1 | 424.6 | 88.2 | 122 |
| | | 2004-2005 | 6.92 | 1.5 | 2156.6 | 53.4 | 0 |
| | | 2005-2006 | 5.47 | 1.0 | 1.2 | 138.8 | 0 |
| | | 2006-2007 | 10.56 | 1.3 | 2316.6 | 127.8 | 11 |
| | | 2007-2008 | 15.05 | 1.5 | 1674.5 | 229.8 | 14 |
| | | 2008-2009 | 7.42 | 0.6 | 817.3 | 92.0 | 0 |
| | | | | | | | |

## Table 3-3 Summary of Historical and Current Waste Water Loadings to the Management Units

| | Season | Campaign | Hydraulic Applied | COD Applied | NVDS Applied | Total Nitrogen | |
|---|---|---|---|---|---|---|---|
| | | | | | | Wastewater | Fertilizer |
| | | | (in/ac/yr) | (lb/ac/day) | (lb/ac/yr) | (lb/ac/yr) | (lb/ac/yr) |
| MU-005008 | Growing | 1995-1996 | 0.00 | 0.00 | 0.0 | 0.0 | |
| West Gillette | Number of Days | 1996-1997 | 0.00 | 0.00 | 0.0 | 0.0 | |
| | 215 | 1997-1998 | 2.00 | 0.29 | 13.0 | 65.0 | |
| | | 1998-1999** | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | 1999-2000 | 3.10 | 0.50 | 16.0 | 78.0 | |
| | | 2000-2001 | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | 2001-2002** | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | 2002-2003 | 0.69 | 0.10 | 9.9 | 9.7 | |
| | | 2003-2004 | 0.12 | 0.00 | 0.3 | 1.9 | |
| | | 2004-2005** | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | 2005-2006** | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | 2006-2007 | 2.48 | 0.40 | 16.8 | 36.5 | |
| | | 2007-2008 | 2.08 | 0.30 | 4.7 | 32.9 | |
| | | 2008-2009 | 1.07 | 0.07 | 4.9 | 16.1 | |
| | | | | | | | |
| | Non-Growing | 1995-1996 | 0.00 | 0.00 | 0.0 | 0.0 | |
| | Number of Days | 1996-1997 | 2.10 | 1.30 | 27.2 | 58.0 | |
| | 150 | 1997-1998 | 4.40 | 0.92 | 35.0 | 186.0 | |
| | | 1998-1999** | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | 1999-2000 | 0.86 | 0.00 | 0.0 | 20.0 | |
| | | 2000-2001 | 2.64 | 1.00 | 25.0 | 58.0 | |
| | | 2001-2002** | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | 2002-2003 | 1.19 | 0.60 | 13.5 | 13.2 | |
| | | 2003-2004 | 2.46 | 0.70 | 16.7 | 7.4 | |
| | | 2004-2005** | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | 2005-2006** | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | 2006-2007 | 1.90 | 0.60 | 103.2 | 30.0 | |
| | | 2007-2008 | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | 2008-2009 | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | | | | | | |
| | Total | 1995-1996 | | | | | |
| | Number of Days | 1996-1997 | 2.10 | 0.5 | 27.2 | 58.0 | 200 |
| | 365 | 1997-1998 | 6.40 | 0.5 | 48.0 | 251.0 | 142 |
| | | 1998-1999** | 0.00 | 0.0 | 0.0 | 0.0 | ND |
| | | 1999-2000 | 3.96 | 0.3 | 16.0 | 98.0 | 101 |
| | | 2000-2001 | 2.64 | 0.4 | 25.0 | 58.0 | 237 |
| | | 2001-2002** | | | | | 109 |
| | | 2002-2003 | 1.88 | 0.3 | 23.4 | 22.9 | 72 |
| | | 2003-2004 | 2.58 | 0.3 | 17.0 | 9.3 | 235 |
| | | 2004-2005** | | | | | 131.3 |
| | | 2005-2006** | | | | | 18 |
| | | 2006-2007 | 4.38 | 0.5 | 120.0 | 66.5 | 164 |
| | | 2007-2008 | 2.08 | 0.2 | 4.7 | 32.9 | 190 |
| | | 2008-2009 | 1.07 | 0.04 | 4.9 | 16.1 | 20 |
| | | | | | | | |

**Table 3-3 Summary of Historical and Current Waste Water Loadings to the Management Units**

| | Season | Campaign | Hydraulic Applied | COD Applied | NVDS Applied | Total Nitrogen | |
|---|---|---|---|---|---|---|---|
| | | | | | | Wastewater | Fertilizer |
| | | | (in/ac/yr) | (lb/ac/day) | (lb/ac/yr) | (lb/ac/yr) | (lb/ac/yr) |
| MU-005009 | Growing | 1995-1996 | | | | | |
| | Number of Days | 1996-1997 | | | | | |
| | 215 | 1997-1998 | | | | | |
| | | 1998-1999† | 0.68 | 24 | 719.0 | 23.0 | |
| | | 1999-2000 | 5.52 | 4.2 | 1982.3 | 75.0 | |
| | | 2000-2001 | 5.10 | 7.1 | 2770.3 | 71.2 | |
| | | 2001-2002 | 6.33 | 2.4 | 427.9 | 94.8 | |
| | | 2002-2003 | 2.77 | 3.6 | 917.3 | 5.0 | |
| | | 2003-2004 | 5.55 | 2.2 | 253.5 | 56.5 | |
| | | 2004-2005 | 4.83 | 0.3 | 14.9 | 20.3 | |
| | | 2005-2006 | 2.60 | 0.2 | 4.4 | 29.5 | |
| | | 2006-2007 | 4.41 | 0.6 | 1588.9 | 56.9 | |
| | | 2007-2008 | 8.21 | 0.7 | 488.8 | 104.3 | |
| | | 2008-2009 | 5.70 | 4.2 | 450.3 | 60.4 | |
| | | | | | | | |
| | Non-Growing | 1995-1996 | | | | | |
| | Number of Days | 1996-1997 | | | | | |
| | 150 | 1997-1998 | | | | | |
| | | 1998-1999† | 0.00 | 0.00 | | | |
| | | 1999-2000 | 3.23 | 0.96 | 4.7 | 56.0 | |
| | | 2000-2001 | 6.23 | 4.10 | 30.8 | 128.8 | |
| | | 2001-2002 | 3.40 | 1.23 | 9.2 | 68.9 | |
| South Schow | | 2002-2003 | 5.06 | 2.50 | 66.8 | 69.6 | |
| | | 2003-2004 | 0.14 | 0.00 | 0.0 | 1.4 | |
| | | 2004-2005 | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | 2005-2006 | 2.00 | 0.40 | 0.5 | 22.1 | |
| | | 2006-2007 | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | 2007-2008 | 4.59 | 1.10 | 54.1 | 80.5 | |
| | | 2008-2009 | 0.00 | 0.00 | 0.0 | 0.0 | |
| | | | | | | | |
| | Total | 1995-1996 | | | | | |
| | Number of Days | 1996-1997 | | | | | |
| | 365 | 1997-1998 | | | | | |
| | | 1998-1999† | 0.68 | 2.0 | 719.0 | 23.0 | 20 |
| | | 1999-2000 | 8.75 | 2.9 | 1987.0 | 131.0 | 22 |
| | | 2000-2001 | 11.33 | 5.9 | 2801.1 | 200.0 | 0 |
| | | 2001-2002 | 9.73 | 1.9 | 437.1 | 163.7 | 0 |
| | | 2002-2003 | 7.83 | 3.1 | 984.1 | 74.6 | 0 |
| | | 2003-2004 | 5.68 | 1.3 | 253.5 | 57.9 | 65 |
| | | 2004-2005 | 4.83 | 0.2 | 14.9 | 20.3 | 46 |
| | | 2005-2006 | 4.60 | 0.3 | 4.9 | 51.6 | 0 |
| | | 2006-2007 | 4.41 | 0.4 | 1588.9 | 56.9 | 11 |
| | | 2007-2008 | 12.80 | 0.9 | 542.9 | 184.8 | 17.5 |
| | | 2008-2009 | 5.70 | 2.47 | 450.3 | 60.4 | 0 |
| | | | | | | | |

**Table 3-3 Summary of Historical and Current Waste Water Loadings to the Management Units**

| | Season | Campaign | Hydraulic Applied | COD Applied | NVDS Applied | Total Nitrogen | |
|---|---|---|---|---|---|---|---|
| | | | | | | Wastewater | Fertilizer |
| | | | (in/ac/yr) | (lb/ac/day) | (lb/ac/yr) | (lb/ac/yr) | (lb/ac/yr) |
| MU-005010 | Growing | 1995-1996 | | | | | |
| | Number of Days | 1996-1997 | | | | | |
| | 215 | 1997-1998 | | | | | |
| | | 1998-1999 | | | | | |
| | | 1999-2000† | | | | | |
| | | 2000-2001 | | | | | |
| | | 2001-2002 | 1.45 | 0.14 | 4.9 | 22.4 | |
| | | 2002-2003 | 1.12 | 0.10 | 48.9 | 7.0 | |
| | | 2003-2004 | 0.67 | 0.10 | 0.2 | 3.0 | |
| | | 2004-2005 | 1.60 | 0.10 | 0.4 | 4.9 | |
| | | 2005-2006 | 3.45 | 0.30 | 4.3 | 42.0 | |
| | | 2006-2007 | 1.20 | 0.40 | 744.4 | 14.9 | |
| | | 2007-2008 | 3.40 | 0.30 | 45.2 | 37.1 | |
| | | 2008-2009 | 1.04 | 0.47 | 173.7 | 12.2 | |
| | | | | | | | |
| | Non-Growing | 1995-1996 | | | | | |
| | Number of Days | 1996-1997 | | | | | |
| | 150 | 1997-1998 | | | | | |
| | | 1998-1999 | | | | | |
| | | 1999-2000† | 0.32 | 0.00 | 0.6 | 5.8 | |
| | | 2000-2001 | 5.25 | 4.33 | 22.0 | 115.3 | |
| | | 2001-2002 | 2.83 | 1.80 | 4.2 | 53.0 | |
| North Schow | | 2002-2003 | 3.77 | 2.20 | 45.0 | 49.0 | |
| | | 2003-2004 | 4.49 | 1.00 | 1.0 | 48.6 | |
| | | 2004-2005 | 4.11 | 1.20 | 0.9 | 65.0 | |
| | | 2005-2006 | 6.29 | 2.30 | 1.4 | 129.5 | |
| | | 2006-2007 | 5.64 | 3.50 | 183.2 | 78.1 | |
| | | 2007-2008 | 1.40 | 0.30 | 15.2 | 23.9 | |
| | | 2008-2009 | 3.63 | 0.32 | 324.7 | 54.6 | |
| | | | | | | | |
| | Total | 1995-1996 | | | | | |
| | Number of Days | 1996-1997 | | | | | |
| | 365 | 1997-1998 | | | | | |
| | | 1998-1999 | | | | | |
| | | 1999-2000† | 0.32 | 0.0 | 0.6 | 5.8 | |
| | | 2000-2001 | 5.25 | 1.8 | 22.0 | 115.3 | 0 |
| | | 2001-2002 | 4.28 | 0.8 | 9.1 | 75.4 | 0 |
| | | 2002-2003 | 4.89 | 1.0 | 93.9 | 56.0 | 0 |
| | | 2003-2004 | 5.16 | 0.5 | 1.2 | 51.6 | 0 |
| | | 2004-2005 | 5.71 | 0.6 | 1.3 | 69.9 | 0 |
| | | 2005-2006 | 9.74 | 1.1 | 5.7 | 171.5 | 0 |
| | | 2006-2007 | 6.84 | 1.7 | 927.6 | 93.0 | 100 |
| | | 2007-2008 | 4.80 | 0.3 | 60.4 | 61.0 | 39.4 |
| | | 2008-2009 | 4.67 | 0.4 | 498.4 | 66.8 | 19.9 |
| | | | | | | | |

## Growing Season

The basic criteria applied to growing season wastewater land treatment includes, but is not limited to, COD loading, nutrient loading, hydraulic loading, soil type, soil-water storage, and climatic conditions. Soil types, soil-water storage, and the climactic conditions are discussed in Section 4.0.

### COD Loading

Growing season COD loading rates are to be less than 50 lbs/acre/day based on a yearly (365 day year) average and, the non-growing season (NGS) COD loading rate is to be less than 25 lbs/acre/day (151 day NGS season). Mini-Cassia's actual average loading rates have been well below these rates, averaging less than 5 lbs/acre/day since the permit was issued in 1995. The actual NGS average loading rate for a single management unit during a single campaign has not exceeded 25 lbs/acre/day, and the average since the issuance of the permit is less than 5 lbs/acre/day (Table 3-3). Since the addition of the North and South Schow properties the average COD loadings on all management units have been less than 2 lbs/acre/day.

### Nutrients

For the purposes of this discussion, nutrients will include nitrogen and phosphorous. Non-volatile dissolved solids (NVDS (total dissolved solids minus volatile dissolved solids)) will be discussed later.

Nitrogen loading limits in general are based on crop needs, nutrient uptake and crop production rates. Nitrogen loadings can be based on a number of factors but a simplified method is to use the crop uptake as a guide. The current permit allows for 150% of the nitrogen uptake (based on published data or tissue samples taken from the actual crop) or 300 lbs per acre per year. The factor 150% allows for nitrogen losses through volatilization, denitrification, and microbiological consumption. The default factor of 300 lbs/ac/yr is a beneficial tool for use in estimating crop needs prior to harvest and definitive calculations of nitrogen uptake. The exceptions to these limits are those applied to the North and South Schow farms. Limits here are set at 250 lb/ac/year without regard for how much nitrogen is consumed. Of this, a maximum of 150 lbs/ac/year can be applied during the non-growing season

Phosphorous loadings are limited to 150% of the crop uptake.

The actual average wastewater nitrogen loading on all management units was less than 50 lb/acre/yr for the growing season. The NVDS loadings were below the permitted rates.

### Hydraulic Loading

Growing season hydraulic loading rates are limited to between 36 and 48 inches per year based on irrigation water requirements. The average of Mini-Cassia's actual annual growing season wastewater (process and condensate) hydraulic loadings between 2004-05 and 2008-09 are less than 3.6 inches, which is well below the limits. The average total wastewater (process and condensate) application rate (growing plus non-growing season) for this same time period is

less than 6.6 inches per year (Table 3-3). Over the term of the permit, actual growing season hydraulic loadings never exceed 6.76 inches per acre and averaged 3.19 inches per acre.

## Non-Growing Season

The basic criteria applied to non-growing season wastewater land treatment includes, but is not limited to, the same parameters as during the growing season.

COD Loading

Non-growing season COD loading rates are to be less than 25 lbs/acre/day based on a non-growing season average only. Mini-Cassia's actual COD loading rates have been well below these rates, averaging less than 2 lbs/acre/day since 1995. The average loading rate for any single management unit during any one campaign has never exceeded 25 lbs/acre/day for the non-growing or growing season.

Nutrients

Nutrient loading limits are based on 150% of crop uptake or 300 lbs/ac/yr maximum loading with the exception of the North and South Schow properties which is 150 lb/ac/year for the non-growing season. These limits have not been exceeded.

Hydraulic Loading

Non-growing season hydraulic loading limits are based on the available water holding capacity, non-growing season evaporation rates, and non-growing season precipitation. Rates are limited to between 5.8 and 9.5 inches per year. Mini-Cassia's average annual non-growing season application is around 4 inches, well below the limits. The average non-growing season application rates for a single management unit during one campaign have not exceeded 8.7 inches per year since 1995.

## NVDS Application Rates

Permitted NVDS limits vary across the site.

East Farm……....7,600 lbs/ac/yr
South Farm…….7,600 lbs/ac/yr
Wilkins (offsite) …...642 lbs/ac/yr
Goitiandia
  a. Total…..4,000 lbs/ac/yr
  b. NGS ……642 lbs/ac/yr
East Gillette
  a. Total…..4,000 lbs/ac/yr
  b. NGS ….…642 lbs/ac/yr

Fisk/Blacker (offsite) …….642 lbs/ac/yr
Seedall…….….2,500 lbs/ac/yr
West Gillette (offsite) …….642 lbs/ac/yr
South Schow
  a. Total…..4,000 lbs/ac/yr
  b. NGS ….…642 lbs/ac/yr
North Schow
  a. Total…..4,000 lbs/ac/yr
  b. NGS ….…642 lbs/ac/yr

Note: Total NVDS load on Goitiandia, East Gillette, North and South Schow Farms includes NVDS applied through supplemental irrigation.

**TASCO-Mini-Cassia Facility**

The NVDS loadings to the TASCO farms have steadily decreased from above 7,000 to below 1,000 lb/acre-day since 1992, with the exception of an increase in the 1998-1999 campaign (Figure 2-4). The 1998-1999 beet slice year resulted in an increase due to the following factors:

- The beets froze due to cold weather and were spoiled when they were thawed. This caused an increase in the COD of the flume water and consequently the TDS (NVDS) of the process water increased.

- Process water was mixed with condensate increasing the volume of water with elevated TDS.

Over the term of the permit, the actual average NVDS loading to all the management units was 57 lb/acre/yr for the non-growing season with the highest average loading over the term of the permit being applied to the South farm at a rate of 147 lb/acre/yr. A review of Table 3-3 shows that NVDS loadings have never exceeded the limits established in the permit and with the exception of application to the South Farm in 1996-97, the annual loadings have not exceeded 3000 lb/ac/yr on any one field.

## 3.4 Crop/Land Management

The crops produced on the management units include alfalfa, grain, potatoes, beans, and beets. Crops for direct human consumption (those crops that are not processed prior to consumption) are not allowed to be grown. The planned crop rotation for alfalfa is 3 to 6 years, followed by a grain crop for a minimum of 1 year. Alfalfa is cut and bailed with a minimum of three cuttings per year. A historical cropping summary is shown in Table 3-4.

Crop cultivation and harvest is consistent with normal practices for the area performed by a local contract farmer. Harvest of alfalfa and grain occurs at appropriate times as dictated by growth and maturity. Late season irrigation is minimized so that soil moisture levels entering the winter season are drawn down for maximum off-season soil storage where needed.

Nitrogen applied was compared with nitrogen removed to assess potential for soil accumulation or groundwater leaching (Table 3-5). For the Onsite Farms, average nitrogen removal exceeded the amount applied. For the Offsite Farms, where TASCO does not have full control of nutrient management, applied nitrogen has occasionally exceeded the amount removed.

**Table 3-4 Summary of Crop Yields and Crop Nitrogen Removal**
**TASCO Mini-Cassia**

| Management Unit | Campaign | Crop Type | Total Yield (lb/ac) | Yield by Crop | Crop Nitrogen Uptake (lbs/ac)* |
|---|---|---|---|---|---|
| **MU-005001** | 1995-1996 | Wheat, Alfalfa | 8135 | 110 bu/ac; 2.9 tons/ac | 176 |
| **East Farm** | 1996-1997 | Alfalfa | 9231 | 4.6 tons/ac | 258 |
| | 1997-1998 | Alfalfa | 8295 | 4.2 tons/ac | 232 |
| | 1998-1999 | Alfalfa | 8088 | 4.04 tons/ac | 226 |
| | 1999-2000 | Wheat, Barley | 5888 | 8 tons/ac; 2.49 tons/ac | 91 |
| | 2000-2001 | Oats, Alfalfa | 21000 | 10.5 tons/ac | 143 |
| | 2001-2002 | Alfalfa | 16040 | 8.02 tons/ac | 520 |
| | 2002-2003 | Oats, Alfalfa | 11820 | 5.91 tons/ac | 322 |
| | 2003-2004 | Alfalfa, Barley | 9640 | 4.82 tons/ac; 46 bu/ac | 243 |
| | 2004-2005 | Alfalfa | 7440 | 3.72 tons/ac | 215 |
| | 2005-2006 | Alfalfa, Barley | 9080 | 4.54 tons/ac | 262 |
| | 2006-2007 | Wheat | 5860 | 97.5 bu/ac | 93 |
| | 2007-2008 | Winter Wheat | 5780 | 2.89 tons/ac | 68 |
| | 2008-2009 | Beets, Barley | 5050 | 41.08 tons/ac; 60 bu/ac | 150 |

| Management Unit | Campaign | Crop Type | Total Yield (lb/ac) | Yield by Crop | Crop Nitrogen Uptake (lbs/ac)* |
|---|---|---|---|---|---|
| **MU-005002** | 1995-1996 | Alfalfa | 8200 | 4.1 tons/ac | 230 |
| **South Farm** | 1996-1997** | Potatoes | 37500 | 375 sacks/ac | 150 |
| | 1997-1998 | Oats, Alfalfa | 8676 | 96 bu/ac; 1.4 tons/ac | 112 |
| | 1998-1999 | Alfalfa | 13007 | 6.5 tons/ac | 364 |
| | 1999-2000 | Alfalfa | 13892 | 6.9 tons/ac | 386 |
| | 2000-2001 | Alfalfa | 10000 | 5 tons/ac | 280 |
| | 2001-2002 | Alfalfa | 11620 | 5.81 tons/ac | 370 |
| | 2002-2003 | Alfalfa | 14140 | 7.07 tons/ac | 384 |
| | 2003-2004 | Winter Wheat | 8280 | 138 bu/ac | 226 |
| | 2004-2005 | Alfalfa | 15400 | 7.70 tons/ac | 339 |
| | 2005-2006 | Alfalfa | 12720 | 6.36 tons/ac | 365 |
| | 2006-2007 | Alfalfa | 15600 | 7.8 tons/ac | 393 |
| | 2007-2008 | Alfalfa | 11760 | 5.88 tons/ac | 326 |
| | 2008-2009 | Alfalfa | 12300 | 6.15 tons/ac | 459 |

## Table 3-4 Summary of Crop Yields and Crop Nitrogen Removal TASCO Mini-Cassia

| Management Unit | Campaign | Crop Type | Total Yield (lb/ac) | Yield by Crop | Crop Nitrogen Uptake (lbs/ac)* |
|---|---|---|---|---|---|
| **MU-005003** | 1995-1996 | Wheat, Potatoes | 22981 | 76 bu/ac; 420 sacks/ac | 135 |
| **Wilkins** | 1996-1997 | Wheat, Early Beets (80 ac) | 17899 | 113 bu/ac; 21.5 tons/ac | 140 |
| | 1997-1998 | ND | ND | ND | ND |
| | 1998-1999 | Wheat (20 ac) | 6144 | 96 bu/ac | 115 |
| | 1999-2000 | Wheat, Beets | ND | ND | ND |
| | 2000-2001 | Wheat, Barley, Beets | ND | 105 bu/ac; 117 bu/ac; 21.5 t/ac | 104 |
| | 2001-2002 | Oats, Wheat | 4320 | 51.5 cwt/ac; 83 bu/ac | 71 |
| | 2002-2003 | Beets, White Wheat | 19640 | 23.55 tons/ac; 3.15 bu/ac | 158 |
| | 2003-2004 | Beets, Barley, Straw | 22260 | 27.5 tons/ac; 113 bu/ac; 8 tons/ac | 187 |
| | 2004-2005 | Wheat, Barley | 3200 | 106 bu/ac; 120 bu/ac | 96 |
| | 2005-2006 | Potatoes, Beets | 21760 | 400 sacks/ac; 28 tons/ac | 196 |
| | 2006-2007 | Wheat, Beets | 23680 | 99 bu/ac; 35 tons/ac | 115 |
| | 2007-2008 | Winter Wheat | 4220 | 113 bu/ac | 44 |
| | 2008-2009 | Wheat, Alfalfa | 7700 | 110 bu/ac, 3.86 tons/ac | 162 |

| Management Unit | Campaign | Crop Type | Total Yield (lb/ac) | Yield by Crop | Crop Nitrogen Uptake (lbs/ac)* |
|---|---|---|---|---|---|
| **MU-005004** | 1995-1996 | Beans, Beets | 22440 | 13.5 sacks/ac; 23.5 tons/ac | 82 |
| **Goitiandia** | 1996-1997** | Beans, Wheat | 4576 | 20 sacks/ac; 125 bu/ac | 115 |
| | 1997-1998 | Beans, Spring Wheat, Fall Wheat | 6573 | 24 sacks/ac; 110 bu/ac; 130 bu/ac | 137 |
| | 1998-1999 | Wheat, Potatoes | 2678 | 127 bu/ac; 372 sacks/ac | 159 |
| | 1999-2000 | Beans, Potatoes | 19510 | 18 sacks/ac; 404 sacks/ac | 107 |
| | 2000-2001 | Winter Wheat | 8432 | 136 bu/ac | 129 |
| | 2001-2002 | Alfalfa, Wheat | 8880 | 6.53 tons/ac; 108 bu/ac | 237 |
| | 2002-2003 | Alfalfa, Beans yellow & pink | 6600 | 6.48 tons/ac; .78 lb/ac; .54 lb/ac | 200 |
| | 2003-2004 | Alfalfa, Winter Wheat | 12560 | 6.28 tons/ac; 141 bu/ac | 333 |
| | 2004-2005 | Alfalfa | 8100 | 4.05 tons/ac | 242 |
| | 2005-2006 | Alfalfa, Barley | 12280 | 6.14 tons/ac; 120 bu/ac | 388 |
| | 2006-2007 | Alfalfa | 14400 | 7.20 tons/ac | 342 |
| | 2007-2008 | Alfalfa | 13400 | 6.7 tons/ac | 430 |
| | 2008-2009 | Alfalfa | 13420 | 6.71 tons/ac | 469 |

## Table 3-4 Summary of Crop Yields and Crop Nitrogen Removal TASCO Mini-Cassia

| Management Unit | Campaign | Crop Type | Total Yield (lb/ac) | Yield by Crop | Crop Nitrogen Uptake (lbs/ac)* |
|---|---|---|---|---|---|
| **MU-005005** | 1995-1996 | Potatoes | 38000 | 380 sacks/ac | 152 |
| **East Gillette** | 1996-1997 | Winter Wheat | 8680 | 140 bu/ac | 189 |
| | 1997-1998 | Beets | 50000 | 25 tons/ac | 128 |
| | 1998-1999 | Wheat | 7936 | 124 bu/ac | 167 |
| | 1999-2000 | Potatoes | 40000 | 400 sacks/ac | 160 |
| | 2000-2001 | Beets | 58000 | 29 tons/ac | 148 |
| | 2001-2002 | Wheat | 5680 | 108 bu/ac | 104 |
| | 2002-2003 | Beets | 64760 | 32.38 tons/ac | 171 |
| | 2003-2004 | Hard Red Wheat | 7500 | 125 bu/ac | 277 |
| | 2004-2005 | Alfalfa | 13000 | 6.50 tons/ac | 393 |
| | 2005-2006 | Alfalfa | 12000 | 6.0 tons/ac | 405 |
| | 2006-2007 | Alfalfa | 14820 | 7.41 tons/ac | 387 |
| | 2007-2008 | Alfalfa | 14000 | 7.0 tons/ac | 413 |
| | 2008-2009 | Alfalfa | 12800 | 6.4 tons/ac | 349 |

| Management Unit | Campaign | Crop Type | Total Yield (lb/ac) | Yield by Crop | Crop Nitrogen Uptake (lbs/ac)* |
|---|---|---|---|---|---|
| **MU-005006** | 1995-1996 | Potatoes, Beans, Barley | 22528 | 380 sacks/ac; 24 sacks/ac;25 ton/sac | 126 |
| **Fisk/Blacker** | 1996-1997** | Barley, Beans, Beets | 27041 | 115 bu/ac; 19 sacks/ac; 28 tons/ac | 102 |
| | 1997-1998 | Beans | 2500 | 25 sacks/ac | 90 |
| | 1998-1999 | ND | ND | ND | ND |
| | 1999-2000 | ND | ND | ND | ND |
| | 2000-2001 | ND | ND | ND | ND |
| | 2001-2002 | ND | ND | ND | ND |
| | 2002-2003 | Malt Barley | 7200 | 3.6 bu/ac | 209 |
| | 2003-2004 | Russet Burbank Potatoes | 48200 | 482sacks/ac | 72 |
| | 2004-2005 | Barley, Potatoes | 6300 | 105 bu/ac; ND | 196 |
| | 2005-2006 | Barley | 6000 | 100 bu/ac | 186 |
| | 2006-2007 | Barley | 6600 | 110 bu/ac | 106 |
| | 2007-2008 | Beans | 1260 | 26 sacks/ac | 47 |
| | 2008-2009 | Malt Barley | 7620 | 127 bu/ac | 123 |

## Table 3-4 Summary of Crop Yields and Crop Nitrogen Removal TASCO Mini-Cassia

| Management Unit | Campaign | Crop Type | Total Yield (lb/ac) | Yield by Crop | Crop Nitrogen Uptake (lbs/ac)* |
|---|---|---|---|---|---|
| **MU-005007** | 1995-1996 | Alfalfa | 11000 | 5.5 tons/ac | 308 |
| **Seedall** | 1996-1997 | Alfalfa | 14482 | 5.5 tons/ac | 405 |
| | 1997-1998 | Alfalfa | 15798 | 7.9 tons/ac | 442 |
| | 1998-1999 | Alfalfa | 11743 | 5.9 tons/ac | 330 |
| | 1999-2000 | Alfalfa | 18405 | 9.2 tons/ac | 515 |
| | 2000-2001 | Alfalfa | 10114 | 5.06 tons/ac | 283 |
| | 2001-2002 | Alfalfa | 9200 | 4.6 tons/ac | 314 |
| | 2002-2003 | Alfalfa | 11720 | 5.86 tons/ac | 296 |
| | 2003-2004 | Winter Wheat | 9240 | 154 bu/ac | 252 |
| | 2004-2005 | Alfalfa | 15380 | 7.69 tons/ac | 377 |
| | 2005-2006 | Alfalfa | 13360 | 6.68 tons/ac | 473 |
| | 2006-2007 | Alfalfa | 14800 | 7.4 tons/ac | 415 |
| | 2007-2008 | Alfalfa | 13060 | 6.53 tons/ac | 391 |
| | 2008-2009 | Alfalfa | 12680 | 6.39 tons/ac | 407 |

| Management Unit | Campaign | Crop Type | Total Yield (lb/ac) | Yield by Crop | Crop Nitrogen Uptake (lbs/ac)* |
|---|---|---|---|---|---|
| **MU-005008** | 1995-1996 | | | | |
| **West Gillette** | 1996-1997** | Wheat | 744 | 120 bu/ac | 162 |
| | 1997-1998 | Wheat, Potatoes | 19160 | 130 bu/ac; 300 sacks/ac | 147 |
| | 1998-1999 | ND | ND | ND | ND |
| | 1999-2000 | Wheat, Beets | 6789 | 130 bu/ac; 32.45 tons/ac | 321 |
| | 2000-2001 | Winter Wheat, Potatoes | 43971 | 96.3 bu/ac; 380 sacks/ac | 121 |
| | 2001-2002 | Potatoes, Beets | 10900 | 380 sacks/ac; 26.5 tons/ac | 144 |
| | 2002-2003 | Beets, Wheat | 25380 | 22.30 tons/ac; 3.21 bu/ac | 146 |
| | 2003-2004 | Potatoes, Wheat | 23480 | 400 sacks/ac | 180 |
| | 2004-2005 | Potatoes, Beets | 50100 | 420 sack/ac; 29.36 tons/ac | 497 |
| | 2005-2006 | Beets | 61960 | 30.98 tons/ac | 743 |
| | 2006-2007 | Wheat | 6300 | 105 bu/ac | 151 |
| | 2007-2008 | Winter Wheat | 7680 | 128 bu/ac | 129 |
| | 2008-2009 | Alfalfa | 11000 | 5.50 tons/ac | 306 |

## Table 3-4 Summary of Crop Yields and Crop Nitrogen Removal TASCO Mini-Cassia

| Management Unit | Campaign | Crop Type | Total Yield (lb/ac) | Yield by Crop | Crop Nitrogen Uptake (lbs/ac)* |
|---|---|---|---|---|---|
| **MU-005009** | 1995-1996 | | | | |
| | 1996-1997 | | | | |
| **South Schow** | 1997-1998 | | | | |
| | 1998-1999 | Oats, Alfalfa | 10532 | 12.5 bu/ac; 2 tons/ac | 196 |
| | 1999-2000 | Alfalfa | 20456 | 10.23 tons/ac | 573 |
| | 2000-2001 | Alfalfa | 11538 | 5.77 tons/ac | 323 |
| | 2001-2002 | Alfalfa | 11360 | 5.68 tons/ac | 383 |
| | 2002-2003 | Alfalfa | 9280 | 4.64 tons/ac | 260 |
| | 2003-2004 | Alfalfa, Winter Wheat | 9200 | 4.6 tons/ac; 123 bu/ac | 294 |
| | 2004-2005 | Winter Wheat | 7440 | 3.72 tons/ac | 220 |
| | 2005-2006 | Alfalfa | 13100 | 6.55 tons/ac | 433 |
| | 2006-2007 | Alfalfa | 15600 | 7.8 tons/ac | 407 |
| | 2007-2008 | Alfalfa | 14000 | 7 tons/ac | 417 |
| | 2008-2009 | Alfalfa | 13060 | 6.53 tons/ac | 466 |

| Management Unit | Campaign | Crop Type | Total Yield (lb/ac) | Yield by Crop | Crop Nitrogen Uptake (lbs/ac)* |
|---|---|---|---|---|---|
| **MU-005010** | 1995-1996 | | | | |
| **North Schow** | 1996-1997** | | | | |
| | 1997-1998 | | | | |
| | 1998-1999 | | | | |
| | 1999-2000 | Oats, Alfalfa | 9670 | 3.99 tons/ac; .64 tons/ac | 124 |
| | 2000-2001 | Alfalfa | 13600 | 6.8 tons/ac | 381 |
| | 2001-2002 | Alfalfa | 10120 | 5.06 tons/ac | 337 |
| | 2002-2003 | Alfalfa | 9300 | 4.65 tons/ac | 352 |
| | 2003-2004 | Alfalfa | 10220 | 5.11 tons/ac | 286 |
| | 2004-2005 | Alfalfa | 8740 | 4.37 tons/ac | 260 |
| | 2005-2006 | Alfalfa | 8000 | 4 tons/ac | 267 |
| | 2006-2007 | Alfalfa | 8100 | 4.05 tons/ac | 130 |
| | 2007-2008 | Alfalfa | 8740 | 4.37 tons/ac | 278 |
| | 2008-2009 | Alfalfa | 11480 | 5.74 tons/ac | 465 |

## Table 3-5 Average Nitrogen Crop Removals from 1995 to Present

## TASCO Mini-Cassia

| Management Unit | Campaign | Wastewater Nitrogen Applied (lbs/ac) | Fertilizer Nitrogen Applied (lbs/ac) | Total Nitrogen Applied (lbs/ac) | Crop Nitrogen Uptake (lbs/ac)* | Residual Nitrogen (lbs/ac) |
|---|---|---|---|---|---|---|
| **MU-005001** | 1995-1996 | 30.0 | 111 | 141 | 176 | -35 |
| **East Farm** | 1996-1997 | 83.0 | 6 | 89 | 258 | -169 |
| | 1997-1998 | 66.0 | 6 | 72 | 232 | -160 |
| | 1998-1999 | 191.0 | 6 | 197 | 226 | -29 |
| | 1999-2000 | 155.0 | 0 | 155 | 91 | 64 |
| | 2000-2001 | 218.6 | 50 | 268.57 | 143 | 125.57 |
| | 2001-2002 | 163.6 | 0 | 163.6 | 520 | -356.4 |
| | 2002-2003 | 59.2 | 0 | 59.2 | 322 | -262.8 |
| | 2003-2004 | 41.0 | 37 | 78 | 243 | -165 |
| | 2004-2005 | 52.3 | 0 | 52.3 | 215 | -162.7 |
| | 2005-2006 | 63.2 | 14.93 | 78.13 | 262 | -183.87 |
| | 2006-2007 | 47.0 | 36 | 83 | 93 | -10 |
| | 2007-2008 | 87.6 | 85 | 172.6 | 68 | 104.6 |
| | 2008-2009 | 67.6 | 72 | 139.6 | 150 | -10.4 |
| | Average | 94.6 | 30.3 | 124.9 | 214.2 | -89.3 |

| Management Unit | Campaign | Wastewater Nitrogen Applied (lbs/ac) | Fertilizer Nitrogen Applied (lbs/ac) | Total Nitrogen Applied (lbs/ac) | Crop Nitrogen Uptake (lbs/ac)* | Residual Nitrogen (lbs/ac) |
|---|---|---|---|---|---|---|
| **MU-005002** | 1995-1996 | 28.0 | 124 | 152 | 230 | -78 |
| **South Farm** | 1996-1997** | | 310 | 310 | 150 | 160 |
| | 1997-1998 | 23.0 | 6 | 29 | 112 | -83 |
| | 1998-1999 | 198.0 | 6 | 204 | 364 | -160 |
| | 1999-2000 | 171.0 | 22 | 193 | 386 | -193 |
| | 2000-2001 | 236.6 | 0 | 236.56 | 280 | -43.44 |
| | 2001-2002 | 119.7 | 0 | 119.7 | 370 | -250.3 |
| | 2002-2003 | 76.1 | 0 | 76.1 | 384 | -307.9 |
| | 2003-2004 | 135.8 | 133 | 268.8 | 226 | 42.8 |
| | 2004-2005 | 92.5 | 0 | 92.5 | 339 | -246.5 |
| | 2005-2006 | 85.4 | 17 | 102.4 | 365 | -262.6 |
| | 2006-2007 | 77.3 | 0 | 77.3 | 393 | -315.7 |
| | 2007-2008 | 148.4 | 61 | 209.4 | 326 | -116.6 |
| | 2008-2009 | 122.4 | 0 | 122.4 | 459 | -336.6 |
| | Average | 116.5 | 48.5 | 156.7 | 313.1 | -156.5 |

## Table 3-5 Average Nitrogen Crop Removals from 1995 to Present

## TASCO Mini-Cassia

| Management Unit | Campaign | Wastewater Nitrogen Applied (lbs/ac) | Fertilizer Nitrogen Applied (lbs/ac) | Total Nitrogen Applied (lbs/ac) | Crop Nitrogen Uptake (lbs/ac)* | Residual Nitrogen (lbs/ac) |
|---|---|---|---|---|---|---|
| **MU-005003** | 1995-1996 | 105.0 | 118 | 223 | 135 | 88 |
| **Wilkins** | 1996-1997 | 141.0 | 66 | 207 | 140 | 67 |
| | 1997-1998 | | ND | | | |
| | 1998-1999 | 141.0 | 110 | 251 | 115 | 136 |
| | 1999-2000 | | ND | | | |
| | 2000-2001 | | 122 | 122 | 104 | 18 |
| | 2001-2002 | 45.5 | 106 | 151.5 | 71 | 80.5 |
| | 2002-2003 | | 114 | 114 | 158 | -44 |
| | 2003-2004 | 20.6 | 95 | 115.6 | 187 | -71.4 |
| | 2004-2005 | 16.6 | 57.6 | 74.2 | 96 | -21.8 |
| | 2005-2006 | | 98.8 | 98.8 | 196 | -97.2 |
| | 2006-2007 | | 19 | 19 | 115 | -96 |
| | 2007-2008 | | 58 | 58 | 44 | 14 |
| | 2008-2009 | | 96.2 | 96.2 | 162 | -65.8 |
| | Average | 78.3 | 88.4 | 127.5 | 126.9 | 0.6 |

| Management Unit | Campaign | Wastewater Nitrogen Applied (lbs/ac) | Fertilizer Nitrogen Applied (lbs/ac) | Total Nitrogen Applied (lbs/ac) | Crop Nitrogen Uptake (lbs/ac)* | Residual Nitrogen (lbs/ac) |
|---|---|---|---|---|---|---|
| **MU-005004** | 1995-1996 | 113.0 | 82 | 195 | 82 | 113 |
| **Goitiandia** | 1996-1997** | 118.0 | 120 | 238 | 115 | 123 |
| | 1997-1998 | 125.0 | 134 | 259 | 137 | 122 |
| | 1998-1999 | 81.0 | 224 | 305 | 159 | 146 |
| | 1999-2000 | 100.0 | 93 | 193 | 107 | 86 |
| | 2000-2001 | 85.9 | 65 | 150.94 | 129 | 21.94 |
| | 2001-2002 | 125.8 | 84 | 209.8 | 237 | -27.2 |
| | 2002-2003 | 70.1 | 9 | 79.1 | 200 | -120.9 |
| | 2003-2004 | 85.3 | 57 | 142.3 | 333 | -190.7 |
| | 2004-2005 | 108.2 | 39.2 | 147.4 | 242 | -94.6 |
| | 2005-2006 | 120.7 | 70.4 | 191.1 | 388 | -196.9 |
| | 2006-2007 | 81.1 | 0 | 81.1 | 342 | -260.9 |
| | 2007-2008 | 143.7 | 0 | 143.7 | 430 | -286.3 |
| | 2008-2009 | 161.5 | 0 | 161.5 | 469 | -307.5 |
| | Average | 108.5 | 69.8 | 178.4 | 240.7 | -62.4 |

## Table 3-5 Average Nitrogen Crop Removals from 1995 to Present

## TASCO Mini-Cassia

| Management Unit | Campaign | Wastewater Nitrogen Applied (lbs/ac) | Fertilizer Nitrogen Applied (lbs/ac) | Total Nitrogen Applied (lbs/ac) | Crop Nitrogen Uptake (lbs/ac)* | Residual Nitrogen (lbs/ac) |
|---|---|---|---|---|---|---|
| **MU-005005** | 1995-1996 | 122.0 | 220 | 342 | 152 | 190 |
| **East Gillette** | 1996-1997 | 318.0 | 160 | 478 | 189 | 289 |
| | 1997-1998 | 102.0 | 123 | 225 | 128 | 97 |
| | 1998-1999 | 246.0 | 0 | 246 | 167 | 79 |
| | 1999-2000 | | 255 | 255 | 160 | 95 |
| | 2000-2001 | | 37 | 37 | 148 | -111 |
| | 2001-2002 | 103.4 | 220 | 323.4 | 104 | 219.4 |
| | 2002-2003 | 66.0 | 9 | 75 | 171 | -96 |
| | 2003-2004 | 60.3 | 175 | 235.3 | 277 | -41.7 |
| | 2004-2005 | 48.2 | 0 | 48.2 | 393 | -344.8 |
| | 2005-2006 | 146.6 | 10 | 156.6 | 405 | -248.4 |
| | 2006-2007 | 107.2 | 13 | 120.2 | 387 | -266.8 |
| | 2007-2008 | 221.0 | 38 | 259 | 413 | -154 |
| | 2008-2009 | 102.0 | 10 | 112 | 349 | -237 |
| | Average | 136.9 | 90.7 | 208.1 | 245.9 | -37.9 |

| Management Unit | Campaign | Wastewater Nitrogen Applied (lbs/ac) | Fertilizer Nitrogen Applied (lbs/ac) | Total Nitrogen Applied (lbs/ac) | Crop Nitrogen Uptake (lbs/ac)* | Residual Nitrogen (lbs/ac) |
|---|---|---|---|---|---|---|
| **MU-005006** | 1995-1996 | 145.0 | 165 | 310 | 126 | 184 |
| **Fisk/Blacker** | 1996-1997** | 166.0 | 70 | 236 | 102 | 134 |
| | 1997-1998 | 243.0 | 0 | 243 | 90 | 153 |
| | 1998-1999 | | ND | | ND | |
| | 1999-2000 | | ND | | ND | |
| | 2000-2001 | | ND | | ND | |
| | 2001-2002 | | ND | | ND | |
| | 2002-2003 | | 52 | 52 | 209 | -157 |
| | 2003-2004 | | 282 | 282 | 72 | 210 |
| | 2004-2005 | | 50 | 50 | 196 | -146 |
| | 2005-2006 | | 51.5 | 51.5 | 186 | -134.5 |
| | 2006-2007 | | 100 | 100 | 106 | -6 |
| | 2007-2008 | | 9.9 | 9.9 | 47 | -37.1 |
| | 2008-2009 | | 75 | 75 | 123 | -48 |
| | Average | 184.7 | 85.5 | 140.9 | 125.7 | 15.2 |

## Table 3-5 Average Nitrogen Crop Removals from 1995 to Present

## TASCO Mini-Cassia

| Management Unit | Campaign | Wastewater Nitrogen Applied (lbs/ac) | Fertilizer Nitrogen Applied (lbs/ac) | Total Nitrogen Applied (lbs/ac) | Crop Nitrogen Uptake (lbs/ac)* | Residual Nitrogen (lbs/ac) |
|---|---|---|---|---|---|---|
| **MU-005007** | 1995-1996 | 59.0 | 83 | 142 | 308 | -166 |
| **Seedall** | 1996-1997 | 61.0 | 6 | 67 | 405 | -338 |
| | 1997-1998 | 51.0 | 6 | 57 | 442 | -385 |
| | 1998-1999 | 157.0 | 6 | 163 | 330 | -167 |
| | 1999-2000 | 204.0 | 22 | 226 | 515 | -289 |
| | 2000-2001 | 217.6 | 0 | 217.6 | 283 | -65.4 |
| | 2001-2002 | 164.5 | 0 | 164.5 | 314 | -149.5 |
| | 2002-2003 | 50.9 | 0 | 50.9 | 296 | -245.1 |
| | 2003-2004 | 88.2 | 122 | 210.2 | 252 | -41.8 |
| | 2004-2005 | 53.4 | 0 | 53.4 | 377 | -323.6 |
| | 2005-2006 | 138.8 | 0 | 138.8 | 473 | -334.2 |
| | 2006-2007 | 127.8 | 11 | 138.8 | 415 | -276.2 |
| | 2007-2008 | 229.8 | 14 | 243.8 | 391 | -147.2 |
| | 2008-2009 | 92.0 | 0 | 92 | 407 | -315 |
| | Average | 121.1 | 19.3 | 140.4 | 372.0 | -231.6 |

| Management Unit | Campaign | Wastewater Nitrogen Applied (lbs/ac) | Fertilizer Nitrogen Applied (lbs/ac) | Total Nitrogen Applied (lbs/ac) | Crop Nitrogen Uptake (lbs/ac)* | Residual Nitrogen (lbs/ac) |
|---|---|---|---|---|---|---|
| **MU-005008** | 1995-1996 | | | | | |
| **West Gillette** | 1996-1997** | 58.0 | 200 | 258 | 162 | 96 |
| | 1997-1998 | 251.0 | 142 | 393 | 147 | 246 |
| | 1998-1999 | | ND | | ND | |
| | 1999-2000 | 98.0 | 101 | 199 | 321 | -122 |
| | 2000-2001 | 58.0 | 237 | 295 | 121 | 174 |
| | 2001-2002 | | 109 | 109 | 144 | -35 |
| | 2002-2003 | 22.9 | 72 | 94.9 | 146 | -51.1 |
| | 2003-2004 | 9.3 | 235 | 244.3 | 180 | 64.3 |
| | 2004-2005 | | 131.3 | 131.3 | 497 | -365.7 |
| | 2005-2006 | | 18 | 18 | 743 | -725 |
| | 2006-2007 | 66.5 | 164 | 230.5 | 151 | 79.5 |
| | 2007-2008 | 32.9 | 190 | 222.9 | 129 | 93.9 |
| | 2008-2009 | 16.1 | 20 | 36.1 | 306 | -269.9 |
| | Average | 68.1 | 134.9 | 186.0 | 253.9 | -67.9 |

## Table 3-5 Average Nitrogen Crop Removals from 1995 to Present

## TASCO Mini-Cassia

| Management Unit | Campaign | Wastewater Nitrogen Applied (lbs/ac) | Fertilizer Nitrogen Applied (lbs/ac) | Total Nitrogen Applied (lbs/ac) | Crop Nitrogen Uptake (lbs/ac)* | Residual Nitrogen (lbs/ac) |
|---|---|---|---|---|---|---|
| **MU-005009** | 1995-1996 | | | | | |
| **South Schow** | 1996-1997 | | | | | |
| | 1997-1998 | | | | | |
| | 1998-1999 | 23.0 | 20 | 43 | 196 | -153 |
| | 1999-2000 | 131.0 | 22 | 153 | 573 | -420 |
| | 2000-2001 | 200.0 | 0 | 200.02 | 323 | -122.98 |
| | 2001-2002 | 163.7 | 0 | 163.7 | 383 | -219.3 |
| | 2002-2003 | 74.6 | 0 | 74.6 | 260 | -185.4 |
| | 2003-2004 | 57.9 | 65 | 122.9 | 294 | -171.1 |
| | 2004-2005 | 20.3 | 46 | 66.3 | 220 | -153.7 |
| | 2005-2006 | 51.6 | 0 | 51.6 | 433 | -381.4 |
| | 2006-2007 | 56.9 | 11 | 67.9 | 407 | -339.1 |
| | 2007-2008 | 184.8 | 17.5 | 202.3 | 417 | -214.7 |
| | 2008-2009 | 60.4 | 0 | 60.4 | 466 | -405.6 |
| | Average | 93.1 | 16.5 | 109.6 | 361.1 | -251.5 |

| Management Unit | Campaign | Wastewater Nitrogen Applied (lbs/ac) | Fertilizer Nitrogen Applied (lbs/ac) | Total Nitrogen Applied (lbs/ac) | Crop Nitrogen Uptake (lbs/ac)* | Residual Nitrogen (lbs/ac) |
|---|---|---|---|---|---|---|
| **MU-005010** | 1995-1996 | | | | | |
| **North Schow** | 1996-1997** | | | | | |
| | 1997-1998 | | | | | |
| | 1998-1999 | | | | | |
| | 1999-2000 | 5.8 | | 5.8 | 124 | -118.2 |
| | 2000-2001 | 115.3 | 0 | 115.33 | 381 | -265.67 |
| | 2001-2002 | 75.4 | 0 | 75.4 | 337 | -261.6 |
| | 2002-2003 | 56.0 | 0 | 56 | 352 | -296 |
| | 2003-2004 | 51.6 | 0 | 51.6 | 286 | -234.4 |
| | 2004-2005 | 69.9 | 0 | 69.9 | 260 | -190.1 |
| | 2005-2006 | 171.5 | 0 | 171.5 | 267 | -95.5 |
| | 2006-2007 | 93.0 | 100 | 193 | 130 | 63 |
| | 2007-2008 | 61.0 | 39.4 | 100.4 | 278 | -177.6 |
| | 2008-2009 | 66.8 | 19.9 | 86.7 | 465 | -378.3 |
| | Average | 76.6 | 17.7 | 92.6 | 288.0 | -195.4 |

# 4.0 Site Conditions

This section provides a discussion of climate, soils, and hydrogeology for the land application system at the Mini Cassia facility. Each of these variables affects the amount of wastewater that can be land applied. Climatic conditions, such as temperature and precipitation, are based on historical information. General soils characteristics are discussed along with site-specific monitoring data that was collected as part of the current permit. A discussion of the hydrogeology is provided for the region, locally, and at the facility.

## 4.1 Climate

Table 4-1 provides general climate data for the Paul, Idaho area (source: Western Regional Climate Center, Paul 1ENE COOP, Idaho, data from 1925 to 2009).

**Table 4-1. General Climate Data for Paul, Idaho Area from 1/1/1925 to 12/31/2009**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Max. Temperature (F) | 35.3 | 41.4 | 50.1 | 59.6 | 69.2 | 77.8 | 88.0 | 86.7 | 76.5 | 64.0 | 47.7 | 37.8 | 61.2 |
| Average Min. Temperature (F) | 16.8 | 21.1 | 26.2 | 32.2 | 40.2 | 46.9 | 53.0 | 50.5 | 41.7 | 32.7 | 24.9 | 19.0 | 33.8 |
| Average Total Precipitation (in) | 1.02 | 0.74 | 0.81 | 0.93 | 1.18 | 0.93 | 0.36 | 0.41 | 0.60 | 0.75 | 0.95 | 1.01 | 9.69 |
| Average Total Snow Fall (in) | 5.6 | 2.9 | 1.8 | 0.9 | 0.3 | 0 | 0 | 0 | 0 | 0.2 | 1.6 | 4.7 | 18.0 |
| Average Snow Depth (in) | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |

Source: Western Regional Climate Center, Paul 1ENE COOP

Climatic data for the Paul area are also available from the Agri-Met weather station (operated and maintained by the U.S. Bureau of Reclamation in Rupert, Idaho) (station location: Latitude: 42° 35' 44", Longitude: 113° 52' 26", Elevation: 4155 feet, Installation Date: 3/9/88). Agri-Met data are available from the early 1980s to present. A list of the current measurements for the station is presented in Table 4-2.

**Table 4-2.Summary of Rupert, Idaho's Agri-Met Weather Station Measurements**

| | |
|---|---|
| PPTI | RUBERT IDAHO WEATHER STATION |
| OB | AIR TEMPERATURE - INST OBSERVATION (DEG F) |
| PC | PRECIP – 25" LOAD CELL STORAGE GAGE (CUMULATIVE INCHES OF WATER) |
| SQ | GLOBAL SOLAR RADIATION (LANGLEYS CUMULATIVE) |
| SI | INCREMENTAL GLOBAL SOLAR RADIATION (LANGLEYS PER HOUR) |
| SW | SOIL TEMPERATURE - 4 INCH DEPTH (DEG F) |
| TP | DEW POINT (DEG F) |
| TU | RELATIVE HUMIDITY (PERCENT) |
| UI | CUMULATIVE WIND RUN (MILES) |
| WD | WIND DIRECTION (DEGREES) |
| WG | PEAK WIND GUST (MPH) |
| WS | AVERAGE WIND SPEED (MPH) |

Precipitation – Average annual precipitation recorded from the Western Regional Climate Center is 9.69 inches (Table 4-1). Average precipitation from the Agri-Met station from March 1987 through May 2009 is 8.64 inches (Table 4-3). Using the Agri-Met data, precipitation for the non-growing season (November through March) is 3.8 inches and precipitation is 4.8 inches for the growing season.

**Table 4-3. Average precipitation for Rupert, Idaho (1987 to 2009)**

| (inches) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Jan.** | **Feb.** | **Mar.** | **Apr.** | **May** | **Jun.** | **Jul.** | **Aug.** | **Sep.** | **Oct.** | **Nov.** | **Dec** | **Annual** |
| 0.73 | 0.42 | 0.85 | 1.02 | 1.33 | 0.73 | 0.17 | 0.43 | 0.53 | 0.63 | 0.91 | 0.91 | 8.64 |

Source: Rupert, Idaho Agri-Met Station.

Air Temperature – Figure 4-1 illustrates Rupert's average daily maximum and minimum temperatures. Diurnal temperatures (daily high and lows) are greater during the summer months compared to the winter months. The daily high temperatures are greatest in July and August with a daily high average of 86.7 and 85.5°F, respectively. The average daily low temperature occurs in December and January, with a daily low average of 19.4 and 19.8°F, respectively.

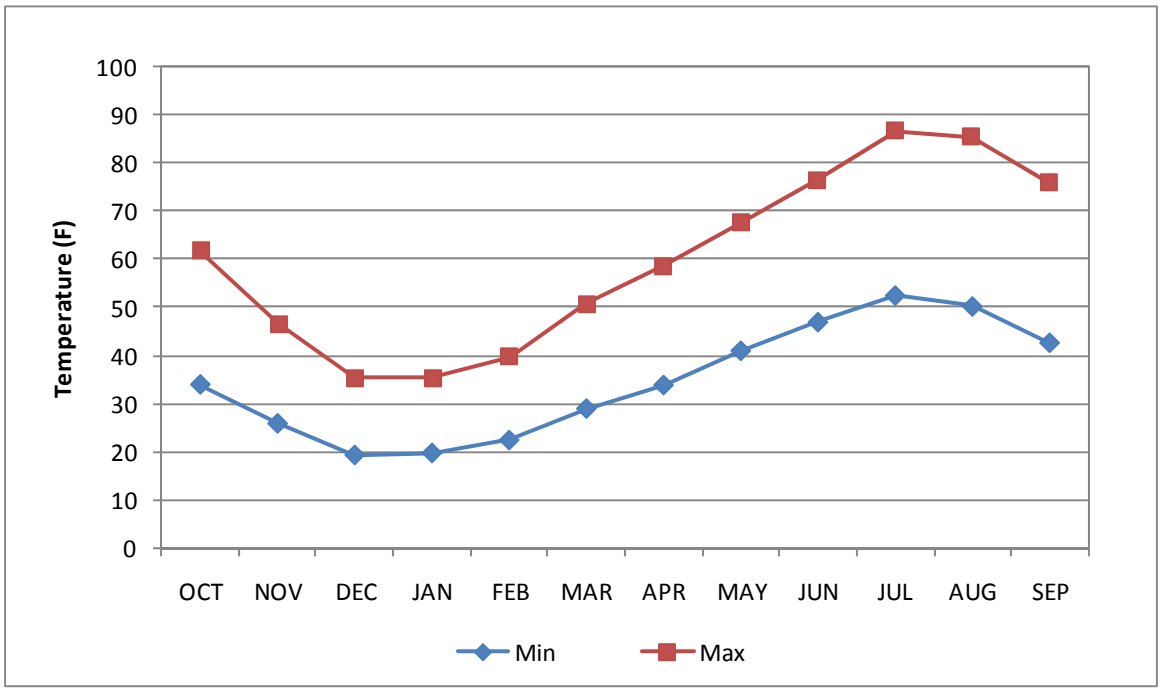



**Figure 4-1. Average Minimum and Maximum Temperature Patterns for Rupert, Idaho**
(source: Agri-Met, Rupert Station data from 1987 to 2009)

Soil Temperature – January has the lowest average daily soil temperature at 31.2 °F; July has the highest average daily temperature at 75.9 °F (Figure 4-2).

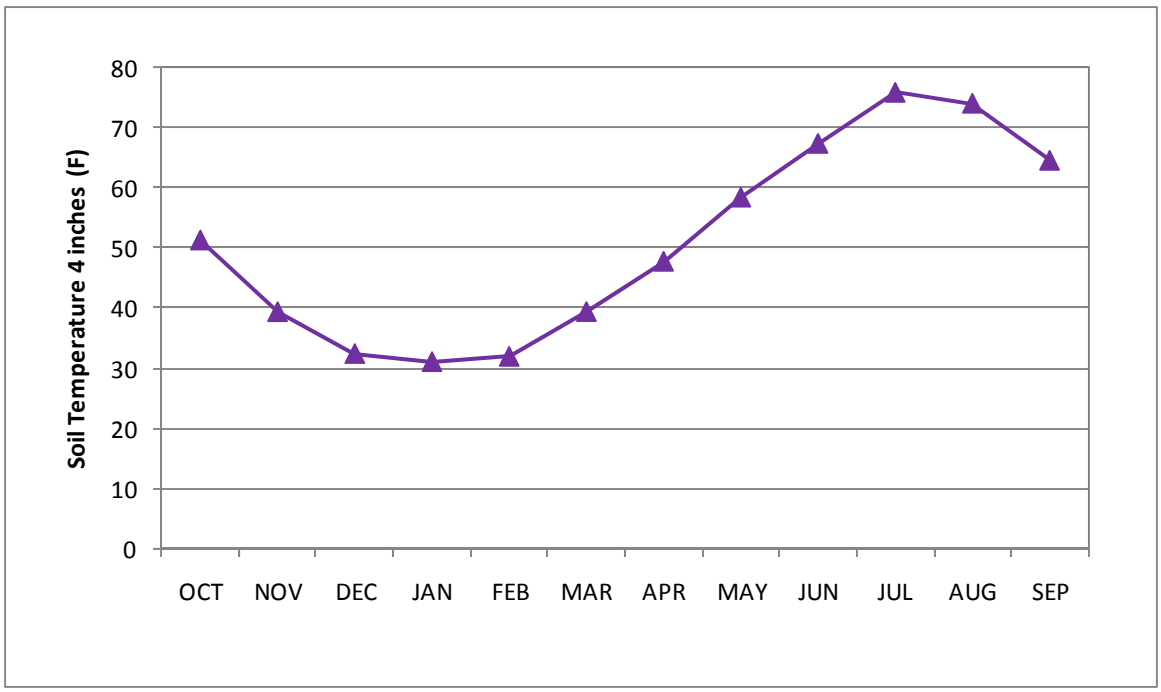



**Figure 4-2 Average Daily Soil Temperature at 4 Inch Depth for Rupert, Idaho**
(source: Agri-Met, Rupert Station, data from 1987 to 2009)

Evapotranspiration (ET) – ET is the combination of two processes in which soil water is lost through surface evaporation and transpiration through vegetation. These two mechanisms are not easily distinguishable, and therefore, are lumped together as a single variable. Crop ET is generally calculated as follows:

$$ET_c = K_c\ ET_o$$

where: $ET_c$ is the ET for the crop being grown
$K_c$ is the crop coefficient
$ET_o$ is the reference ET

A number of methods exist for calculating the $ET_o$, many of which are based on meteorological data. Examples of $ET_o$ methods include Penman (and modifications), Jensen-Haise, Blaney-Criddle, and Thornthwaite (Ward and Elliot, 1995). Crop coefficients are published in the literature and are based on field trials.

Agri-Met uses the 1982 Kimberly-Penman ET model, developed by the USDA Agricultural Research Service (ARS) in Kimberly, Idaho, to calculate $ET_o$. This model uses alfalfa as the reference crop ($ET_o$). Crop coefficients vary throughout the growing season based on the plant growth stage. The Kimberly-Penman equation uses air temperature, humidity, radiation, and wind speed data for daily, weekly, ten-day, or monthly calculations.

Table 4-4 presents monthly average reference evapotranspiration ($ET_r$) for the Rupert station. These values ($ET_r$) are for the alfalfa reference crop (also known as "tall crop" reference). Values during the winter months roughly approximate evaporation from bare (non-snow

covered) wet soil, frozen or thawed. The calculated values are for irrigated agricultural (or turf grass) environments, and represent the ET conditions found in actively growing, irrigated cropland.

**Table 4-4. Monthly Average Reference Evapotranspiration ($ET_r$) for Agri-Met Rupert Station (based on average 1987 to 2009)**

| (inches) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Total** |
| 0.83 | 1.37 | 3.05 | 4.86 | 6.77 | 8.47 | 9.81 | 8.69 | 5.83 | 3.63 | 1.54 | 0.74 | 55.60 |

$ET_r$ is greatest in July followed by August. Note that the relationship between $ET_r$ and $ET_o$ is (Wright et al., 2000):

$$ET_o = 0.87*ET_r$$

Non-Growing Season $ET_{ngs}$ – the $ET_r$ in Table 4-4 can be used to estimate non-growing season ET ($ET_{ngs}$) by:

$$ET_{ngs} = ET_r*0.7$$

Table 4-5 summarizes the predicted $ET_{ngs}$ where 0.7 is the evaporation coefficient, recommended by Dr. James Wright (2003).

**Table 4-5. Non-Growing Season Evapotranspiration ($ET_{ngs}$) based on the Agri-Met Rupert Station $ET_r$ data and Using an Evaporation Coefficient of 0.7**

| (inches) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Total** |
| 0.58 | 0.96 | 2.14 | - | - | - | - | - | - | - | 1.08 | 0.52 | 5.28 |

Section 5.0 addresses the hydraulic loadings for both GS and NGS, which use the climatic data presented above.

## 4.2 Soils

To effectively evaluate the performance of the wastewater land application system, soils at each of the management units must be properly characterized and monitored.

**Soil Survey**

The Natural Resource Conservation Service (NRCS, formally the Soil Conservation Service, SCS) soil survey was used to identify land application site soil types and general characteristics. Figure 4-3 shows soil mapping units for the land application sites. As shown on the map, soils in the management units north of the processing facility (MU-005003, MU-005004, MU-005005, MU-005008) are dominated by the Woozle loam soil series. This soil is well-drained, deep, and has a water holding capacity of 8.7 inches for the upper 60-inches of soil. The Decker loam, Schodson sandy loam, Wodskow sandy loam, Paulville loam, and Declo loam are the

predominant soil series for the management units located east and south of the processing facility (Figure 4-3). Table 4-6 gives the characteristics of the dominant soil types for each land management unit.

**Soil Storage Capacity**

Site-specific loading rate estimates are based on soil and crop characteristics, and management criteria. Growing season loading rates are based on crop water requirements, annual nitrogen requirements, and reasonable daily COD loads.

Non-growing season loading rates are based on criteria to minimize the potential for groundwater impact. The non-growing season (November to March) hydraulic loading rate ($HLR_{ngs}$) was calculated using the soil storage capacity, evaporation, and precipitation (DEQ 2007).

$$HLR_{ngs} = AWC + E - PPT_{ngs}$$

Where:

$HLR_{ngs}$ = non-growing season hydraulic loading rate

AWC = weighted composite available water holding capacity of the soil to 60 inches or root limiting layer, whichever is shallowest

E = estimate of evaporation/evapotranspiration during the non-growing season

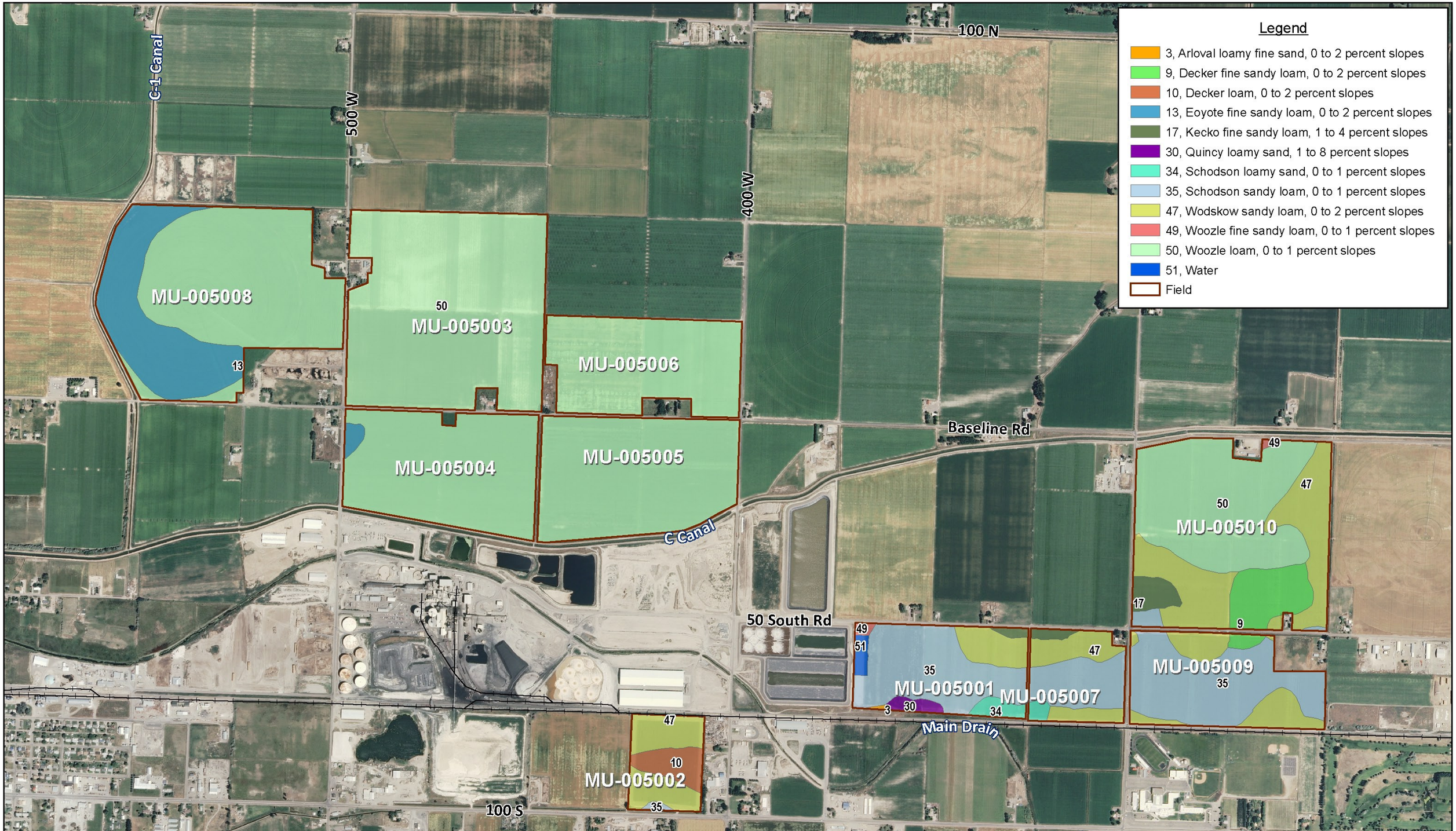
$PPT_{ngs}$ = average precipitation falling during the non-growing season

**AWC**. The AWC is available from the NRCS for specific soil mapping units (Figure 4-3). Table 4-6 presents calculation of a weighted average AWC for each site, based on NRCS data and approximate percentage of land area. As presented in Table 4-6, the AWC is based on 60 inches or the depth of the restrictive layer, which ever is shallower. In general, TASCO grows alfalfa, which is deep rooted.

**E**. An estimate of non-growing season evaporation/evapotranspiration was based on the average of the sum of the non-growing season monthly values, presented in Table 4-5.

**$PPT_{ngs}$**. The average precipitation falling during the non-growing season was obtained from the mean monthly precipitation for Idaho in the Paul area (Table 4-3).

Table 4-7 shows calculations of the $HLR_{ngs}$ for each site.




N

0 1,000 2,000 3,000 Feet

**Soils**

The Amalgamated Sugar Company
Mini-Cassia Facility, Paul, Idaho

Map Date: 05/19/10
Q:\TASCO\Paul\map_docs\PaulFigures.mxd

Imagery: 2009 1 meter resolution NAIP
Source: NRCS Digital Gateway
Other Data Sources:US Censue Bureau

HDR | ONE COMPANY Many Solutions℠

**Figure 4-3**

**Table 4-6. Summary of Soil Characteristics**

| Map Unit Name[1] | Map Unit Symbol | Percent of Field | Soil Depth (in) | Typical Profile | Restrictive Layer (in) | Available Water Capacity (in/in) | Overall Available Water Capacity (in) |
|---|---|---|---|---|---|---|---|
| **East Farm (MU-005001)** | | | | | | | |
| Arloval loamy fine sand, 0 to 2 percent slopes | 3 | 1 | 60 | 0-10 in: loamy fine sand<br>10-23 in: loamy fine sand<br>23-35 in: loamy fine sand<br>35-52 in: loamy fine sand<br>52-60 in: loamy sand | >80 | 0-10 in: 0.09-0.11<br>10-23 in: 0.05-0.08<br>23-35 in: 0.05-0.08<br>35-52 in: 0.05-0.08<br>52-60 in: 0.05-0.08 | 4.5 |
| Quincy loamy sand, 1 to 8 percent slopes | 30 | 5 | 70 | 0-16 in: loamy sand<br>16-36: loamy sand<br>36-70: stratified sand to loamy sand | > 80 | 0-16 in: 0.08-0.11<br>16-36 in: 0.08-0.11<br>36-70 in: 0.08-0.11 | 6.0 |
| Schodson loamy sand, 0 to 1 percent slopes | 34 | 6 | 60 | 0-9 in: loamy sand<br>9-25 in: sandy loam<br>25-32 in: loamy course sand<br>32-43 in: coarse sand<br>43-60 in: coarse sand | >80 | 0-9 in: 0.06-0.08<br>9-25 in: 0.11-0.13<br>25-32 in: 0.08-0.10<br>32-43 in: 0.08-0.10<br>43-60 in: 0.08-0.10 | 5.7 |
| Schodson sandy loam, 0 to 1 percent slopes | 35 | 70 | 60 | 0-9 in: sandy loam<br>9-25 in: sandy loam<br>25-32 in: loamy course sand<br>32-43 in: coarse sand<br>43-60 in: coarse sand | >80 | 0-9 in: 0.11-0.13<br>9-25 in: 0.11-0.13<br>25-32 in: 0.08-0.10<br>32-43 in: 0.08-0.10<br>43-60 in:0.08-0.10 | 6.1 |
| Wodskow sandy loam, 0 to 2 percent slopes | 47 | 15 | 60 | 0-8 in: sandy loam<br>8-12 in: sandy loam<br>12-20 in: sandy loam<br>20-28 in: sandy loam<br>28-34 in: loam<br>34-40 in: sandy loam<br>40-55 in: loamy fine sand<br>55-60 in: course sand | >80 | 0-8 in: 0.13-0.16<br>8-12 in: 0.13-0.16<br>12-20 in: 0.13-0.16<br>20-28 in: 0.13-0.16<br>28-34 in: 0.15-0.17<br>34-40 in: 0.13-0.16<br>40-55 in: 0.06-0.09<br>55-60 in: 0.02-0.05 | 7.4 |
| Woozle fine sandy loam, 0 to 1 percent slopes | 49 | 1 | 60 | 0-10 in: fine sandy loam<br>10-21 in: loam<br>21-35in: silt loam<br>35-42 in: silty clay loam<br>42-47 in: loamy fine sand<br>47-60 in: fine same | >80 | 0-10 in: 0.14-0.19<br>10-21 in: 0.14-0.20<br>21-35in: 0.14-0.20<br>35-42 in: 0.14-0.20<br>42-47 in: 0.08-0.11<br>47-60 in: 0.05-0.10 | 8.7 |
| Kecko fine sandy loam, 1 to 4 percent slopes | 17 | 2 | 62 | 0-4 in: fine sandy loam<br>4-9 in: fine sandy loam<br>9-21 in: fine sandy loam<br>21-26 in: very fine sandy loam<br>26-42 in: very fine sandy loam<br>42-62 in: stratified and to silt loam | >80 | 0-4 in: 0.12-0.14<br>4-9 in: 0.13-0.15<br>9-21 in: 0.13-0.15<br>21-26 in: 0.13-0.15<br>26-42 in: 0.13-0.15<br>42-62 in: 0.03-0.12 | 7.3 |
| | | | | | | Weighted Average for Available Water Capacity | 6.3 |
| **South Farm (MU-005002)** | | | | | | | |
| Decker loam, 0 to 2 percent slopes | 10 | 30 | 65 | 0-10 in: fine sandy loam<br>10-15 in: loam<br>15-23 in: loam<br>23-29 in: loam<br>29-35 in: sandy loam<br>35-51 in: loam | >80 | 0-10 in: 0.07-0.11<br>10-15 in: 0.07-0.15<br>15-23 in: 0.07-0.15<br>23-29 in: 0.07-0.15<br>29-35 in: 0.17-0.15<br>35-51 in: 0.17-0.15 | 6.3 |

**Table 4-6. Summary of Soil Characteristics**

| Map Unit Name[1] | Map Unit Symbol | Percent of Field | Soil Depth (in) | Typical Profile | Restrictive Layer (in) | Available Water Capacity (in/in) | Overall Available Water Capacity (in) |
|---|---|---|---|---|---|---|---|
| | | | | 51-65 in: stratified sand to fine sand | | 51-65 in: 0.09-0.10 | |
| Schodson sandy loam, 0 to 1 percent slopes | 35 | 3 | 60 | 0-9 in: sandy loam<br>9-25 in: sandy loam<br>25-32 in: loamy course sand<br>32-43 in: coarse sand<br>43-60 in: coarse sand | >80 | 0-9 in: 0.11-0.13<br>9-25 in: 0.11-0.13<br>25-32 in: 0.08-0.10<br>32-43 in: 0.08-0.10<br>43-60 in:0.08-0.10 | 6.1 |
| Wodskow sandy loam, 0 to 2 percent slopes | 47 | 67 | 60 | 0-8 in: sandy loam<br>8-12 in: sandy loam<br>12-20 in: sandy loam<br>20-28 in: sandy loam<br>28-34 in: loam<br>34-40 in: sandy loam<br>40-55 in: loamy fine sand<br>55-60 in: course sand | >80 | 0-8 in: 0.13-0.16<br>8-12 in: 0.13-0.16<br>12-20 in: 0.13-0.16<br>20-28 in: 0.13-0.16<br>28-34 in: 0.15-0.17<br>34-40 in: 0.13-0.16<br>40-55 in: 0.06-0.09<br>55-60 in: 0.02-0.05 | 7.4 |
| | | | | | | Weighted Average for Available Water Capacity | 7.0 |
| **Wilkins (MU-005003)** | | | | | | | |
| Woozle loam, 0 to 1 percent slopes | 50 | 100 | 60 | 0-10 in: loam<br>10-21 in: loam<br>21-35 in: silt loam<br>35-42 in: silty clay loam<br>42-47 in: loamy fine sand<br>47-60 in: fine sand | >10 | 0-10 in: 0.14-0.19<br>10-21 in: 0.14-0.20<br>21-35 in: 0.14-0.20<br>35-42 in: 0.14-0.20<br>42-47 in: 0.08-0.11<br>47-60 in: 0.05-0.10 | 8.7 |
| | | | | | | Weighted Average for Available Water Capacity | 8.7 |
| **Goitiandia (MU-005004)** | | | | | | | |
| Eoyote fine sandy loam, 0 to 2 percent slopes | 13 | 2 | 60 | 0-8 in: fine sandy loam<br>8-18in: fine sandy loam<br>18-36 in: fine sandy loam<br>36-60 in: fine sandy loam | >80 | 0-8 in: 0.13-0.16<br>8-18in: 0.13-0.15<br>18-36 in: 0.13-0.15<br>36-60 in: 0.13-0.15 | 8.5 |
| Woozle loam, 0 to 1 percent slopes | 50 | 98 | 60 | 0-10 in: loam<br>10-21 in: loam<br>21-35 in: silt loam<br>35-42 in: silty clay loam<br>42-47 in: loamy fine sand<br>47-60 in: fine sand | >80 | 0-10 in: 0.14-0.19<br>10-21 in: 0.14-0.20<br>21-35 in: 0.14-0.20<br>35-42 in: 0.14-0.20<br>42-47 in: 0.08-0.11<br>47-60 in: 0.05-0.10 | 8.7 |
| | | | | | | Weighted Average for Available Water Capacity | 8.7 |
| **East Gillette (MU-005005)** | | | | | | | |
| Woozle loam, 0 to 1 percent slopes | 50 | 100 | 60 | 0-10 in: loam<br>10-21 in: loam<br>21-35 in: silt loam<br>35-42 in: silty clay loam<br>42-47 in: loamy fine sand<br>47-60 in: fine sand | >80 | 0-10 in: 0.14-0.19<br>10-21 in: 0.14-0.20<br>21-35 in: 0.14-0.20<br>35-42 in: 0.14-0.20<br>42-47 in: 0.08-0.11<br>47-60 in: 0.05-0.10 | 8.7 |
| | | | | | | Weighted Average for Available Water Capacity | 8.7 |
| **Seedall (MU-005007)** | | | | | | | |
| Kecko fine sandy loam, 1 to 4 percent slopes | 17 | 5 | 62 | 0-4 in: fine sandy loam<br>4-9 in: fine sandy loam<br>9-21 in: fine sandy loam<br>21-26 in: very fine sandy loam | >80 | 0-4 in: 0.12-0.14<br>4-9 in: 0.13-0.15<br>9-21 in: 0.13-0.15<br>21-26 in: 0.13-0.15 | 7.3 |

**Table 4-6. Summary of Soil Characteristics**

| Map Unit Name[1] | Map Unit Symbol | Percent of Field | Soil Depth (in) | Typical Profile | Restrictive Layer (in) | Available Water Capacity (in/in) | Overall Available Water Capacity (in) |
|---|---|---|---|---|---|---|---|
| | | | | 26-42 in: very fine sandy loam<br>42-62 in: stratified and to silt loam | | 26-42 in: 0.13-0.15<br>42-62 in: 0.03-0.12 | |
| Schodson loamy sand, 0 to 1 percent slopes | 34 | 5 | 60 | 0-9 in: loamy sand<br>9-25 in: sandy loam<br>25-32 in: loamy course sand<br>32-43 in: coarse sand<br>43-60 in: coarse sand | >80 | 0-9 in: 0.06-0.08<br>9-25 in: 0.11-0.13<br>25-32 in: 0.08-0.10<br>32-43 in: 0.08-0.10<br>43-60 in: 0.08-0.10 | 5.7 |
| Schodson sandy loam, 0 to 1 percent slopes | 35 | 52 | 60 | 0-9 in: sandy loam<br>9-25 in: sandy loam<br>25-32 in: loamy course sand<br>32-43 in: coarse sand<br>43-60 in: coarse sand | >80 | 0-9 in: 0.11-0.13<br>9-25 in: 0.11-0.13<br>25-32 in: 0.08-0.10<br>32-43 in: 0.08-0.10<br>43-60 in:0.08-0.10 | 6.1 |
| Wodskow sandy loam, 0 to 2 percent slopes | 47 | 39 | 60 | 0-8 in: sandy loam<br>8-12 in: sandy loam<br>12-20 in: sandy loam<br>20-28 in: sandy loam<br>28-34 in: loam<br>34-40 in: sandy loam<br>40-55 in: loamy fine sand<br>55-60 in: course sand | >80 | 0-8 in: 0.13-0.16<br>8-12 in: 0.13-0.16<br>12-20 in: 0.13-0.16<br>20-28 in: 0.13-0.16<br>28-34 in: 0.15-0.17<br>34-40 in: 0.13-0.16<br>40-55 in: 0.06-0.09<br>55-60 in: 0.02-0.05 | 7.4 |
| | | | | | | Weighted Average for Available Water Capacity | 6.7 |
| **West Gillette (MU-005008)** | | | | | | | |
| Woozle loam, 0 to 1 percent slopes | 50 | 67 | 60 | 0-10 in: loam<br>10-21 in: loam<br>21-35 in: silt loam<br>35-42 in: silty clay loam<br>42-47 in: loamy fine sand<br>47-60 in: fine sand | >10 | 0-10 in: 0.14-0.19<br>10-21 in: 0.14-0.20<br>21-35 in: 0.14-0.20<br>35-42 in: 0.14-0.20<br>42-47 in: 0.08-0.11<br>47-60 in: 0.05-0.10 | 8.7 |
| Eoyote fine sandy loam, 0 to 2 percent slopes | 13 | 33 | 60 | 0-8 in: fine sandy loam<br>8-18in: fine sandy loam<br>18-36 in: fine sandy loam<br>36-60 in: fine sandy loam | >80 | 0-8 in: 0.13-0.16<br>8-18in: 0.13-0.15<br>18-36 in: 0.13-0.15<br>36-60 in: 0.13-0.15 | 8.5 |
| | | | | | | Weighted Average for Available Water Capacity | 8.6 |
| **South Schow (MU-005009)** | | | | | | | |
| Decker fine sandy loam, 0 to 2 percent slopes | 9 | 3 | 65 | 0-10 in: fine sandy loam<br>10-15 in: loam<br>15-23 in: loam<br>23-29 in: loam<br>29-35 in: sandy loam<br>35-51 in: loam<br>51-65 in: stratified sand to fine sand | >80 | 0-10 in: 0.07-0.11<br>10-15 in: 0.07-0.15<br>15-23 in: 0.07-0.15<br>23-29 in: 0.07-0.15<br>29-35 in: 0.17-0.15<br>35-51 in: 0.17-0.15<br>51-65 in: 0.09-0.10 | 6.3 |
| Schodson sandy loam, 0 to 1 percent slopes | 35 | 73 | 60 | 0-9 in: sandy loam<br>9-25 in: sandy loam<br>25-32 in: loamy course sand<br>32-43 in: coarse sand<br>43-60 in: coarse sand | >80 | 0-9 in: 0.11-0.13<br>9-25 in: 0.11-0.13<br>25-32 in: 0.08-0.10<br>32-43 in: 0.08-0.10<br>43-60 in:0.08-0.10 | 6.1 |
| Wodskow sandy loam, 0 to 2 percent slopes | 47 | 24 | 60 | 0-8 in: sandy loam | >80 | 0-8 in: 0.13-0.16 | 7.4 |

**Table 4-6. Summary of Soil Characteristics**

| Map Unit Name[1] | Map Unit Symbol | Percent of Field | Soil Depth (in) | Typical Profile | Restrictive Layer (in) | Available Water Capacity (in/in) | Overall Available Water Capacity (in) |
|---|---|---|---|---|---|---|---|
| | | | | 8-12 in: sandy loam<br>12-20 in: sandy loam<br>20-28 in: sandy loam<br>28-34 in: loam<br>34-40 in: sandy loam<br>40-55 in: loamy fine sand<br>55-60 in: course sand | | 8-12 in: 0.13-0.16<br>12-20 in: 0.13-0.16<br>20-28 in: 0.13-0.16<br>28-34 in: 0.15-0.17<br>34-40 in: 0.13-0.16<br>40-55 in: 0.06-0.09<br>55-60 in: 0.02-0.05 | |
| | | | | | | Weighted Average for Available Water Capacity | 6.4 |
| **North Schow (MU-005010)** | | | | | | | |
| Decker fine sandy loam, 0 to 2 percent slopes | 9 | 12 | 65 | 0-10 in: fine sandy loam<br>10-15 in: loam<br>15-23 in: loam<br>23-29 in: loam<br>29-35 in: sandy loam<br>35-51 in: loam<br>51-65 in: stratified sand to fine sand | >80 | 0-10 in: 0.07-0.11<br>10-15 in: 0.07-0.15<br>15-23 in: 0.07-0.15<br>23-29 in: 0.07-0.15<br>29-35 in: 0.17-0.15<br>35-51 in: 0.17-0.15<br>51-65 in: 0.09-0.10 | 6.3 |
| Kecko fine sandy loam, 1 to 4 percent slopes | 17 | 4 | 62 | 0-4 in: fine sandy loam<br>4-9 in: fine sandy loam<br>9-21 in: fine sandy loam<br>21-26 in: very fine sandy loam<br>26-42 in: very fine sandy loam<br>42-62 in: stratified and to silt loam | >80 | 0-4 in: 0.12-0.14<br>4-9 in: 0.13-0.15<br>9-21 in: 0.13-0.15<br>21-26 in: 0.13-0.15<br>26-42 in: 0.13-0.15<br>42-62 in: 0.03-0.12 | 7.3 |
| Schodson sandy loam, 0 to 1 percent slopes | 35 | 2 | 60 | 0-9 in: sandy loam<br>9-25 in: sandy loam<br>25-32 in: loamy course sand<br>32-43 in: coarse sand<br>43-60 in: coarse sand | >80 | 0-9 in: 0.11-0.13<br>9-25 in: 0.11-0.13<br>25-32 in: 0.08-0.10<br>32-43 in: 0.08-0.10<br>43-60 in:0.08-0.10 | 6.1 |
| Wodskow sandy loam, 0 to 2 percent slopes | 47 | 30 | 60 | 0-8 in: sandy loam<br>8-12 in: sandy loam<br>12-20 in: sandy loam<br>20-28 in: sandy loam<br>28-34 in: loam<br>34-40 in: sandy loam<br>40-55 in: loamy fine sand<br>55-60 in: course sand | >80 | 0-8 in: 0.13-0.16<br>8-12 in: 0.13-0.16<br>12-20 in: 0.13-0.16<br>20-28 in: 0.13-0.16<br>28-34 in: 0.15-0.17<br>34-40 in: 0.13-0.16<br>40-55 in: 0.06-0.09<br>55-60 in: 0.02-0.05 | 7.4 |
| Woozle loam, 0 to 1 percent slopes | 50 | 52 | 60 | 0-10 in: loam<br>10-21 in: loam<br>21-35 in: silt loam<br>35-42 in: silty clay loam<br>42-47 in: loamy fine sand<br>47-60 in: fine sand | >10 | 0-10 in: 0.14-0.19<br>10-21 in: 0.14-0.20<br>21-35 in: 0.14-0.20<br>35-42 in: 0.14-0.20<br>42-47 in: 0.08-0.11<br>47-60 in: 0.05-0.10 | 8.7 |
| | | | | | | Weighted Average for Available Water Capacity | 7.9 |

[1]Soils data based on NRCS, Minidoka Area, Idaho Soil Survey. Data downloaded from NRCS Web Soil Survey. AWC based on 60 inch depth or the restrictive layer, whichever is shallower.

**Table 4-7. Proposed HLRngs for TASCO Mini-Cassia**

| **Parameter** | **005001 East Farm** | **005002 South Farm** | **005003 Wilkins** | **005004 Goitiandia** | **005005 East Gillette** | **005007 Seedall** | **005008 West Gillette** | **005009 S Schow** | **005010 N Schow** | **Comment** |
|---|---|---|---|---|---|---|---|---|---|---|
| | **(inches)** | | | | | | | | | |
| AWC | 6.3 | 7.0 | 8.7 | 8.7 | 8.7 | 6.7 | 8.6 | 6.4 | 7.9 | See Table 4-6 |
| Average E | 5.3 | 5.3 | 5.3 | 5.3 | 5.3 | 5.3 | 5.3 | 5.3 | 5.3 | See Table 4-5 |
| Precipitation | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | See Table 4-3 |
| Proposed NGS Hydraulic Limit | **7.8** | **8.5** | **10.2** | **10.2** | **10.2** | **8.2** | **10.1** | **7.9** | **9.4** | Calculated: AWC + E – $PPT_{ngs}$ |

## Site Soil Analysis

The soils for each management unit are monitored for several constituents once each year (typically in April) to evaluate the performance of the wastewater land application system. Composite samples are collected at one foot intervals to a depth of 3 feet. The exceptions are the Schow sites (MU-005009 and MU-005010), which are sampled twice per year (spring and fall) and at one foot depth intervals to 5 feet below the ground surface. Table 4-8 summarizes the average soil monitoring parameters for April 2009. Appendix 4-1 presents a summary of soil data from 1996 through 2009.

For the purposes of measuring the treatment efficiency of the land application system, the average soil soluble salts and average nitrate-N concentrations in the zero to 3 foot depth range (0-5 foot for the Schow Farms) are summarized for each management unit (Figures 5-1 through 5-14). This represents data from 1995 through 2009. An important soil management goal is to avoid the buildup of soluble salts in soils over time. Elevated soluble salts in soils can affect crop yields. A soluble salt level in soils below 2 millimhos per centimeter (mmhos/cm) is desirable when growing grasses and alfalfa. Grains can tolerate soil soluble salt levels up to approximately 6 mmhos/cm (PNW-Extension Publication 601E). In April 2009, soluble salt levels in soils were generally below 2 mmhos/cm (Table 4-8). Time series plots for soluble salts (presented in annual reports) show that salts showed a slight increase in soils between 1996 and 2003, but have been declining or steady through 2009.

The average nitrate-N concentration values for the upper 3 feet over time shows a general decline in levels from 1998 to 2007 (presented in annual report). The concentration levels, however, are below 45 milligrams per kilogram (mg/Kg) and considered to be within typical ranges found in agricultural soils. In April 2009, nitrate-N concentrations ranged from 3 to 15 mg/Kg (Table 4-8), within a typical range for agricultural soils. Section 5.0 further addresses management practices, including salt loadings to soils.

**Table 4-8. Summary of Soil Data for April 2009**

| Depth top (inches) | Depth Bottom (inches) | Soil Mon. Unit | Location | Nitrate (mg/Kg) | Ammonia (mg/Kg) | SAR | EC (umhos/cm) | Total Phos (mg/Kg) |
|---|---|---|---|---|---|---|---|---|
| 0 | 12 | SU-005001 A | East Farm west | 3 | 3.3 | 8.22 | 2100.0 | 50 |
| 12 | 24 | SU-005001 A | East Farm west | 15 | 3.0 | 8.87 | 3800.0 | 84 |
| 24 | 36 | SU-005001 A | East Farm west | 7 | 9.4 | 8.39 | 1300.0 | 39 |
| 0 | 12 | SU-005001 B | East Farm center | 3 | 3.0 | 2.99 | 1300.0 | 8 |
| 12 | 24 | SU-005001 B | East Farm center | 3 | 2.5 | 1.26 | 1000.0 | 8 |
| 24 | 36 | SU-005001 B | East Farm center | 4 | 3.1 | 1.66 | 1200.0 | 9 |
| 0 | 12 | SU 005001 C | East Farm east | 11 | 2.3 | 2.99 | 900.0 | 14 |
| 12 | 24 | SU 005001 C | East Farm east | 5 | 2.3 | 2.36 | 900.0 | 5 |
| 24 | 36 | SU 005001 C | East Farm east | 3 | 3.0 | 2.71 | 600.0 | 5 |
| 0 | 12 | SU 005002 | South Farm | 7 | 3.0 | 2.48 | 1400.0 | 16 |
| 12 | 24 | SU 005002 | South Farm | 3 | 2.6 | 2.30 | 1100.0 | 8 |
| 24 | 36 | SU 005002 | South Farm | 3 | 2.0 | 3.70 | 1700.0 | 4 |
| 0 | 12 | SU 005003 | North Wilkins | 7 | 3.0 | 1.29 | 1300.0 | 12 |
| 12 | 24 | SU 005003 | North Wilkins | 5 | 2.9 | 1.63 | 1000.0 | 6 |
| 24 | 36 | SU 005003 | North Wilkins | 4 | 5.5 | 1.90 | 900.0 | 6 |
| 0 | 12 | SU 005004 | South Wilkins | 8 | 2.9 | 1.72 | 1800.0 | 32 |
| 12 | 24 | SU 005004 | South Wilkins | 7 | 2.5 | 1.78 | 1300.0 | 11 |
| 24 | 36 | SU 005004 | South Wilkins | 3 | 2.5 | 1.95 | 1300.0 | 12 |
| 0 | 12 | SU 005005 | Goitiandia | 5 | 2.6 | 1.09 | 1100.0 | 10 |
| 12 | 24 | SU 005005 | Goitiandia | 4 | 2.4 | 0.94 | 900.0 | 18 |
| 24 | 36 | SU 005005 | Goitiandia | 8 | 2.5 | 0.79 | 900.0 | 29 |
| 0 | 12 | SU 005006 | East Gillette | 10 | 2.8 | 0.85 | 1200.0 | 21 |
| 12 | 24 | SU 005006 | East Gillette | 3 | 2.6 | 1.23 | 1100.0 | 5 |
| 24 | 36 | SU 005006 | East Gillette | 3 | 2.6 | 1.57 | 900.0 | 4 |
| 0 | 12 | SU 005007 | Blacker/Fisk | 9 | 2.9 | 0.91 | 1200.0 | 20 |
| 12 | 24 | SU 005007 | Blacker/Fisk | 3 | 2.4 | 1.15 | 800.0 | 4 |
| 24 | 36 | SU 005007 | Blacker/Fisk | 4 | 2.4 | 1.05 | 900.0 | 6 |
| 0 | 12 | SU 005008 A | West Gillette east 1/2 | 7 | 2.5 | 2.27 | 1400.0 | 41 |
| 12 | 24 | SU 005008 A | West Gillette east 1/3 | 5 | 2.6 | 2.06 | 1800.0 | 14 |
| 24 | 36 | SU 005008 A | West Gillette east 1/4 | 8 | 2.2 | 1.82 | 1300.0 | 5 |
| 0 | 12 | SU 005008 B | West Gillette west 1/2 | 11 | 2.9 | 2.28 | 1700.0 | 38 |
| 12 | 24 | SU 005008 B | West Gillette west 1/3 | 6 | 2.3 | 2.43 | 2000.0 | 13 |
| 24 | 36 | SU 005008 B | West Gillette west 1/4 | 4 | 2.5 | 2.26 | 2100.0 | 10 |
| 0 | 12 | SU 005009 | South Schow | 4 | 2.5 | 1.36 | 1000.0 | 13 |

**Table 4-8. Summary of Soil Data for April 2009**

| Depth top (inches) | Depth Bottom (inches) | Soil Mon. Unit | Location | Nitrate (mg/Kg) | Ammonia (mg/Kg) | SAR | EC (umhos/cm) | Total Phos (mg/Kg) |
|---|---|---|---|---|---|---|---|---|
| 12 | 24 | SU 005009 | South Schow | 3 | 2.4 | 1.66 | 900.0 | 9 |
| 24 | 36 | SU 005009 | South Schow | 3 | 2.2 | 1.30 | 600.0 | 9 |
| 36 | 48 | SU 005009 | South Schow | 3 | 2.5 | 1.36 | 600.0 | 7 |
| 48 | 60 | SU 005009 | South Schow | 3 | 2.4 | 1.02 | 300.0 | 6 |
| 0 | 12 | SU 005010 | North Schow | 6 | 2.4 | 1.77 | 800.0 | 10 |
| 12 | 24 | SU 005010 | North Schow | 6 | 2.4 | 1.16 | 600.0 | 5 |
| 24 | 36 | SU 005010 | North Schow | 3 | 2.5 | 0.93 | 600.0 | 5 |
| 36 | 48 | SU 005010 | North Schow | 3 | 2.7 | 1.16 | 800.0 | 3 |
| 48 | 60 | SU 005010 | North Schow | 3 | 2.5 | 0.78 | 500.0 | 4 |
| 0 | 12 | SU 005011 | Seedall | 11 | 3.6 | 1.37 | 1000.0 | 12 |
| 12 | 24 | SU 005011 | Seedall | 15 | 7.1 | 1.92 | 900.0 | 5 |
| 24 | 36 | SU 005011 | Seedall | 5 | 2.9 | 1.18 | 800.0 | 7 |

## 4.3 Hydrogeology

### Regional Hydrogeology

The regional hydrogeology consists of surface deposits of unconsolidated clay, silt, sand, and gravel of alluvial or eolian origin, generally with a total thickness of 30 to 35 feet. Beneath the surficial sediments are alternating sequences of sediments and basalt to a depth of approximately 800 feet, which, in turn, is underlain by a very thick section of basalt. The deeper sediments (Burley beds) were deposited in one or more lacustrine environments, created when lava flows to the west blocked the Snake River drainage (Montgomery, 1986). Both the shallow alluvial deposits and the deeper sediments of the Burley beds thin to the north and eventually disappear. Approximately 10 miles north of the facility, basalt occurs at land surface and continues to great depths.

The principal water bearing units in the region include the shallow sand and gravel deposits (surficial alluvium), sand and gravel zones in the deeper lake-bed deposits, and broken zones in the various basalt flows.

### Site Hydrogeology

The TASCO facility and land application sites are located on the southern rim of the eastern Snake River Plain, which is a sole source aquifer. In the vicinity of the site, the surficial deposits of unconsolidated material (sand, small gravel, and silt) are underlain by a continuous clay layer, located approximately 30 to 35 feet below grade. The clay layer acts as a confining unit between the shallow alluvial aquifer and the regional aquifer, which is composed of the Snake River

Basalt and the Burley lakebeds (consolidated and unconsolidated clays and silts intercalated with basalt).

Based on water level data collected between 1998 and 2009 (Appendix 4-2), depth to water measurements in the site monitoring wells ranged from 4 to 29 feet below grade. Monitoring well hydrographs indicate the highest water levels in the shallow aquifer occur in the fall at the end of the irrigation season. Water levels then gradually decline until the following spring.

Figures 4-4 and 4-5 present groundwater contour maps for the shallow alluvial aquifer for October 2008 and April 2009. Groundwater flow direction is predominantly to the north, with localized northeast and northwest vectors. The average hydraulic gradient between wells 114 and 118 on the North and South Schow sites is 0.0028 feet per foot. The gradient is considerably flatter to the west. Between monitoring wells J and 112, the average hydraulic gradient is 0.0015 feet per foot.

A regional groundwater contour map in the vicinity of the facility indicates the groundwater flow direction in the deeper basalt aquifer is to the west-northwest (Montgomery, 1986), which is a departure from the northerly flow direction in the shallow alluvial aquifer.

## Shallow Aquifer Parameter Estimates

Hydraulic parameters have been estimated from short-term pump test data recorded for site monitoring wells. These are representative of the shallow alluvial aquifer in the vicinity of TASCO's Mini-Cassia land application farms. Table 4-9 summarizes the parameter estimates for specific capacity, transmissivity, hydraulic conductivity, groundwater velocity, and the Darcy velocity. The table is sub-divided into four sections: East Farm Monitoring Wells (D through H and V), South Farm Monitoring Wells (I and J), South Schow Site Monitoring Wells (114 and 115), and North Schow Site Monitoring Wells (116 through 119).

Specific capacity tests were conducted on East and South Farm monitoring wells in 1991 (CH2M HILL 1992) and on North and South Schow site monitoring wells in 1999 (HDR 1999). The specific capacities of the selected monitoring wells were calculated by dividing the pump discharge rate by the total drawdown that occurred at that rate. The average specific capacities of the four land application sites vary between 6 gallons per minute per foot (gpm/ft) (South Farm) and 57 gpm/ft (North Schow site).

The transmissivity (T) of an unconfined alluvial aquifer can be estimated, when the specific capacity (Q/s) is known, using the following empirical equation (Driscoll, 1986, p. 1,021):

- T= (Q/s)(1,500) where T is in units of gallons per day per feet (gpd/ft) and Q/s is in units of gpm/ft

The empirical constant of 1,500 includes a unit conversion. Using this equation and the known specific capacity values calculated for the monitoring wells, the estimated transmissivity of the shallow aquifer varies between 9,300 gpd/ft (1,240 $ft^2$/day) for the South Farm and 84,800 gpd/ft (11,340 $ft^2$/day) for the North Schow site.

| Well Number | Ground Water Elevation (ft) |
|---|---|
| A | Dry |
| C | 4,140.22 |
| E | 4,139.63 |
| I | 4,141.83 |
| J | 4,146.74 |
| N | 4,145.25 |
| M | 4,147.86 |
| Seedall | 4,140.45 |
| 107 | 4,142.27 |
| 109 | 4,143.23 |
| 112 | 4,131.67 |
| 114 | 4,144.21 |
| 115 | 4,142.50 |
| 116 | 4,141.38 |
| 117 | 4,138.54 |
| 118 | 4,136.97 |
| 119 | 4,138.21 |
| 120 | 4,138.03 |
| 121 | 4,136.07 |
| H | 4,142.63 |
| 102 | 4,142.33 |

N

0 1,000 2,000 3,000 Feet

**October 2008 Ground Water Elevation Contours**

The Amalgamated Sugar Company
Mini-Cassia Facility, Paul, Idaho

Map Date: 05/19/10
Q:\TASCO\Paul\map_docs\PaulFigures.mxd

Imagery: 2009 1 meter resolution NAIP
Source: NRCS Digital Gateway
Other Data Sources:US Censue Bureau

HDR ONE COMPANY Many Solutions℠

**Figure 4-4**

| Well Number | Ground Water Elevation (ft) |
|---|---|
| A | Dry |
| C | 4,137.12 |
| E | 4,136.53 |
| I | 4,141.63 |
| J | 4,142.94 |
| N | 4,144.05 |
| M | 4,142.56 |
| Seedall | 4,136.95 |
| 107 | 4,136.97 |
| 109 | Dry |
| 112 | Dry |
| 114 | 4,140.51 |
| 115 | 4,138.30 |
| 116 | 4,136.08 |
| 117 | 4,132.24 |
| 118 | 4,131.17 |
| 119 | 4,133.71 |
| 120 | 4,134.63 |
| 121 | 4,132.47 |
| H | 4,140.53 |
| 102 | Dry |

N

0 1,000 2,000 3,000 Feet

**April 2009 Ground Water Elevation Contours**

The Amalgamated Sugar Company
Mini-Cassia Facility, Paul, Idaho

Map Date: 05/19/10
Q:\TASCO\Paul\map_docs\PaulFigures.mxd

Imagery: 2009 1 meter resolution NAIP
Source: NRCS Digital Gateway
Other Data Sources:US Censue Bureau

HDR ONE COMPANY Many Solutions℠

**Figure 4-5**

**Table 4-9. Shallow Aquifer Parameter Estimates Determined from Site Monitoring Well Data**

| Well Number | Test Date | Well Depth (ft bgs) | Pumping Rate (gpm) | Total Drawdown (feet) | Specific Capacity (gpm/ft) | Aquifer Transmissivity (gpd/ft) | Hydraulic Conductivity (ft2/day) | Hydraulic Conductivity (feet/day) | Groundwater Velocity (feet/day) | Darcy Velocity (feet/day) |
|---|---|---|---|---|---|---|---|---|---|---|
| **East Farm Monitoring Wells** | | | | | | | | | | |
| D | 1991 | 14.6 | 1.7 | 0.04 | 43 | 63,750 | 8,523 | 371 | 1.6 | 0.6 |
| E | 1991 | 16.0 | 18.8 | 1.30 | 14 | 21,692 | 2,900 | 126 | 0.5 | 0.2 |
| F | 1991 | 15.2 | 18.8 | 1.55 | 12 | 18,194 | 2,432 | 106 | 0.5 | 0.2 |
| G | 1991 | 15.8 | 30.0 | 2.81 | 11 | 16,014 | 2,141 | 93 | 0.4 | 0.1 |
| H | 1991 | 12.7 | 6.7 | 0.70 | 10 | 14,357 | 1,919 | 83 | 0.4 | 0.1 |
| V | 1991 | 17.0 | 30.0 | 2.97 | 10 | 15,152 | 2,026 | 88 | 0.4 | 0.1 |
| **Average Aquifer Parameters- East Farm** | | | | | **17** | **24,860** | **3,324** | **145** | **0.6** | **0.2** |
| **South Farm Monitoring Wells** | | | | | | | | | | |
| I | 1991 | 13.5 | 20.0 | 3.25 | 6 | 9,231 | 1,234 | 54 | 0.2 | 0.1 |
| J | 1991 | 14.2 | 25.0 | 4.01 | 6 | 9,352 | 1,250 | 54 | 0.2 | 0.1 |
| **Average Aquifer Parameters- South Farm** | | | | | **6** | **9,291** | **1,242** | **54** | **0.2** | **0.1** |
| **South Schow Site Monitoring Wells** | | | | | | | | | | |
| 114 | Apr-99 | 23.0 | 4.0 | 0.12 | 33 | 50,000 | 6,684 | 291 | 2.3 | 0.8 |
| 115 | Apr-99 | 25.1 | 3.0 | 0.09 | 33 | 50,000 | 6,684 | 291 | 2.3 | 0.8 |
| **Average Aquifer Parameters- South Schow Site** | | | | | **33** | **50,000** | **6,684** | **291** | **2.3** | **0.8** |
| **North Schow Site Monitoring Wells** | | | | | | | | | | |
| 116 | Oct-99 | 23.5 | 5.3 | 0.07 | 76 | 113,571 | 15,183 | 660 | 5.3 | 1.8 |
| 117 | Oct-99 | 25.4 | 4.7 | 0.11 | 43 | 64,091 | 8,568 | 373 | 3.0 | 1.0 |
| 118 | Oct-99 | 31.3 | 3.5 | 0.05 | 70 | 105,000 | 14,037 | 610 | 4.9 | 1.7 |
| 119 | Oct-99 | 25.7 | 4.9 | 0.13 | 38 | 56,538 | 7,559 | 329 | 2.6 | 0.9 |
| **Average Aquifer Parameters- North Schow Site** | | | | | **57** | **84,800** | **11,337** | **493** | **3.9** | **1.4** |

The hydraulic conductivity of an unconfined aquifer is equal to the transmissivity divided by the aquifer's saturated thickness. Well drillers' reports of deeper wells in the area indicate the average depth to the top of the confining clay layer, between the shallow alluvial aquifer and the deeper basalt aquifer, is approximately 35 feet below ground surface (bgs) (CH2M HILL and HDR, 1997). Based on historical data, the average depth to water recorded in site monitoring wells has been approximately 12 feet bgs. This corresponds to an average saturated thickness of

23 feet. Using this information, the estimated hydraulic conductivity of the shallow aquifer varies between 55 feet/day (South Farm) and 490 feet/day (North Schow site).

The determination of representative groundwater velocities within the shallow alluvial aquifer was accomplished by applying the Darcy flow equation to the hydrogeologic conditions observed at each of the monitoring wells. The Darcy equation is based on the following relationship:

$$\text{Groundwater Velocity (V)} = KI/n_e$$

where:

- K = hydraulic conductivity
- I = horizontal hydraulic gradient
- $n_e$ = effective porosity of the aquifer material

Based on historical groundwater contour maps, generated from monitoring well water level data, the average hydraulic gradient for the East and South Farms is 0.0015 feet per foot. The gradient steepens in the vicinity of the North and South Schow sites to 0.0028 feet per foot.

The shallow aquifer matrix consists of sand and small gravel. Freeze and Cherry (1979) report porosity (n) values of 0.25 to 0.50 for sand and 0.25 to 0.40 for gravel. Freeze and Cherry also state that, for most granular media, approximating effective porosity ($n_e$) with actual porosity (n) introduces little error. On this basis, the estimated actual porosity is considered to also represent the effective porosity. An average effective porosity for sand and gravel of 0.35 is used in groundwater velocity calculations for the shallow aquifer underlying the land application farms.

Using the Darcy flow equation, the groundwater velocity within the shallow aquifer varies between 0.2 feet/day (75 feet/year) for the South Farm and 3.9 feet/day (1,420 feet/year) for the North Schow site. Prior investigators have reported an estimated groundwater velocity in the vicinity of TASCO's Mini-Cassia facility of 1.1 feet/day or 400 feet/year (J.M. Montgomery, 1986).

The Darcy velocity is a parameter used in water balance and mixing zone analysis calculations. The Darcy velocity is similar to the groundwater velocity, only it does not include a porosity term. Thus, the Darcy velocity equals the hydraulic conductivity multiplied by the hydraulic gradient. The Darcy velocity varies between 0.1 feet/day (South Farm) and 1.4 feet/day (North Schow site).

## Monitoring Well Construction and Suitability

Table 4-10 summarizes monitoring well construction and Figure 4-4 presents well locations.

**Table 4-10 Monitoring Well Construction Details**

| Well ID | Well Completion Date | Well Location Description | Elevation (ft amsl) Top PVC Casing | Borehole Depth (ft bgs) | Total Casing Depth (ft) | Well Screen Interval (ft bgs) | Well Screen Interval (ft TOC) | Filter Sand Interval (ft bgs) | Aquifer Completed In |
|---|---|---|---|---|---|---|---|---|---|
| MW-A | - | - | 4153.23 | - | - | - | - | - | Shallow |
| MW-C | 11-Dec-95 | Figure 4-4 | 4150.12 | 25.00 | 23.0 | 7.6-22.6 | 10.0-25.0 | 6.5-25.0 | Shallow |
| MW-E | - | Figure 4-4 | 4149.73 | - | 16.0 | - | - | - | Shallow |
| MW-H | - | Figure 4-4 | 4151.73 | - | 12.7 | - | - | - | Shallow |
| MW-I | - | Figure 4-4 | 4151.53 | - | 13.5 | - | - | - | Shallow |
| MW-J | - | Figure 4-4 | 4151.04 | - | 14.2 | - | - | - | Shallow |
| MW-M | 12-Dec-95 | Figure 4-4 | 4153.46 | 23.00 | 21.4 | 6.0-21.0 | 8.6-23.6 | 5.1-23.0 | Shallow |
| MW-N | | Figure 4-4 | 4153.45 | | | | | | Shallow |
| MW-102 | 17-Sep-85 | Figure 4-4 | 4152.83 | 20.00 | 19.0 | 9.0-19.0 | 10.3-20.3 | 7.0-19.0 | Shallow |
| MW-105 | 17-Sep-85 | Figure 4-4 | 4147.39 | 20.00 | 18.4 | 8.4-18.4 | 10.4-20.4 | 6.5-18.4 | Shallow |
| MW-107 | 18-Sep-85 | Figure 4-4 | 4154.67 | 20.00 | 20.4 | 10.4-20.4 | 11.9-21.9 | 7.0-20.4 | Shallow |
| MW-108 | 19-Sep-85 | Figure 4-4 | 4150.06 | 20.00 | 19.7 | 9.7-19.7 | 10.3-20.3 | 5.0-19.7 | Shallow |
| MW-109 | 20-Sep-85 | Figure 4-4 | 4155.23 | 15.00 | 15.0 | 5.0-15.0 | 8.2-18.2 | 4.0-15.0 | Shallow |
| MW-112 | 18-Sep-85 | Figure 4-4 | 4152.97 | 33.00 | 32.3 | 22.3-32.3 | 23.8-33.8 | 17.0-27.0 | Shallow |
| Seedall | 11-Dec-95 | Figure 4-4 | 4153.45 | 28.00 | 27.4 | 12.0-27.0 | 14.4-29.3 | 10.2-28.0 | Shallow |
| MW 114 | 8-Apr-99 | Figure 4-4 | 4153.11 | 23.0 | 23.0 | 7.7-22.7 | 9.8-24.8 | 6.0-23.0 | Shallow |
| MW 115 | 8-Apr-99 | Figure 4-4 | 4154.20 | 25.1 | 25.1 | 9.8-24.8 | 12.5-27.5 | 8.0-25.1 | Shallow |
| MW 116 | 21-Oct-99 | Figure 4-4 | 4153.78 | 23.5 | 23.5 | 8.3-23.3 | 10.8-25.8 | 6.1-23.5 | Shallow |
| MW 117 | 22-Oct-99 | Figure 4-4 | 4153.34 | 25.4 | 25.4 | 10.2-25.2 | 12.5-27.5 | 8.0-25.4 | Shallow |
| MW 118 | 22-Oct-99 | Figure 4-4 | 4157.17 | 31.3 | 31.3 | 16.1-31.1 | 18.6-33.6 | 14.0-31.3 | Shallow |
| MW 119 | 21-Oct-99 | Figure 4-4 | 4153.21 | 25.7 | 25.7 | 10.5-25.5 | 12.9-27.9 | 8.1-25.7 | Shallow |
| MW-120 | 27-May-08 | Figure 4-4 | 4155.33 | 23.0 | 22.0 | 12-22 | 15-24 | 9.8-22.0 | Shallow |
| MW-121 | 27-May-08 | Figure 4-4 | 4152.07 | 20.1 | 20.0 | 10-20 | 13-23 | 7.8-20.0 | Shallow |

Notes: Elevations based on 2008 survey.
ft bgs= feet below ground surface; Blank cell = data not available
ft TOC = feet from top of casing

Appendix 4-2 presents depth to groundwater time series plots. The well screening interval is also included at the top of each plot in order to make comparisons between groundwater depth and screening depth. Regarding groundwater depth and elevations:

- All monitoring wells show a similar time series trend for groundwater depth (Appendix 4-2). In general, groundwater elevation is lowest (drop in groundwater level) in April and is highest (rise in groundwater elevation) in October. This is typical of groundwater elevations in irrigation areas, where groundwater rises during the irrigation season due to seepage from nearby canals and ditches.

- There appears to be a very slight decreasing trend in groundwater elevation for most of the plots. In general, the overall trend appears to be about a 1 foot decline in groundwater elevation over a 10-year period.

- Groundwater elevation fluctuations during the sampling period range from 2.9 feet for MW-H to 16 feet for MW-107. Wells with the greatest seasonable fluctuations are nearest to surface irrigation structures, such as canals and ditches.

- To assess potential impacts of land application activities on groundwater, it is desirable to sample groundwater near the upper portion of the aquifer. Thus, it is desirable to have the well screened through the top of the aquifer. Appendix 4-2 presents well screen depth intervals at the top of each plot. The following statements are made regarding screen intervals:

    - The screen depths for wells A, E, H, I, J, and N are unknown. Well A was dry for several April sampling events (but not all). Based on water measurements, it appears that this well is screened to a depth of approximately 18 feet below ground surface (bgs). Wells E, H, I, and J contain water for all sampling events. Assuming total casing depth reported in Table 4-10 is equal to the depth of the screen bottom, and assuming a 10-foot screen interval, the reported groundwater depths are within the screened interval.
    - Wells 102 and 105 are screened from 10 to 20 feet bgs. Groundwater levels drop below the screen depths during the non-growing season, as indicated in the April monitoring events where static water level was reported as “dry.” Water depths are within the screen interval for the October sampling event.
    - Groundwater elevation rises above the top of screen for MW-112 and MW-114 near the end of the irrigation season. However, the groundwater levels are generally within 1 to 2 feet above the top of screen. Given that the sand filter pack extends 2 feet above the top of screen (see well construction information in Table 4-10), samples collected from these wells are expected to be representative of upper aquifer conditions.

In summary, the screening depths of existing monitoring wells are suitable for monitoring of the upper aquifer. Wells MW-A, 102, and 105 become dry during the non-growing season, indicating the groundwater levels drop below the bottom of the screen. Thus, data for the late irrigation season are lacking for these three wells.

**Upgradient and Downgradient Wells**

Table 4-11 list up- and downgradient wells for each hydraulic management unit.

**Table 4-11 Existing Monitoring Well Locations in Relation to Hydraulic Management Units**

| Hydraulic Management Unit | Upgradient Wells | Downgradient Wells | Comment |
|---|---|---|---|
| East Farm MU-005001 | H, 108 | E | Wells H and E immediately adjacent to fields. Well MW-108 is approximately 1200 feet upgradient from field. Groundwater velocity 160 feet/year. Travel time for groundwater near MW-108 to reach field is 8 years. |
| South Farm MU-005002 | J | I | These wells are immediately adjacent to the field. Groundwater velocity is 73 feet/year. |
| Wilkins MU-005003 | 102 | 112 | Off-site Management Unit, no wells required. Downgradient well 112 is approximately 3800 feet downgradient from the Wilkins field. Assuming a groundwater velocity of 400 ft/year, this results in a travel time of 9.5 years for water beneath the field to reach the well. |
| Goitiandia MU-005004 | | 120 | Well 120 is directly downgradient of this site. |
| East Gillette MU-005005 | 107, A | 121 | Well 121 is directly downgradient of this site |
| Seedall MU-005007 | 109 | Seedall | These wells are immediately adjacent to the field. Groundwater velocity is expected to be in the 500-feet/year range (average of East Farm and South Schow). |
| West Gillette MU-005008 | | | Off-site Management Unit, no wells required. No upgradient or downgradient monitoring wells. Well 112 may reflect a portion of the West Gillette site but groundwater must first pass beneath the Wilkins site. |
| South Schow MU-005009 | 114 | 115 | Both wells adjacent to field, groundwater velocity measured at 840 ft/year. |
| North Schow MU-005010 | 115, 116 | 117, 118, 119 | Wells adjacent to field, groundwater velocity measured at 1400 feet/year. |

## 4.4 Groundwater Quality

As required by TASCO's current wastewater land application permit, 23 monitoring wells and one domestic well are monitored on a semi-annual basis to track the performance of the wastewater land application system. The wells are monitored for groundwater quality indicators, including TDS, nitrate, chloride, COD, iron, manganese, total coliform, and standard plate count. Other constituents have been historically monitored on a non-routine basis.

Appendix 4-3 summarizes monitoring well groundwater quality data collected since 1990 on a semi-annual basis. For this permit renewal, 23 groundwater monitoring wells are proposed for monitoring.

**TASCO-Mini-Cassia Facility**

Summary statistics, including trend analysis, for each well for the full data sets for nitrate-N and TDS are presented in Tables 4-12 and 4-13, respectively. For trend analysis, the IDEQ statistical guidance recommends that secular trends be evaluated using the Mann-Kendall test, a non-parametric procedure that is robust against outliers and also does not rely on the assumption of normality.

In addition to the Mann-Kendall test, Tables 4-14 through 4-22 show trend plots of nitrate and TDS concentrations for the monitoring wells, presented by management unit. Trends are plotted using Locally Weighted robust Scatter plot Smoothing (LOWESS) trend analysis for graphically evaluating long-term and short-term trends in groundwater data. This technique, which uses locally weighted polynomial regression, is an improvement over least squares smoothing when the data are not equally spaced. The LOWESS line provides a means to visualize the overall time series trend in the data. Because it is locally weighted technique, it tends to reflect changes in trends (increasing and decreasing values) and is much more suited for evaluation of groundwater data than linear regression.

Nitrate-N Trends

Using full data sets, a decreasing trend was statistically significant for 10 wells; an increasing trend was significant for two wells; and no trend was detected in 11 wells.

Wells with increasing nitrate-N trends were well 108 (an upgradient well) and well E (a downgradient well on the East Farm, MU-005001).

TDS Trends

A decreasing trend was statistically significant for 14 wells (Table 4-13). No wells show a statistically significant increasing trend for TDS.

**Table 4-12 Summary Statistics and Trend Analysis for Nitrate**

| Well ID | Number of Samples | Earliest Year | Latest Year | Mean (mg/L) | Maximum (mg/L) | Minimum (mg/L) | Mann-Kendal Trend |
|---|---|---|---|---|---|---|---|
| 102 | 12 | 1999 | 2009 | 21.30 | 35.40 | 7.22 | No Trend |
| 105 | 12 | 1999 | 2009 | 1.19 | 7.88 | 0.02 | No Trend |
| 107 | 30 | 1999 | 2009 | 0.44 | 2.57 | 0.02 | No Trend |
| 108 | 20 | 1999 | 2009 | 10.30 | 35.00 | 1.18 | Increasing |
| 109 | 21 | 1999 | 2009 | 17.04 | 95.40 | 0.41 | No Trend |
| 112 | 19 | 1999 | 2009 | 2.16 | 10.00 | 0.33 | No Trend |
| 114 | 102 | 1999 | 2009 | 9.54 | 21.20 | 1.49 | Decreasing |
| 115 | 103 | 1999 | 2009 | 8.03 | 16.40 | 0.01 | Decreasing |
| 116 | 103 | 1999 | 2009 | 8.62 | 24.30 | 0.80 | Decreasing |
| 117 | 102 | 1999 | 2009 | 8.31 | 26.30 | 0.62 | Decreasing |
| 118 | 102 | 1999 | 2009 | 8.06 | 27.30 | 0.15 | Decreasing |
| 119 | 103 | 1999 | 2009 | 10.82 | 20.10 | 2.98 | Decreasing |
| 120 | 5 | 2008 | 2009 | 7.37 | 12.90 | 4.38 | NA |
| 121 | 5 | 2008 | 2009 | 8.59 | 10.70 | 5.97 | NA |
| A | 19 | 1999 | 2008 | 12.74 | 102.00 | 0.02 | No Trend |
| C | 21 | 1999 | 2009 | 6.46 | 12.00 | 0.06 | Decreasing |
| E | 21 | 1999 | 2009 | 8.18 | 20.90 | 0.27 | Increasing |
| H | 22 | 1999 | 2009 | 3.71 | 27.20 | 0.15 | No Trend |
| I | 21 | 1999 | 2009 | 1.07 | 8.31 | 0.05 | Decreasing |
| J | 21 | 1999 | 2009 | 2.11 | 14.80 | 0.05 | No Trend |
| Ketterling | 21 | 1999 | 2009 | 1.10 | 2.64 | 0.66 | Decreasing |
| M | 23 | 1999 | 2009 | 0.19 | 1.14 | 0.02 | No Trend |
| N | 28 | 1999 | 2009 | 1.50 | 32.50 | 0.02 | No Trend |
| Seedall | 20 | 1999 | 2009 | 7.66 | 12.70 | 4.40 | Decreasing |
| Whitecar | 21 | 1999 | 2009 | 6.34 | 13.20 | 5.26 | No Trend |

NA = not available, should have at least 8 data points to run test

**Table 4-13 Summary Statistics and Trend Analysis for TDS**

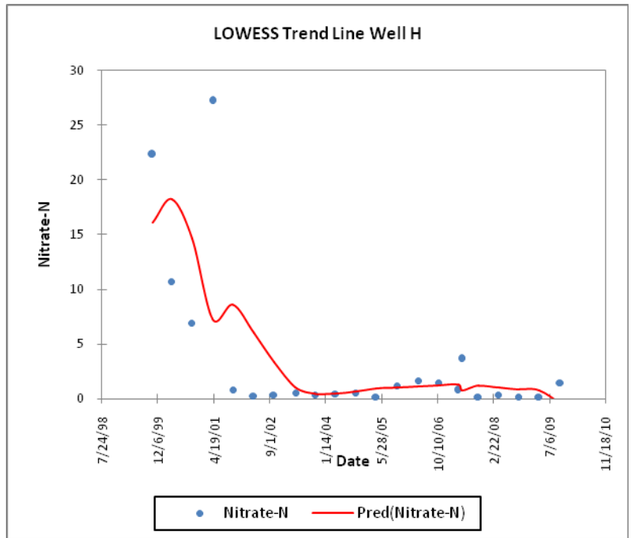
| Well ID | Number of Samples | Earliest Year | Latest Year | Mean (mg/L) | Maximum (mg/L) | Minimum (mg/L) | Mann-Kendal Trend |
|---|---|---|---|---|---|---|---|
| 102 | 12 | 1999 | 2009 | 660 | 880 | 200 | No Trend |
| 105 | 12 | 1999 | 2009 | 389 | 920 | 270 | No Trend |
| 107 | 30 | 1999 | 2009 | 617 | 1710 | 1 | Decreasing |
| 108 | 20 | 1999 | 2009 | 785 | 1480 | 488 | No Trend |
| 109 | 21 | 1999 | 2009 | 433 | 1110 | 228 | Decreasing |
| 112 | 19 | 1999 | 2009 | 376 | 715 | 265 | No Trend |
| 114 | 102 | 1999 | 2009 | 534 | 840 | 410 | No Trend |
| 115 | 103 | 1999 | 2009 | 512 | 960 | 300 | Decreasing |
| 116 | 103 | 1999 | 2009 | 463 | 794 | 141 | Decreasing |
| 117 | 102 | 1999 | 2009 | 497 | 708 | 247 | Decreasing |
| 118 | 102 | 1999 | 2009 | 526 | 730 | 214 | Decreasing |
| 119 | 103 | 1999 | 2009 | 577 | 830 | 395 | No Trend |
| 120 | 5 | 2008 | 2009 | 486 | 550 | 463 | NA |
| 121 | 5 | 2008 | 2009 | 497 | 576 | 422 | NA |
| A | 19 | 1999 | 2008 | 1097 | 1700 | 396 | No Trend |
| C | 21 | 1999 | 2009 | 611 | 775 | 460 | Decreasing |
| E | 21 | 1999 | 2009 | 641 | 891 | 74 | No Trend |
| H | 22 | 1999 | 2009 | 438 | 700 | 252 | Decreasing |
| I | 21 | 1999 | 2009 | 824 | 1180 | 239 | Decreasing |
| J | 21 | 1999 | 2009 | 401 | 856 | 253 | No Trend |
| Ketterling | 21 | 1999 | 2009 | 570 | 710 | 465 | Decreasing |
| M | 23 | 1999 | 2009 | 1341 | 1780 | 996 | Decreasing |
| N | 28 | 1999 | 2009 | 296 | 430 | 224 | Decreasing |
| Seedall | 20 | 1999 | 2009 | 560 | 778 | 422 | Decreasing |
| Whitecar | 21 | 1999 | 2009 | 534 | 760 | 444 | Decreasing |

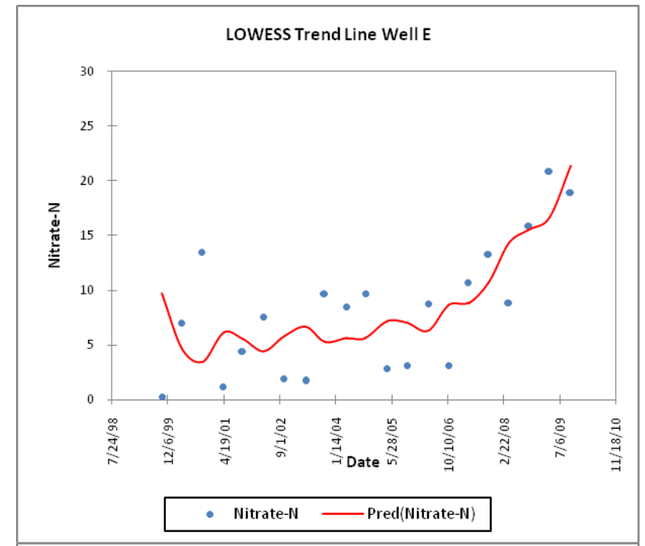
NA = not available, should have at least 8 data points to run test

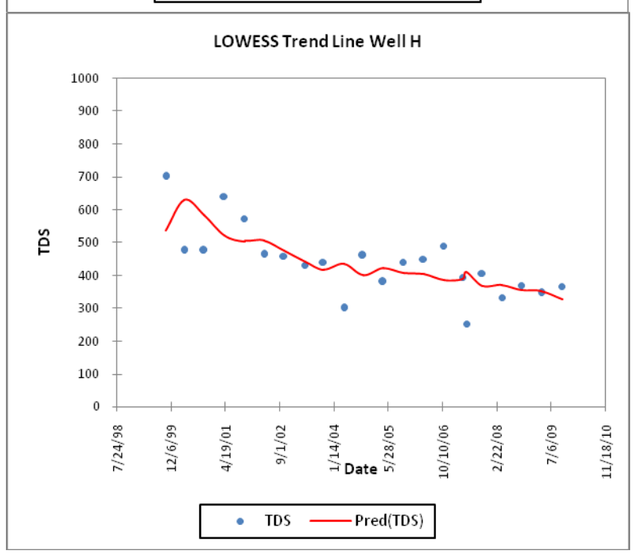
## LOWESS Trend Plots

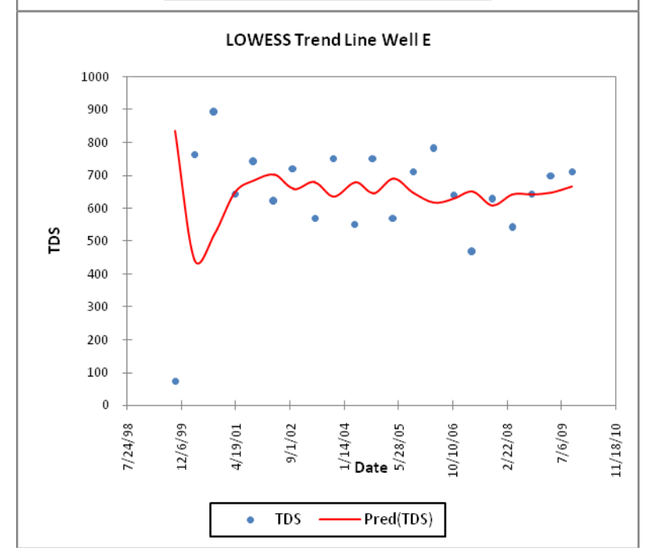
Table 4-14 through 4-22 present a summary of groundwater characteristics for each management unit, along with LOWESS trend plots for nitrate-N and TDS for upgradient and downgradient wells.

| Table 4-17 East Farm (MU-005001) Groundwater Summary | |
|---|---|
| Irrigation Acreage | 60 |
| Gradient ft/ft | 0.002 |
| Groundwater Direction | North |
| Groundwater Velocity, ft/day | 0.6 |
| Travel time for conservative compound from upgradient well to downgradient well (approximate) | 6 years |
| Upgradient Wells | H |
| Downgradient Wells | E |

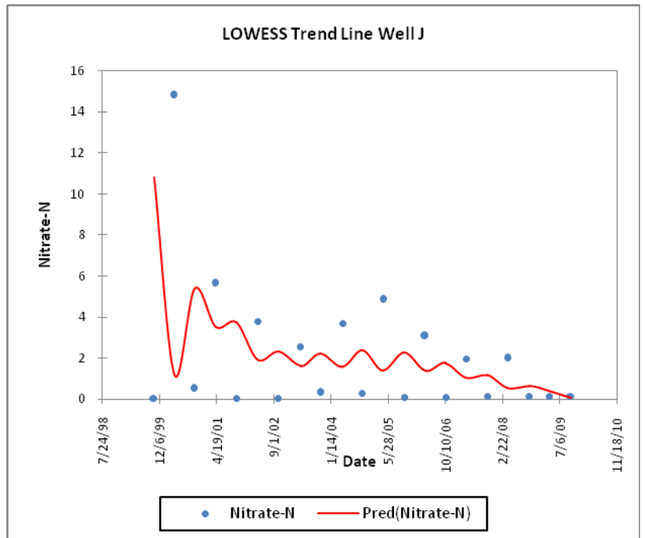


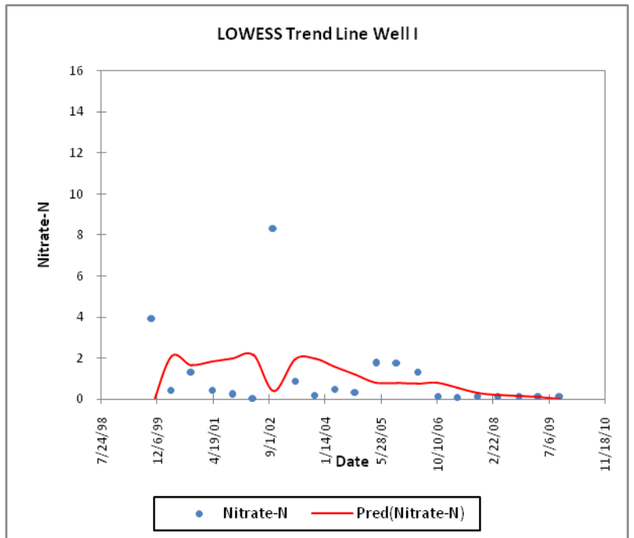



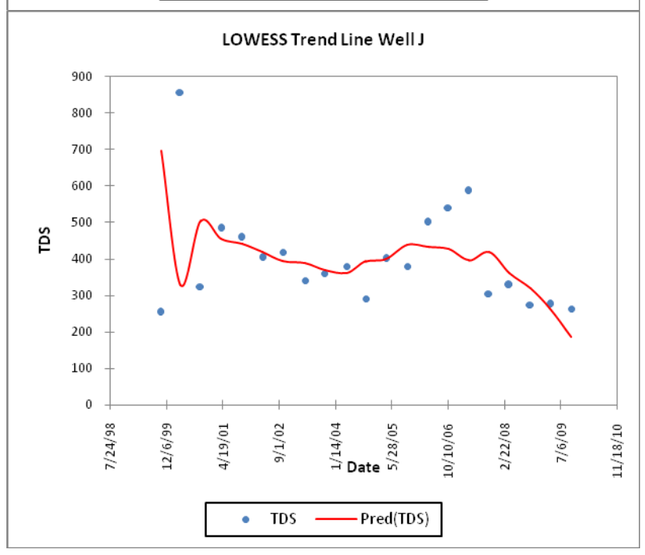



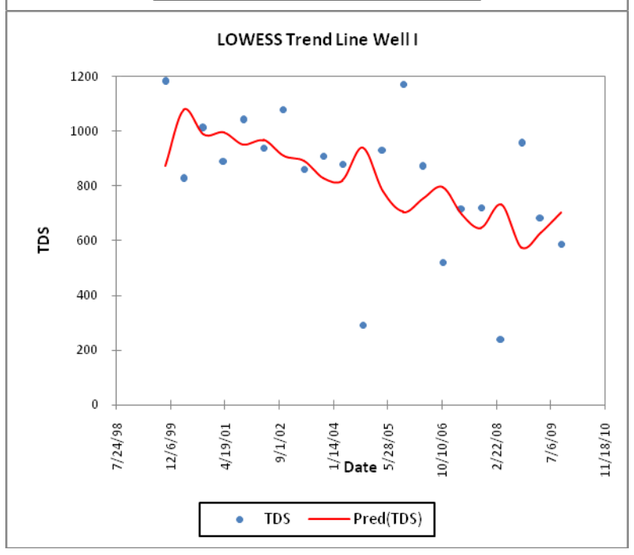



| **Table 4-10. South Farm (MU-005002) Groundwater Summary** | |
|---|---|
| Irrigation Acreage | 27 |
| Gradient ft/ft | 0.002 |
| Groundwater Direction | Northeast |
| Groundwater Velocity, ft/day | 0.2 |
| Travel time for conservative compound from upgradient well to downgradient well (approximate) | 13 years |
| Upgradient Wells | J |
| Downgradient Wells | I |

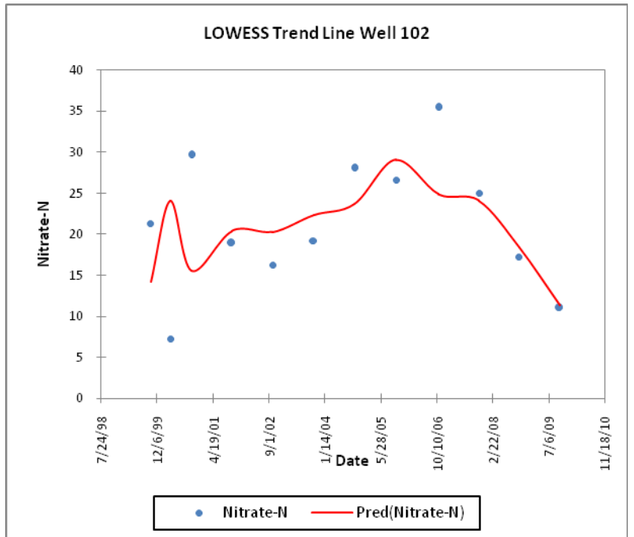


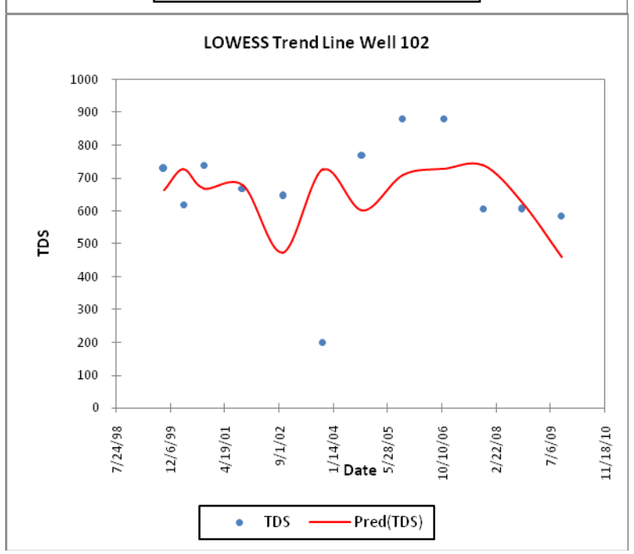



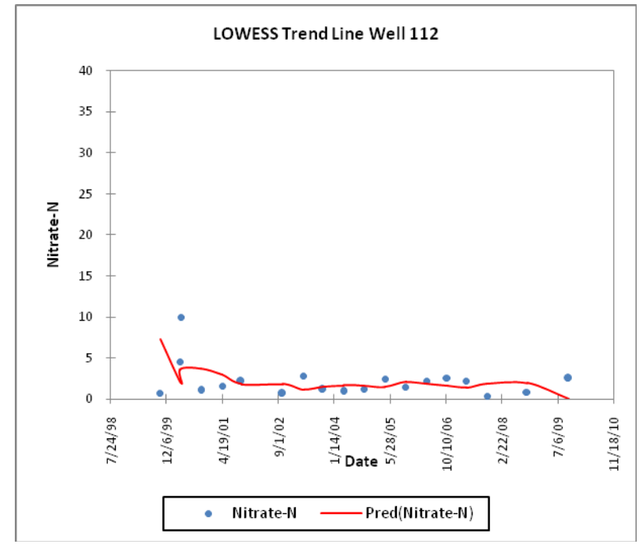



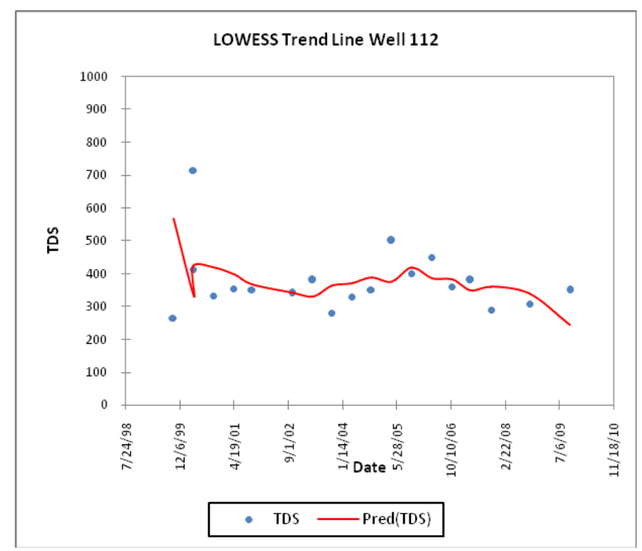



| **Table 4-11. Wilkins (MU-005003) Groundwater Summary** | |
|---|---|
| Irrigation Acreage | 160 |
| Gradient ft/ft | 0.003 |
| Groundwater Direction | Northeast |
| Groundwater Velocity, ft/day | 0.5 |
| Travel time for conservative compound from upgradient well to downgradient well (approximate) | 40 years |
| Upgradient Wells | 102 |
| Downgradient Wells | 112 |

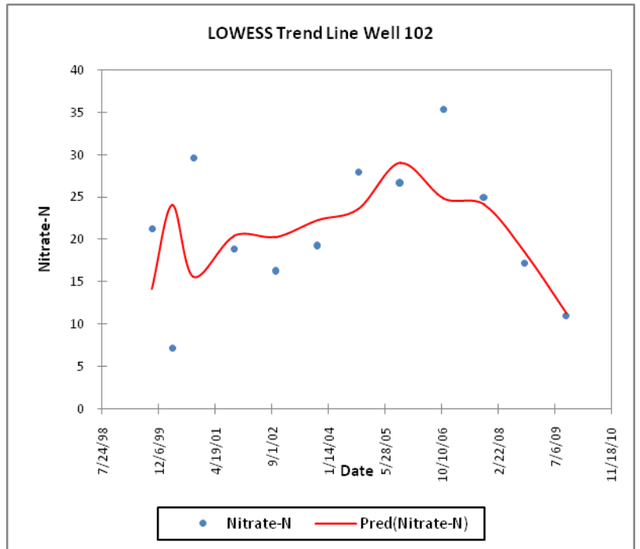


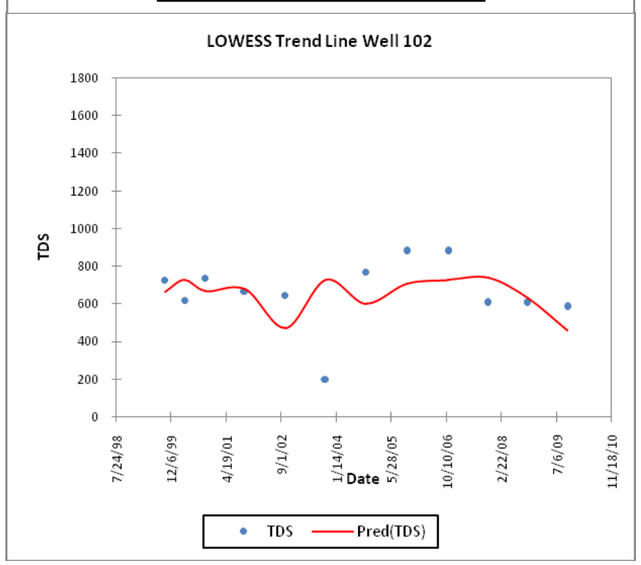



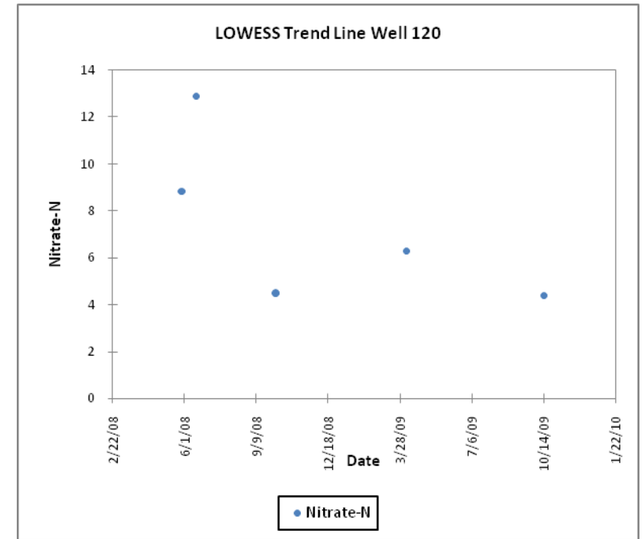



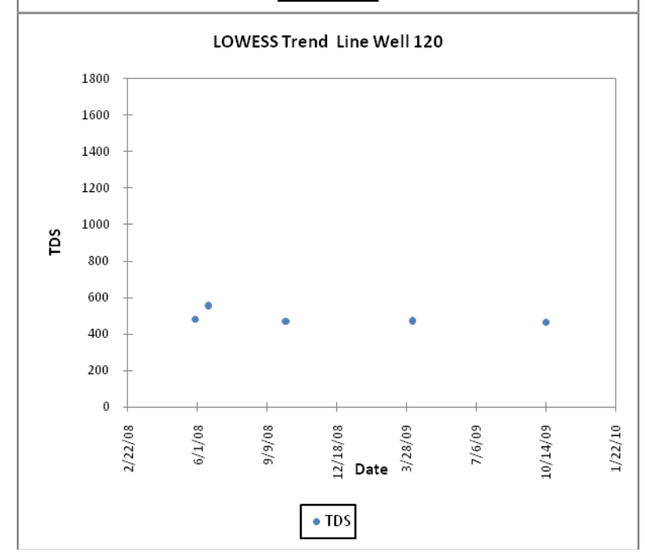



| **Table 4-12. Goitiandia (MU-005004) Groundwater Summary** | |
|---|---|
| Irrigation Acreage | 87 |
| Gradient ft/ft | 0.003 |
| Groundwater Direction | Northeast |
| Groundwater Velocity, ft/day | 0.5 |
| Travel time for conservative compound from upgradient well to downgradient well (approximate) | N/A |
| Upgradient Wells | 102 is cross-gradient |
| Downgradient Wells | 120 |

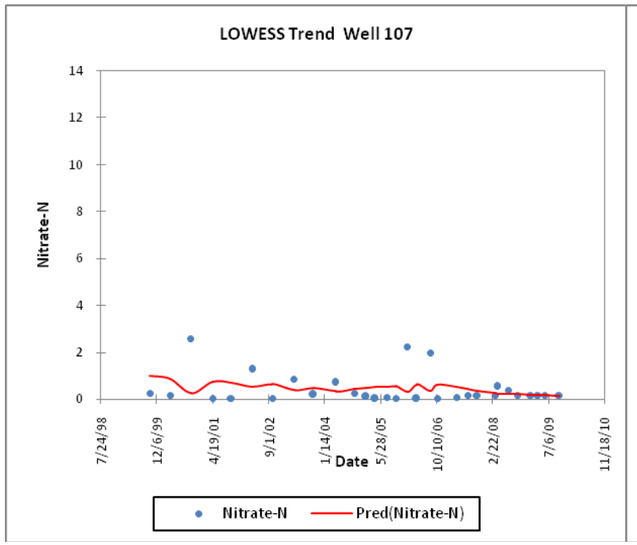


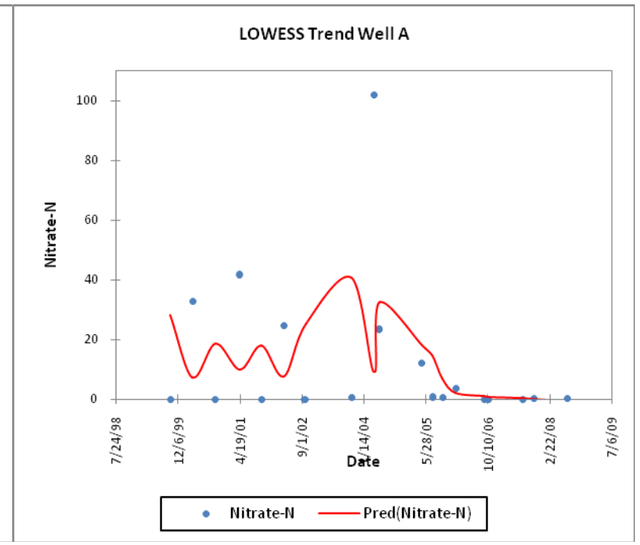



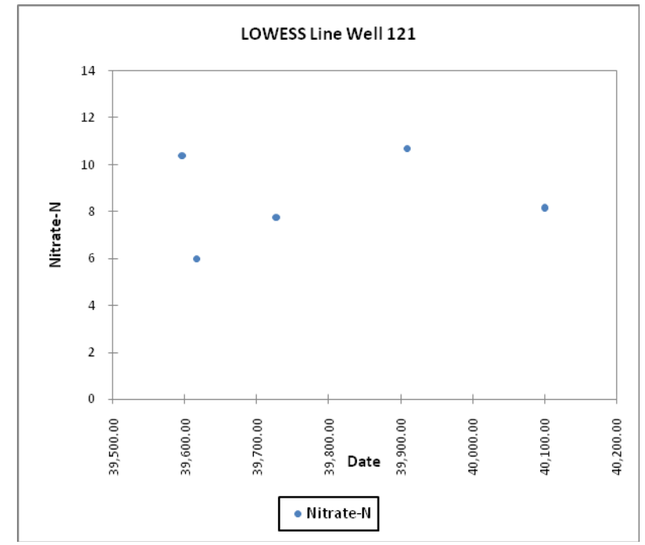



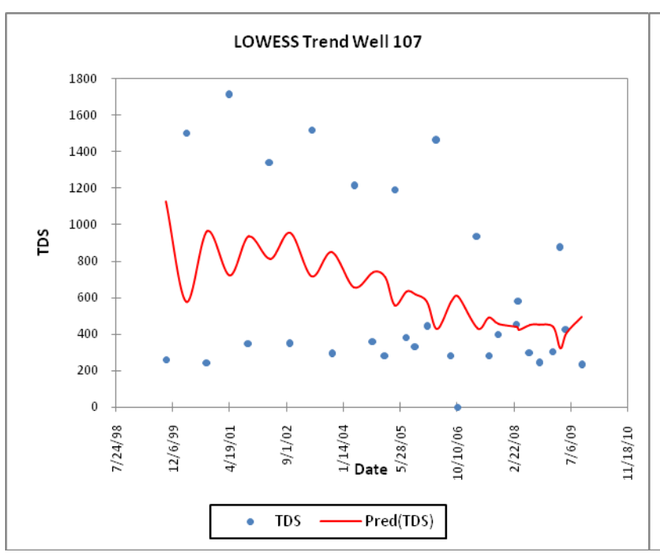



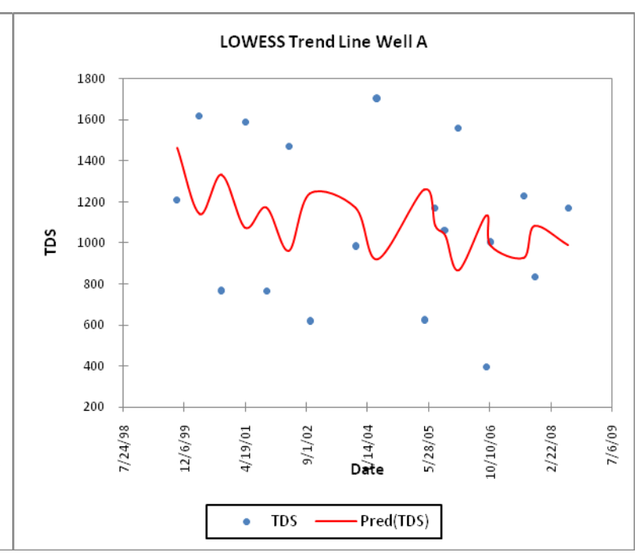
| **Table 4-13. East Gillette (MU-005005) Groundwater Summary** | |
|---|---|
| Irrigation Acreage | 89 |
| Gradient ft/ft | 0.003 |
| Groundwater Direction | Northeast |
| Groundwater Velocity, ft/day | 0.5 |
| Travel time for conservative compound from upgradient well to downgradient well (approximate) | 10 years |
| Upgradient Wells | 107, A |
| Downgradient Wells | 121 |

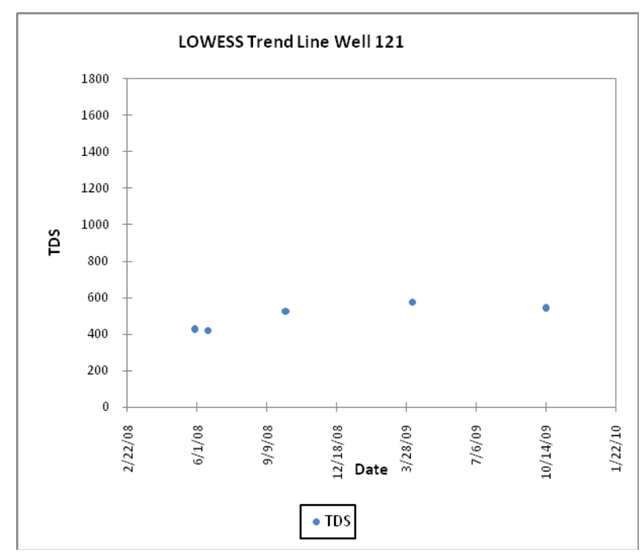


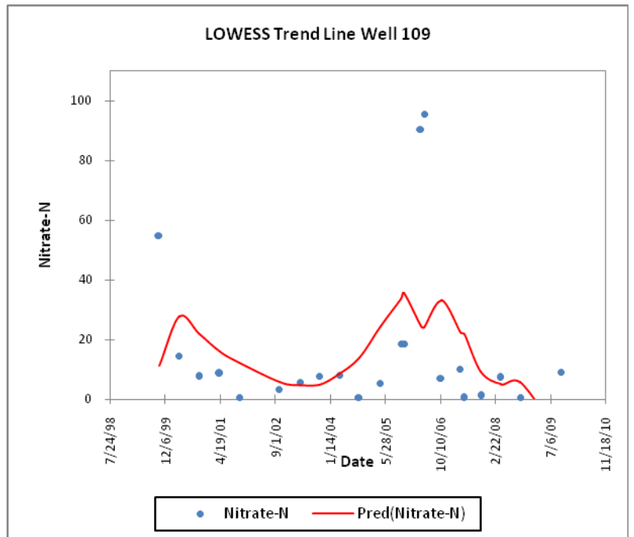



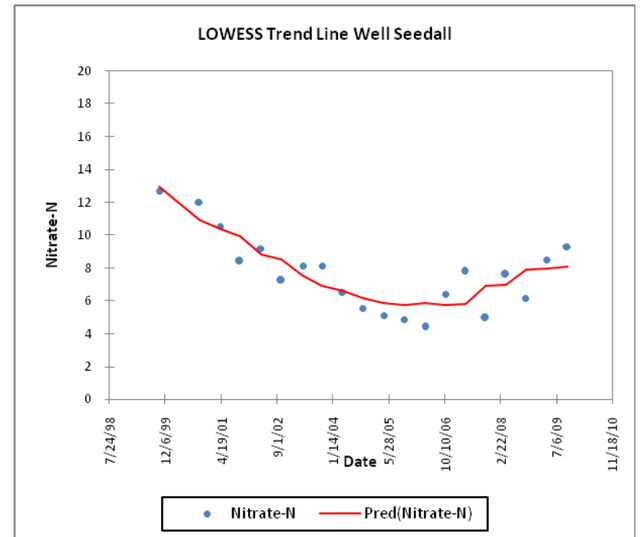



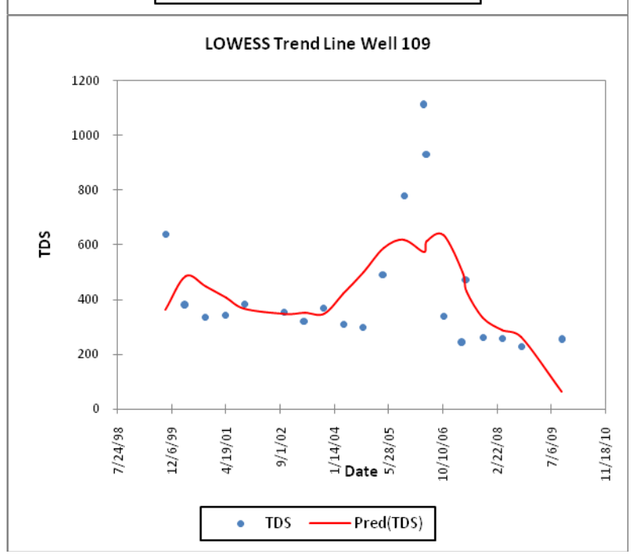



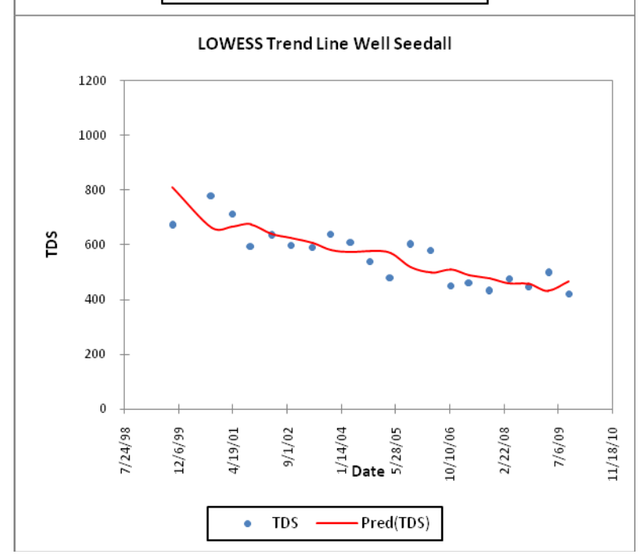



| **Table 4-14. Seedall (MU-005007) Groundwater Summary** | |
|---|---|
| Irrigation Acreage | 35 |
| Gradient ft/ft | 0.003 |
| Groundwater Direction | Northwest |
| Groundwater Velocity, ft/day | 1.4 |
| Travel time for conservative compound from upgradient well to downgradient well (approximate) | 2 years |
| Upgradient Wells | 109 |
| Downgradient Wells | Seedall |

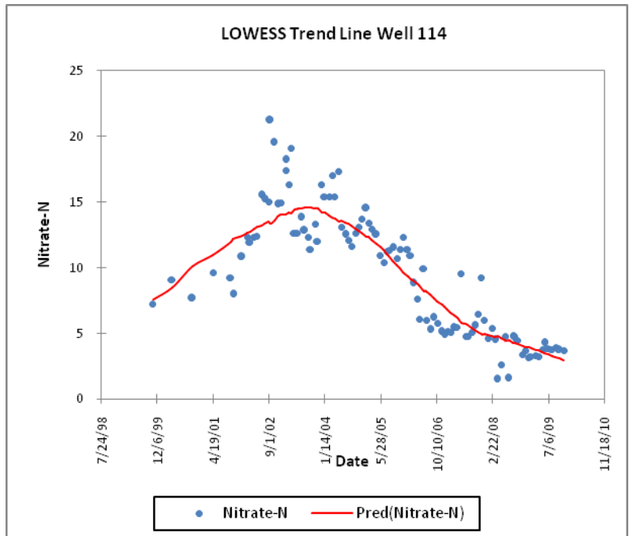


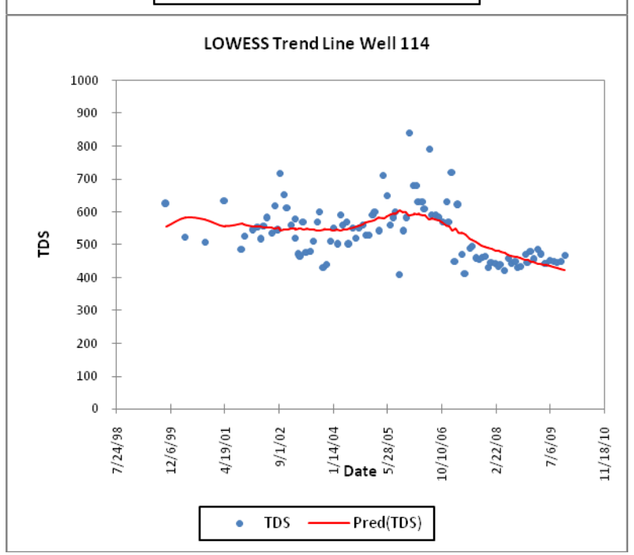



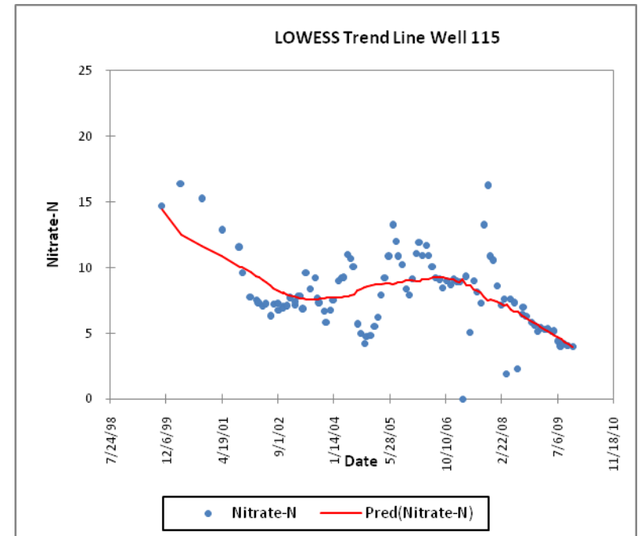



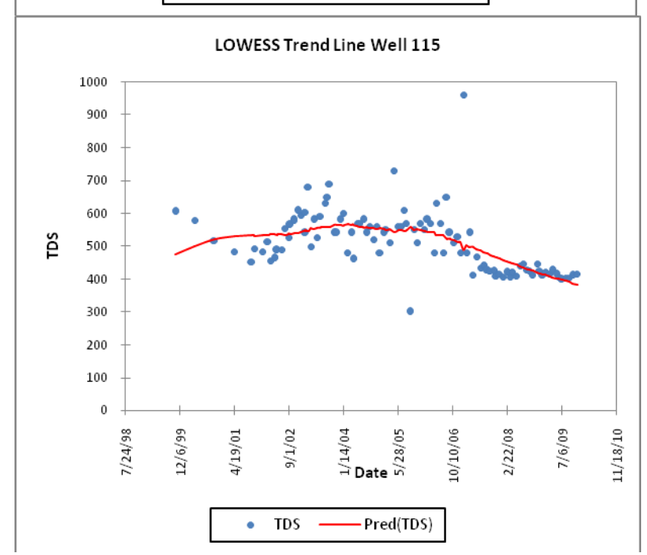



| **Table 4-15. South Schow (MU-005009) Groundwater Summary** | |
|---|---|
| Irrigation Acreage | 65 |
| Gradient ft/ft | 0.003 |
| Groundwater Direction | Northwest |
| Groundwater Velocity, ft/day | 2.3 |
| Travel time for conservative compound from upgradient well to downgradient well (approximate) | 1 year |
| Upgradient Wells | 114 |
| Downgradient Wells | 115 |

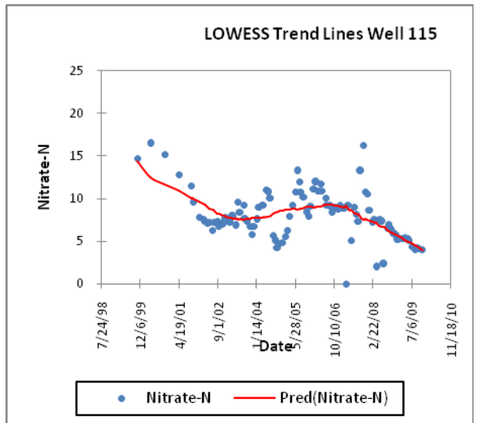


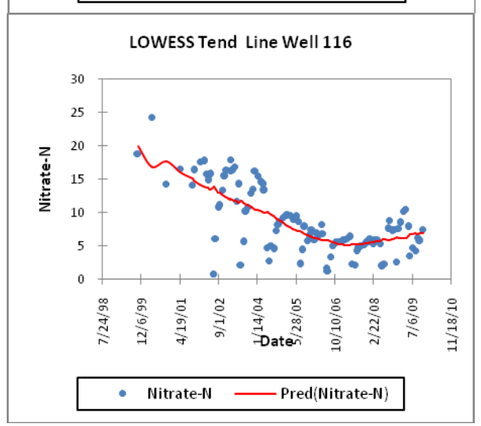



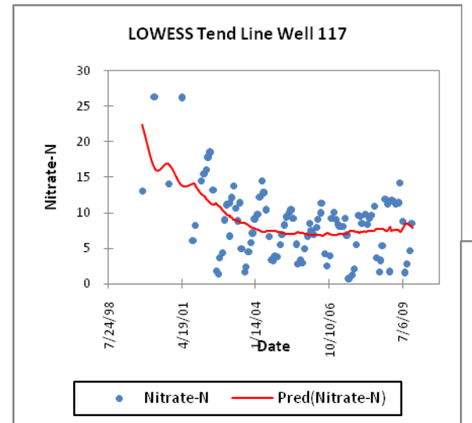



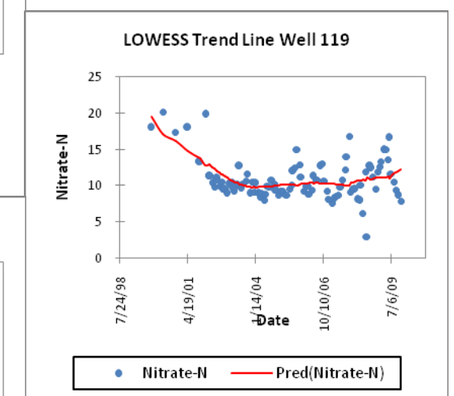



| **Table 4-16. North Schow (MU-005010) Groundwater Summary For Nitrate-N** | |
|---|---|
| Irrigation Acreage | 155 |
| Gradient ft/ft | 0.003 |
| Groundwater Direction | Northwest |
| Groundwater Velocity, ft/day | 3.9 |
| Travel time for conservative compound to travel from upgradient to downgradient wells | |
| Upgradient Wells | 115, 116 |
| Downgradient Wells | 119, 117, 118 |



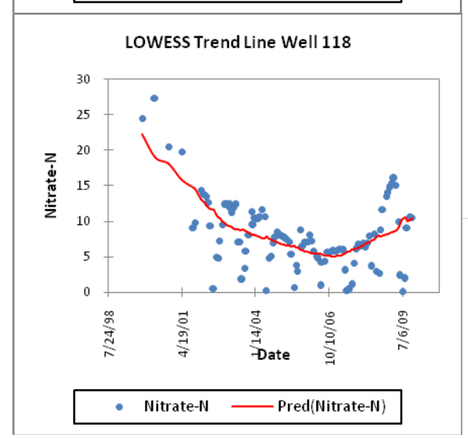
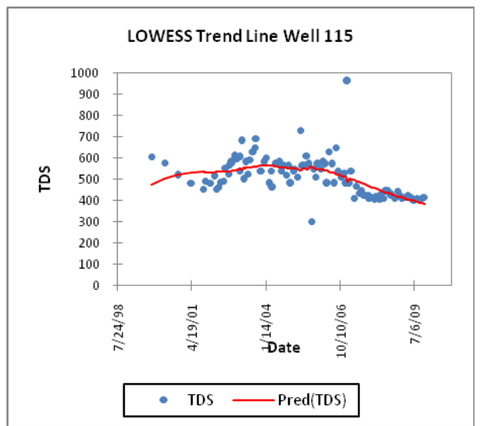
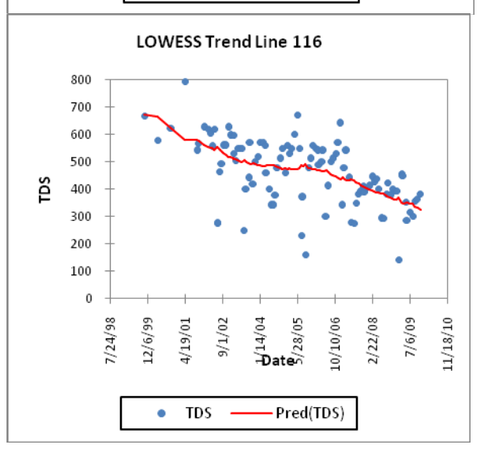
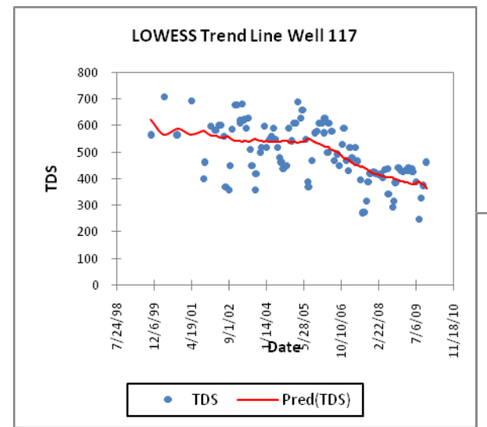



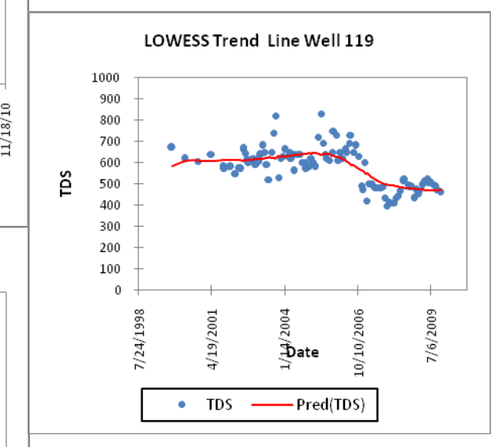
**Table 4-17.North Schow (MU-005010) Groundwater Summary for TDS**

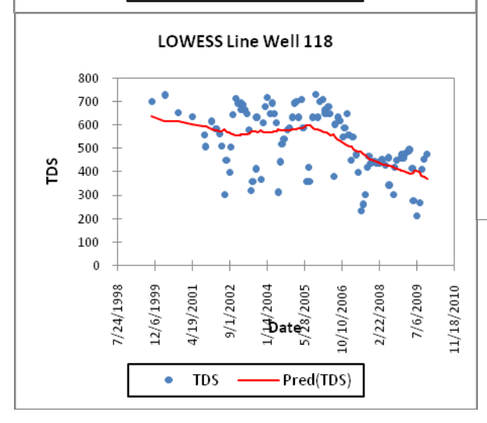
| | |
|---|---|
| Irrigation Acreage | 155 |
| Gradient ft/ft | 0.003 |
| Groundwater Direction | Northwest |
| Groundwater Velocity, ft/day | 3.9 |
| Travel time for conservative compound from upgradient well to downgradient well (approximate) | 1 year (115 to 119) |
| Upgradient Wells | 115, 116 |
| Downgradient Wells | 119, 117, 118 |



East Farm (MU-005001) (Table 4-14)

The average annual nitrogen and TDS loadings for the East Farm, from 2000 through 2009, were 96 pounds per acre (lbs/acre) and 898 lbs/acre, respectively. The upgradient well H shows a strong decline in nitrate-N from 1998 through 2009. This is compared to downgradient well E, where nitrate-N shows an increasing trend. TDS concentrations in upgradient well H show a steady decline in concentration over time, while TDS in downgradient well E does not have a discernable trend, but appears elevated compared to the upgradient well. This disconnect between up and downgradient groundwater concentrations could be attributed to the removal of top soil in portions of the field for construction of the lagoon storage system and replacement of the top soil with aged soil recovered from the mud ponds. Time series plots of the soil nitrogen and soluble salts show how the soil concentrations have returned to within typical ranges found in agricultural soils. Shortly after the top soil was removed and replaced with recovered soils from the mud ponds, wastewater application at this portion of the East Farm was discontinued until such time that the soil concentrations returned to the normal ranges while crops have still been grown. Recently TASCO decided to recommence the application of wastewater to this section of the East Farm. TASCO expects to see the nitrate and TDS levels in downgradient well E to reflect the downward trends shown in the upgradient well H.

South Farm (MU-005002) (Table 4-15)

Nitrogen loadings for the South Farm averaged 120 lbs/acre/year from 2000 through 2009, and non-volatile dissolved solids (NVDS) loadings averaged 2086 lbs/acre/year. Nitrate-N and TDS concentrations in upgradient well J show a declining concentration over time, as does the downgradient well I. TDS shows a sharper (steeper) decline in concentration for the downgradient well, though TDS remains elevated in the downgradient well compared to the upgradient well. Travel time for a conservative compound (e.g., chloride) from well J to well I is predicted to be 13 years, thus caution is warranted when making inference between the wells. The steep declining trend in TDS in this downgradient well is encouraging and would indicate that loadings in the 2100 lbs/acre range of NVDS are sustainable.

Wilkins (MU-005003) (Table 4-16)

Nitrogen and NVDS loadings to this field averaged 8 lbs/acre/year and 2 lbs/acre/year over the past 9 years. This field does not receive process water and has received less than the permitted loading limit of condensate water over the course of this permit term. Caution is warranted when comparing upgradient and downgradient wells (see Figure 4-5) in that downgradient well 107 is not adjacent to the field (over 1 mile downgradient). The travel time between wells is predicted to be over 40 years.

Goitiandia (MU-005004) (Table 4-17)

There is no upgradient well for this field. The downgradient well (MW-120) has had six sampling events, thus inference about trends cannot be made. Nitrate-N appears elevated, though the last few sampling rounds have nitrate-N below 7 mg/L. TDS is in the 500 mg/L range. NVDS loadings from wastewater at this site averaged 52 lbs/acre/year from 2000 through 2009, and nitrogen loadings have averaged 108 lbs/acre/year.

East Gillette (MU-005005) (Table 4-18)
Downgradient well MW-121 is similar to MW-120 in that nitrate-N is slightly elevated and TDS is in the 500 mg/L range. Upgradient wells, 107 and A, are elevated in TDS, but both show a decreasing trend. Nitrates are generally low in the two upgradient wells. NVDS loadings from 2000 to 2009 averaged 56 lbs/acre/year and nitrogen averaged 85 lbs/acre/year.

Seedall (MU-005007) (Table 4-19)
NVDS loadings on Seedall averaged 1315 lbs/acre/year from 2000 to 2009 and nitrogen loadings were 137 lbs/acre/year. Nitrate-N in upgradient well 109 is highly variable with some samples exceeding of 10 mg/L, the groundwater standard. Nitrate-N concentrations in the downgradient well declined from1999 to 2006, and then showed an increasing trend. Given the relatively low nitrogen loadings (within agronomic rates), the reason for the recent increase in nitrate-N in groundwater is uncertain. TDS, on the other hand, shows a steady decline in the downgradient well (Seedall). Travel time between upgradient and downgradient wells in this field is predicted to be within a few years.

South Schow (MW-005009) (Table 4-20)
Wastewater nitrogen loadings on South Schow averaged 100 lbs/acre/year, from 2000 to 2009, and wastewater NVDS loadings averaged 906 lbs/acre/year. Nitrate-N concentrations show a decline in concentration for both upgradient (well 114) and downgradient wells (well 115). Part of this decline is attributed to the upgradient high school changing from a septic system leach field to sending wastewater to the sanitary sewer.

TDS in upgradient well 114 is near steady state, but shows a slight decreasing trend in recent years. Downgradient well 115 shows a decreasing trend in TDS suggesting the South Schow has additional NVDS assimilative capacity.

North Schow (MW-005010) (Table 4-21 and 4-22)
Wastewater loadings of nitrogen and NVDS from 2000 through 2009 averaged 77 and 162 lbs/acre/year, respectively. Upgradient wells, 115 and 116, show a decreasing trend in nitrate-N concentrations, though nitrate-N concentrations appear to be increasing in the past few years for MW-116. Nitrate in the downgradient wells show a similar decreasing trend with a slight increase in concentrations in recent years. For upgradient and downgradient wells, TDS shows a declining concentration over time.

**Mixing Zone Analysis**

Based on groundwater monitoring results, TDS concentrations are declining (or steady state) in downgradient monitoring wells at the site (Table 4-14 through 4-22). TASCO desires to improve the distribution of NVDS loadings among the land application fields. Section 5.0 provides proposed loadings. To support these loadings, a mixing zone analysis was performed for the Schow sites and for the Goitiandia and East Gillette sites. Modeling was conducted using the peer reviewed IDEQ developed spreadsheets:

1. Nutrient and Hydraulic Balance Model (July 25, 2008 version)
2. Groundwater Mixing Zone Model (July 31, 2008 version)

**Nutrient and Hydraulic Balance Model**
For this evaluation, the spreadsheets were used to calculate:

- Loading rates for salts
- Salt losses to groundwater
- Hydraulic loading rates of both reuse water and fresh irrigation water
- Salt percolate concentration and volume.

The estimated percolate concentrations and volumes were then used for the Groundwater Mixing Zone Model.

**Groundwater Mixing Zone Model**
This tool calculates an estimate of groundwater constituent concentration discharging from the down-gradient boundary of a land treatment site.

**North Schow**
Appendix 4-4 provides input parameters used in the WWRU Constituent Hydraulic Balance Model. The following scenarios were run:

- Scenario 1: 2500 lbs/acre/year NVDS loading with 5-inches of leachate
- Scenario 2: 2000 lbs/acre/year NVDS loading with 5 inches of leachate
- Scenario 3: 2500 lbs/acre/year NVDS loading with 2 inches of leachate
- Scenario 4: 2000 lbs/acre/year NVDS loading with 2 inches of leachate
- Scenario 5: 2500 lbs/acre/year NVDS loading with 10 inches of leachate

An alfalfa crop was assumed with 1200 lbs/acre/year of NVDS uptake. The scenarios were run using the Nutrient and Hydraulic Balance Model. The predicted percolate concentrations for TDS and the leachate volume (acre-in/acre) were then entered into the Groundwater Mixing Zone Model.

For the groundwater mixing zone analysis, a range of hydraulic conductivity values were used to assess potential groundwater impacts based on site-specific measurements for hydraulic conductivity (Table 4-9). The range of hydraulic conductivity values were 200 to 600 feet/day with an average of 490 feet/day. Table 4-23 summarizes results for TDS. Using an average hydraulic conductivity of 486 ft/day and a leachate rate of 5 acre-inches/acre, the maximum TDS concentration downgradient of the field is estimated at 439 mg/L or an increase of 28 mg/L over the upgradient value. Irrigated agriculture results in some TDS getting into groundwater. The challenge is to determine an acceptable level. The Groundwater Quality Rules allows for flexibility in determining an acceptable TDS impact to groundwater. In general, because TDS is a secondary drinking water standard, there is greater flexibility in TDS loadings as long as it can be shown that there is not an injury to beneficial use of groundwater and best management practices are being applied.

Similar results are found for South Schow, however, the lower hydraulic conductivity results in an increase in TDS of 41 mg/L, rather than 28 mg/L at 2500 lbs/acre/year NVDS, and leachate volume of 5 acre-in/acre (Appendix 4-4).

| Table 4-18. Estimated Cmix as a Function of Hydraulic Conductivity for North Schow | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Hydraulic Conductivity (ft/day)** | 600 | 543 | 486 | 429 | 371 | 314 | 257 | 200 |
| | **TDS (mg/L) at Edge of Field** | | | | | | | |
| Cmix @ Scenario 1: 2500 lbs/acre; 5 inches leachate | 434 | 436 | **439** | 443 | 447 | 453 | 461 | 473 |
| Cmix @ Scenario 2: 2000 lbs/acre; 5 inches leachate | 421 | 422 | **423** | 424 | 426 | 428 | 432 | 437 |
| Cmix @ Scenario 3: 2500 lbs/acre; 2 inches leachate | 444 | 447 | **451** | 456 | 463 | 472 | 485 | 504 |
| Cmix @ Scenario 4: 2000 lbs/acre: 2 inches leachate | 429 | 431 | **434** | 437 | 440 | 445 | 453 | 464 |
| Cmix @ Scenario 5: 2500 lbs/acre: 10 inches leachate | 421 | 422 | **423** | 424 | 426 | 428 | 431 | 435 |

Upgradient concentration MW-115 411 mg/L

## Goitiandia and East Gillette

The same input parameters and scenarios that were run for Schow were also run for Goitiandia and East Gillette to estimate NVDS leachate concentrations entering the groundwater. The main difference is upgradient concentrations and the hydraulic conductivities. For these two sites, an upgradient concentration of 458 mg/L was assumed, based on 2009 data for well 107 and monitoring results from wells 120 and 121. A hydraulic conductivity range of 50 to 200 feet per day (ft/day) was assumed.

The output from the Goitiandia-East Gillette groundwater model is presented in Appendix 4-4.

Table 4-24 summarizes results for TDS. Using a hydraulic conductivity of 114 ft/day, the TDS concentration for the 2500 lbs/acre loading, at 5 inches of leachate, exceeds 500 mg/L (increase from 458 mg/L upgradient to 549 mg/L). Using 2000 lbs/acre loading, at 5 acre-inches/acre of leachate, results in a downgradient TDS concentration of 492 mg/L, or an increase of 34 mg/L. This is an acceptable increase based on the intent of the Groundwater Quality Rules. For these sites, because of the lower hydraulic conductivities, a loading of 2000 lbs/acre NVDS of wastewater is recommended.

In summary, groundwater monitoring results show improvements in TDS in groundwater for the management units with decreasing trends observed in most of the downgradient wells (Tables 4-14 to 4-22). TASCO desires to better spread out NVDS on all fields. The mixing zone analysis demonstrates that the Schow sites and the Goitiandia and East Gillette sites can assimilate higher NVDS loadings and remain protective of groundwater quality. A NVDS loading of 2500 lbs/acre/year is recommended for the Schow sites and 2000 lbs/acre/year for the Goitiandia and East Gillette sites.

| **Table 4-24 Estimated Cmix as a Function of Hydraulic Conductivity for Goitiandia (MU-005004 and East Gillette (MU-005005)** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Hydraulic Conductivity (ft/day)** | 200 | 179 | 157 | 136 | 114 | 93 | 71 | 50 |
| | **TDS (mg/L) at Edge of Field** | | | | | | | |
| Cmix @ Scenario 1: 2500 lbs/acre; 5 inches leachate | 516 | 522 | 529 | 537 | 549 | 563 | 584 | 616 |
| Cmix @ Scenario 2: 2000 lbs/acre; 5 inches leachate | 480 | 482 | 485 | 488 | 492 | 498 | 506 | 518 |
| Cmix @ Scenario 3: 2500 lbs/acre; 2 inches leachate | 550 | 560 | 572 | 588 | 610 | 640 | 685 | 759 |
| Cmix @ Scenario 4: 2000 lbs/acre: 2 inches leachate | 509 | 514 | 521 | 530 | 542 | 559 | 584 | 625 |
| Cmix @ Scenario 5: 2500 lbs/acre: 10 inches leachate | 475 | 476 | 478 | 480 | 482 | 486 | 490 | 498 |

Upgradient concentration well 107 is 458 mg/L based on average 2009 data.

## 5.0 Land Application System Performance Assessment

This performance assessment uses groundwater, soils, and wastewater monitoring results for the East, South, Seedall, North & South Schow, Goitiandia and East Gillette, and Offsite Farms to evaluate wastewater land application system treatment and management effectiveness. However, the relationship between loading rates, soils analysis, and groundwater analysis is difficult to establish. This is due to the complexity of the land application system, including the following:

- The lag time between loadings and potential impacts on soils and groundwater downdgradient of the site;
- Natural and anthropogenic variations in groundwater level, flow, and concentrations;
- Effects of other regional local sources, including irrigation practices, septic systems, confined animal feeding operations, and other industries.

In order to assess performance of the wastewater land application system and its potential effects on groundwater, individual farms and facilities have been subdivided into separate sections for analysis.

### 5.1 East Farm (MU-005001)

Dissolved solids and nitrogen monitoring results for the East Farm are shown on Figures 5-1 and 5-2, respectively. Along with wastewater and soils data, wastewater land application performance on the East Farm is monitored using the following groundwater wells:

- Wells C, E and 105 (downgradient of the acreage)
- Wells H and 108 (upgradient of the acreage)

**Dissolved Solids**

Since 1995, the wastewater NVDS load applied has been well below the permitted 7,600 lb/ac-yr. Actual loading levels for 1996-2009 ranged from 21 lb/ac-yr (2003-04) to 2,994 lb/ac-yr (1998-99) The increase NVDS load in the 1998-99 crop year increased to 2,994 lb/ac-yr because of unusual weather conditions that caused beets to spoil during the end of the processing season.

The soil EC (soluble salts) has fluctuated from approximately 600 to 4367 *u*mhos/cm. In 1998 approximately 28 acres of topsoil were required for building the dikes on the South Lagoon. The soil was taken from the western half of the East farm. During the 1998-1999 beet campaign, this area was used to compost dirt/material recovered from the dry beet handling system and the resulting compost as well as mud pond dirt were used to replace the top soil. Because of elevated nutrient and salts in the replacement soil, this area was temporarily removed from any wastewater application schedule thus reducing the area of the East Farm to approximately 40 acres. Recently, soils analyses have shown a return to within the normal range for agricultural land and wastewater application has resumed (Figure 5-7).

Upgradient and downgradient groundwater TDS concentrations have at times exceeded the SMCL of 500 mg/L. This is a reflection of a regional issue. During the past four years, the lowest TDS concentrations have occurred in upgradient well 108 and downgradient well 105. Since 1998, no wastewater has been applied directly upgradient of well C (land is covered with lined lagoons) and the improvement in TDS measured in well C is closely mirrored by the TDS concentrations found in monitoring well E, directly downgradient of the East farm. This suggests that the wastewater load applied to the East farm is supportive of continued improvement of the groundwater TDS concentrations.

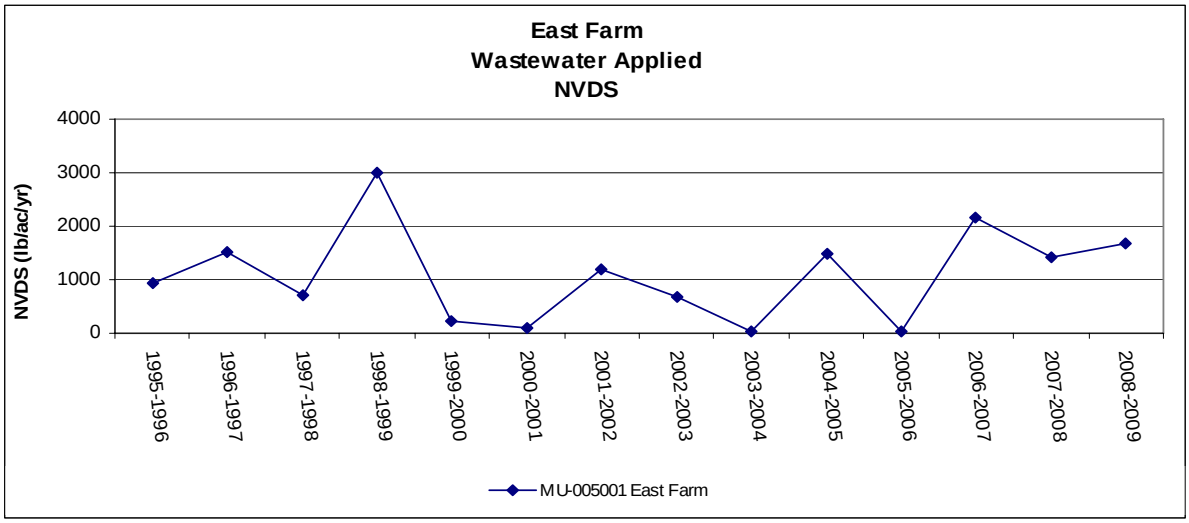
Throughout the permit term NVDS loads were applied at rates well below permitted levels, and the TDS groundwater monitoring plots suggest a gradual decreasing trend although no statistical trend for downgradient TDS is indicated. It should be noted that TDS is non-conservative (i.e., the constituents in TDS can react with the aquifer matrix).

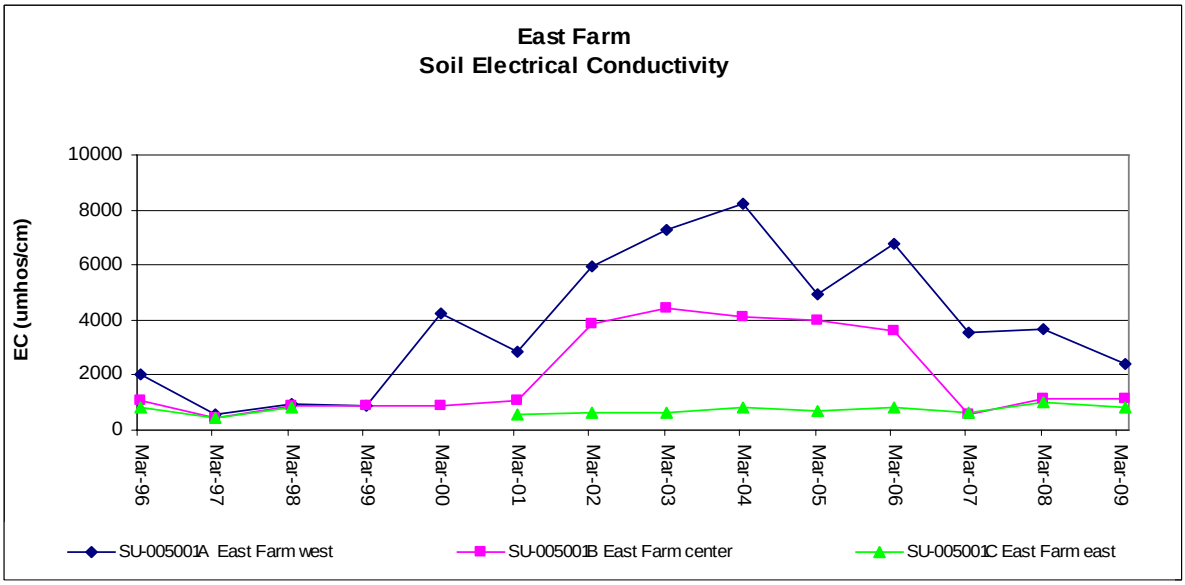
**Nitrogen**

The total nitrogen loading (wastewater and fertilizer application) for the permit term has in general been significantly below 200 lbs/ac/year. This is well below the 150 percent of crop uptake or 300 lb/ac-yr permit limit set in 1995. In 1999-2000, 2000-01 and again in the 2007-08 crop years, nitrogen uptake dropped just below the application rate but these were offset by significant uptake the prior or following years. The soil nitrogen levels peaked shortly after the soil used in the construction of the lagoon berms was replaced but they have dropped back to acceptable range. The west 20 acres are currently being utilized for wastewater application. TASCO expects to see the soil available nitrogen levels to remain low.

Trend plots for nitrate-N in groundwater wells around the East Farm show how complex nitrogen management can be. Until October of 2001, nitrate concentrations in upgradient Well H were high with values occasionally as high as 25 mg/L while nitrate concentrations in downgradient well E and near by well C have generally been below 10 mg/L but at levels suggesting aerobic groundwater conditions. Subsequent to October 2001, upgradient concentrations (Well H) have been very low and occasionally below detection. This suggests potential upgradient impacts causing anoxic reducing conditions which would cause any available nitrate to be denitrified to nitrogen gas. If organic nitrogen is present in an anoxic zone, the mineralization of this material would result in ammonium only. If the groundwater changes to oxic conditions, then this ammonium would convert to nitrate-N. For areas of high organic loadings, very low or non-detect nitrate concentrations in groundwater is often observed. Once this heavy organic loading ceases, it is non uncommon to observe a spike in nitrate concentrations until the organic nitrogen and ammonium pool are exhausted. Since 2007, the single upgradient well H and sidegradient well C and downgradient well 105 (½ mile downgradient) to the East Farm have been showing reducing conditions and the well immediately downgradient of the East Farm (well E) is showing the effects with elevated nitrate. The nitrogen load to the field has been uniform and much less than the permitted rates, however; the application of mud pond solids and composted material to the western 20 acres may be contributing to the elevated nitrogen in the groundwater as seen in Well E. If this is the case, it is expected that these conditions should start declining in the near future.

## Figure 5-1 Dissolved Solids Analysis - East Farm



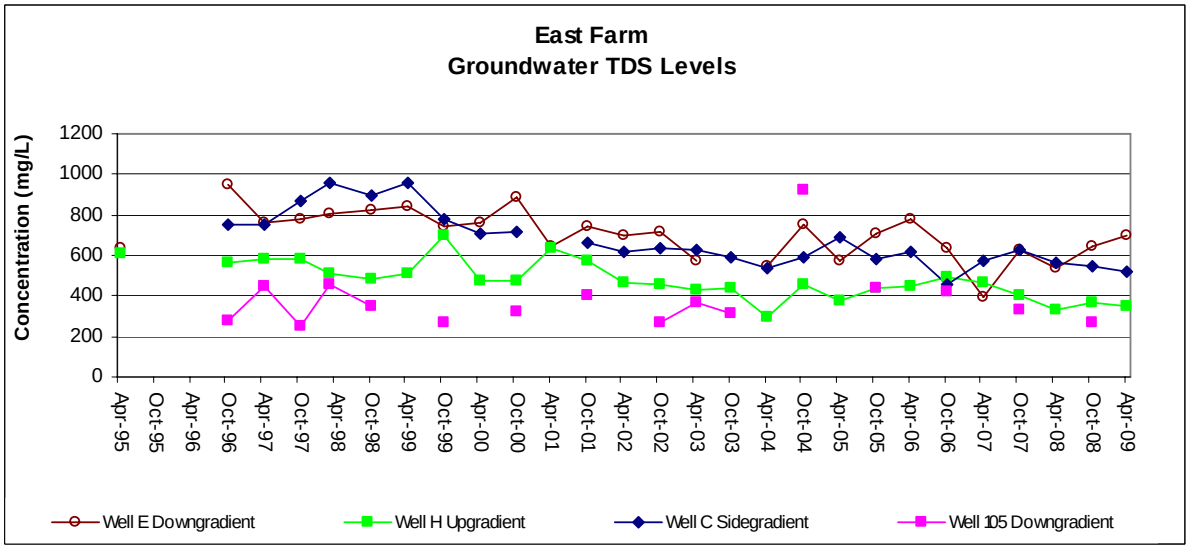
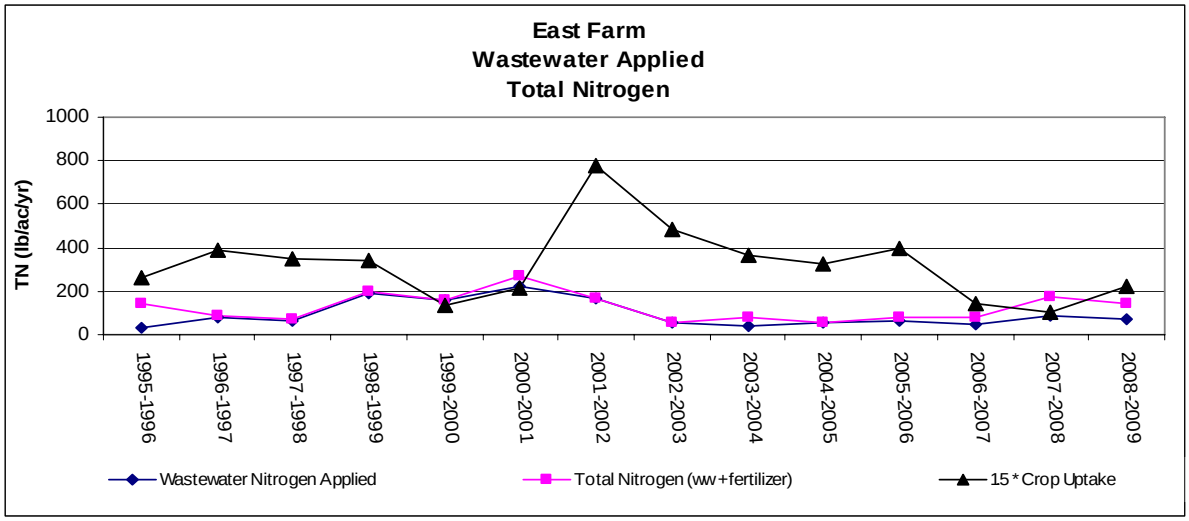
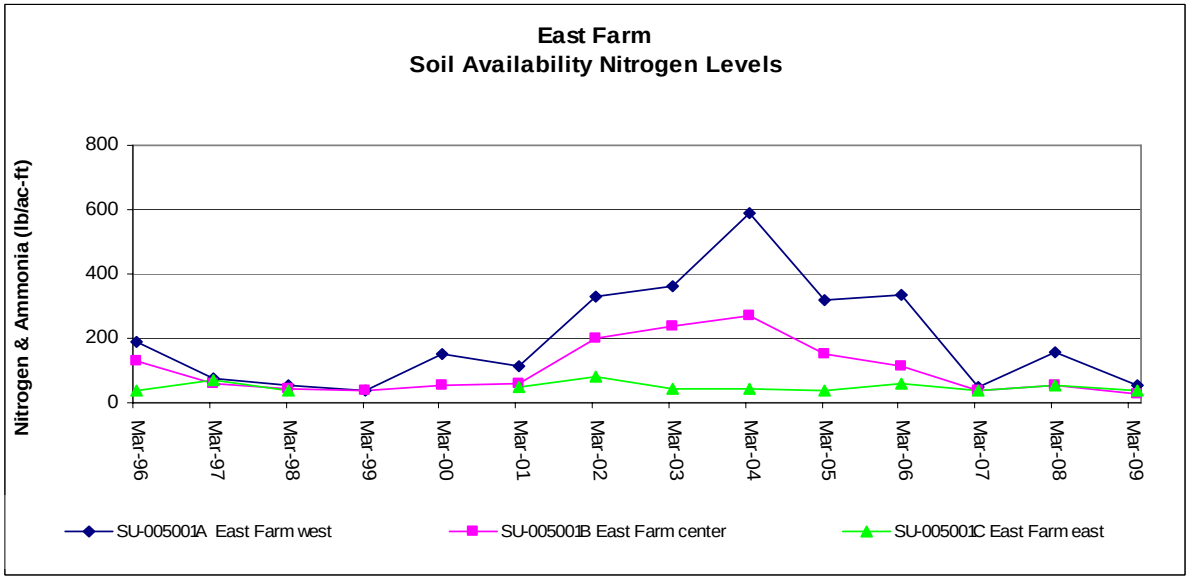
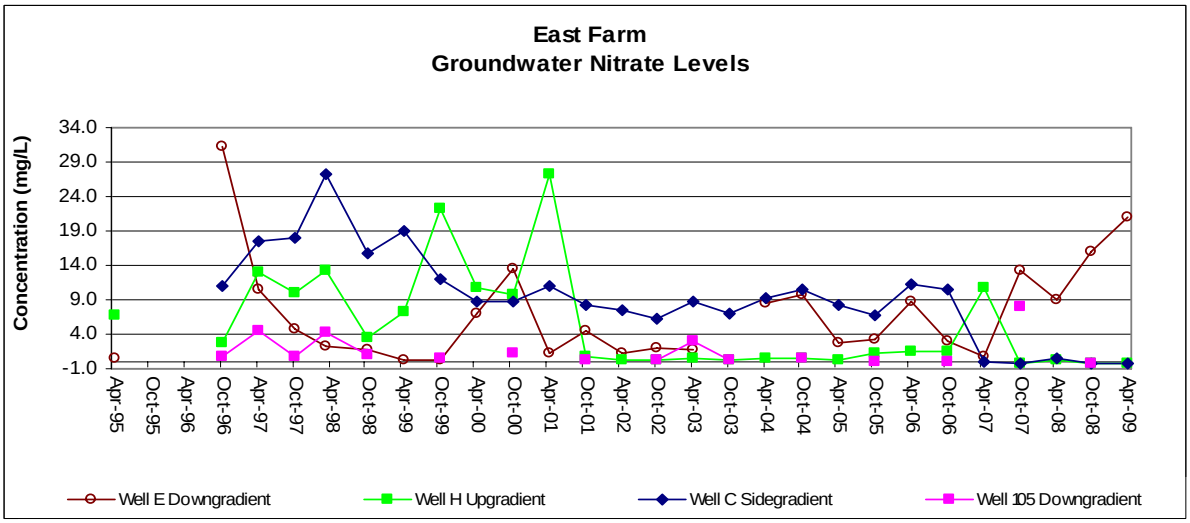



**Figure 5-2 Nitrate Analysis - East Farm**



## 5.2 South Farm (MU-005002)

Dissolved solids and nitrogen monitoring results for the South Farm are shown on Figures 5-3 and 5-4, respectively. Along with wastewater and soil data, wastewater land application performance on the South Farm is monitored using the following groundwater wells:

- Well J (upgradient of the acreage)
- Well I (downgradient of the acreage)

**Dissolved Solids**

Over the term of the permit, the wastewater NVDS loads applied have been well below the permitted loads of 7,600 lbs/ac/yr. Actual NVDS loading levels have averaged approximately 2,000 lbs/ac/yr. The soil EC has fluctuated between 800 and 1,400 umhos/cm. These values are very similar to the EC concentrations found in on the East Gillette Management Unit (SU-005005 discussed below) which has received very low solids loadings over the history of the permit. "A soluble salt level in soils below 2 millimhos per centimeter (mmhos/cm) is desirable when growing grasses and alfalfa" (Managing Salt-Affected Soils for Crop Production, PNW-601E, November 2007).

TDS in downgradient well I shows a statistically significant decreasing trend (Tables 4-14 and 4-16), while the upgradient well J does not show a statistically significant trend. TDS concentrations remain elevated at downgradient well I when compared to upgradient well J but a statistical comparison of up and downgradient wells should be done with caution given the decreasing trend.

Because the loadings to the South Farm have been much less than the permit, and the soil EC is very similar to other sites that have had very low NVDS loadings, the elevated TDS levels in the downgradient well is attributed to historic practices (pre 1995) and possibly the influence from the effects of mounding from the (now inactive) lime pond and not from wastewater applications. Regardless, groundwater data for TDS shows that site groundwater conditions are improving.

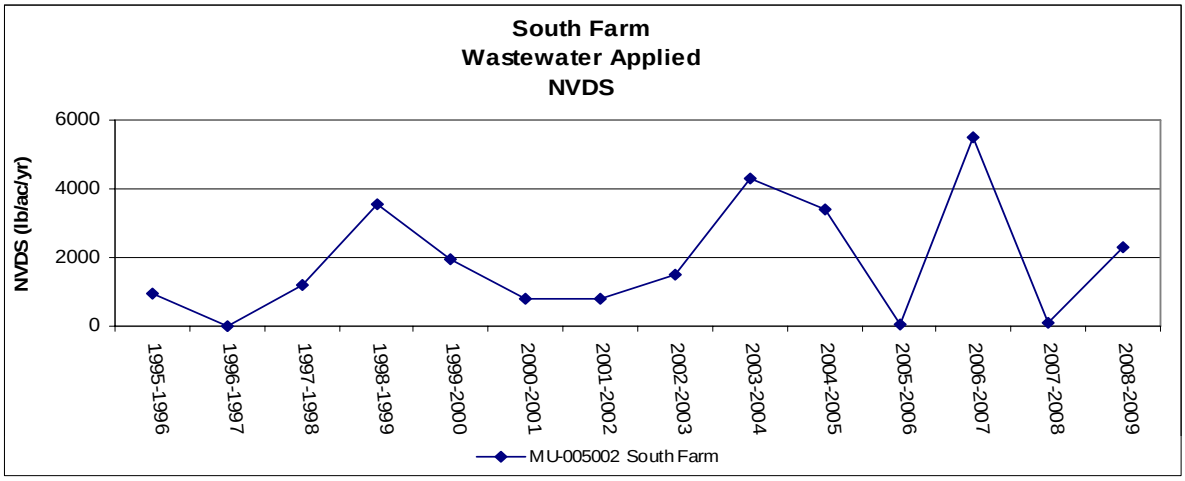
**Nitrogen**

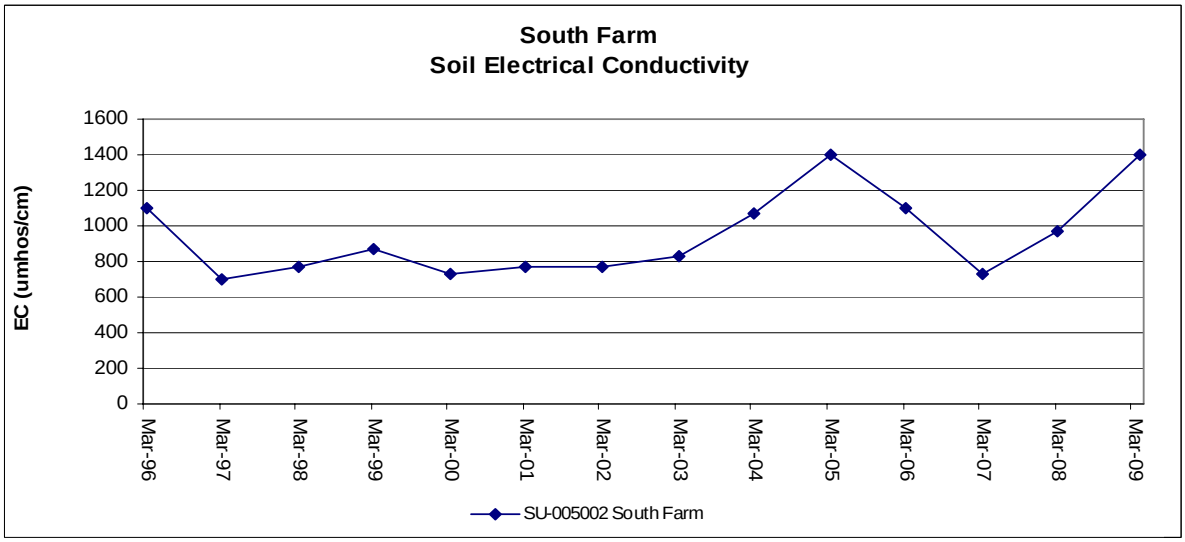
The total nitrogen loading (wastewater-N + fertilizer-N) during the permit cycle has consistently been around 200 lbs/ac/yr. On a few occasions the loading has approached 300 lbs/ac/yr but the nitrogen load has been well below the permit limit of 1.5 times the nitrogen uptake for all but crop year 1996-97.

The soil nitrogen levels peaked in sample years 1996 and 1997 then dropped back to in 1999. This was possibly a response to spring fertilizer application in 1997, followed by the reduction. TASCO changed management of the site after this application and subsequent soil samples show a continuing decline in soil nitrogen levels to the current 30 lbs/ac (+/- 10).

Nitrate concentrations in both the downgradient (Well I) and upgradient (Well J) wells are low (below 5 mg/L). Upgradient well J often shows evidence of seasonal fluctuations probably due to irrigation canal influence (see LOWESS trend plot in Table 4-16).

Figure 5-3 Dissolved Solids Analysis - South Farm



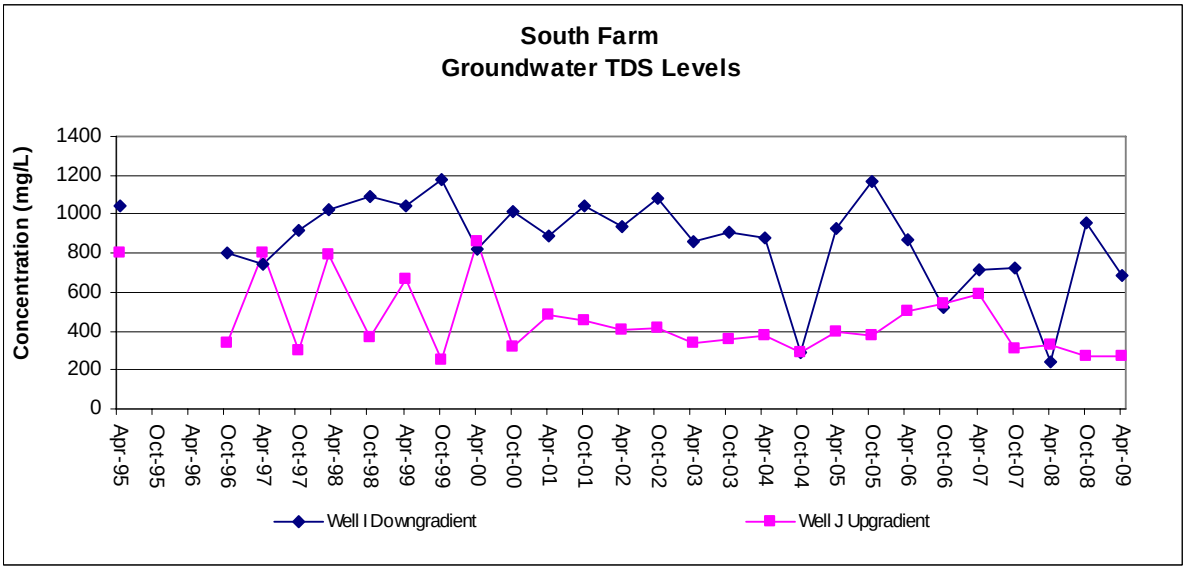
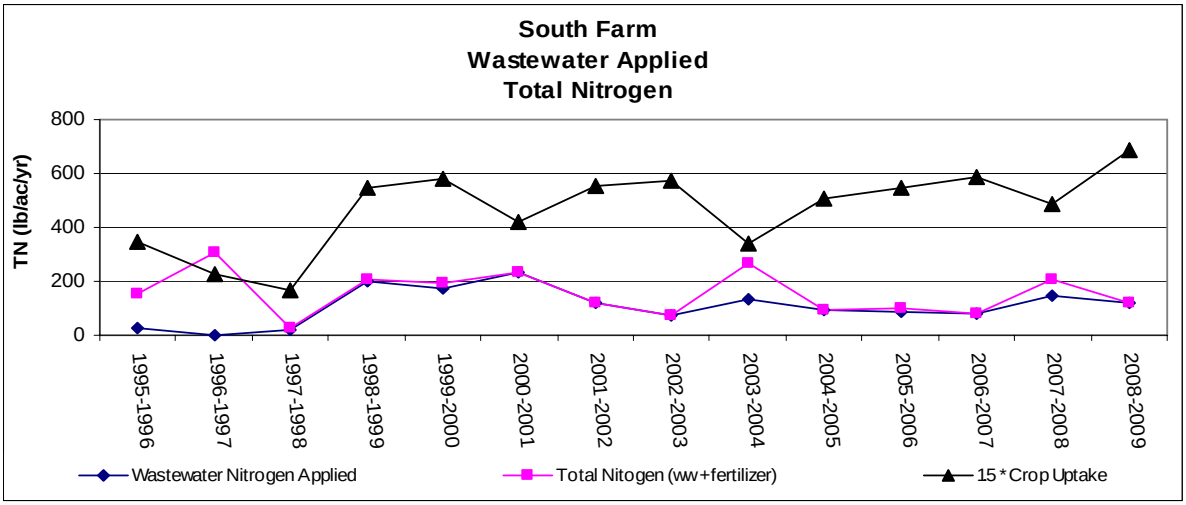
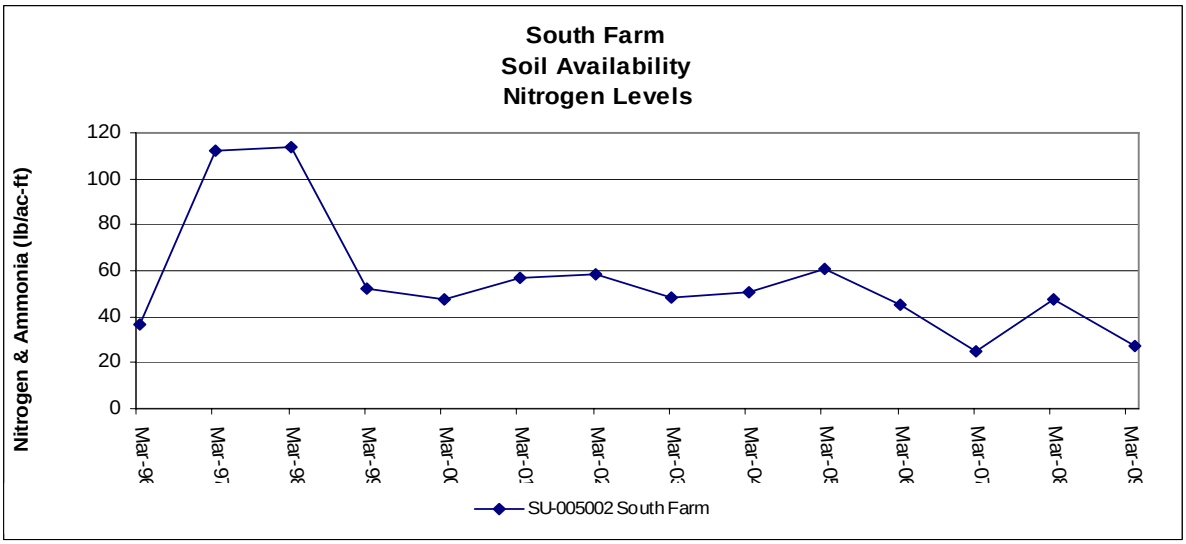
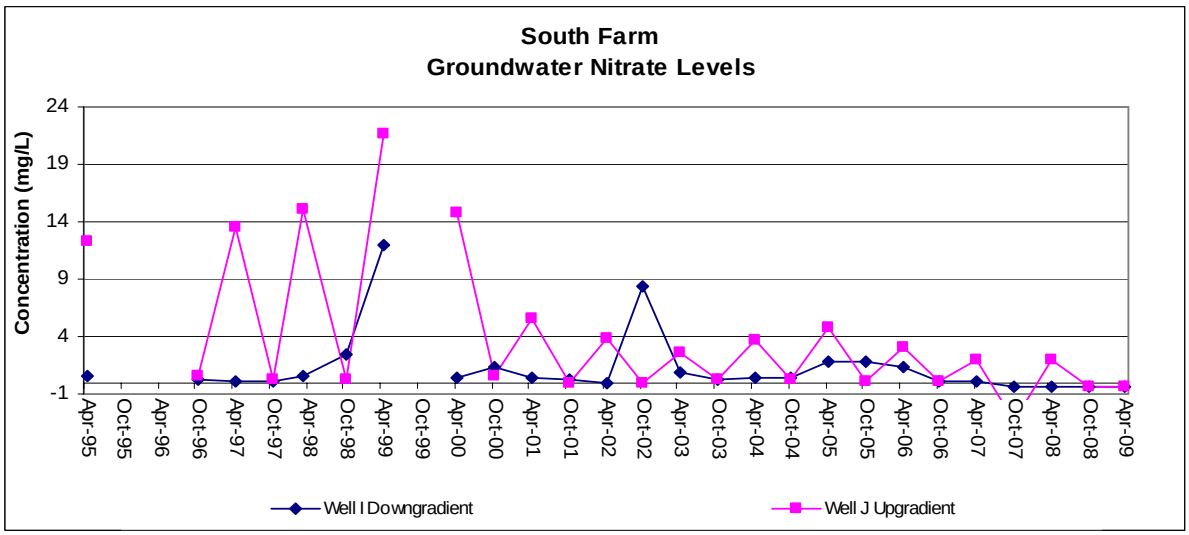



Figure 5-4 Nitrate Analysis - South Farm



## 5.3 Goitiandia Farm (MU-005004)

In January of 2004, TASCO notified the Department of the purchase of the Goitiandia Farm (MU-005004). Acquisition of this acreage allowed TASCO better control of the fertilizer application rates and thus the total nitrogen load on the farm. In fall of 2006, TASCO requested a modification to the permit reflecting the Goitiandia Management Units (MU) be transferred from offsite to onsite and on November 30, 2006 IDEQ granted that request.

Dissolved solids and nitrogen monitoring results for the Goitiandia Farm are shown on Figures 5-5 and 5-6, respectively. Along with wastewater and soils data, wastewater land application performance on the Goitiandia Farm is monitored using the following wells:

- Well 102 (side gradient of the acreage)
- Well 120 (downgradient of the acreage)

**Dissolved Solids**

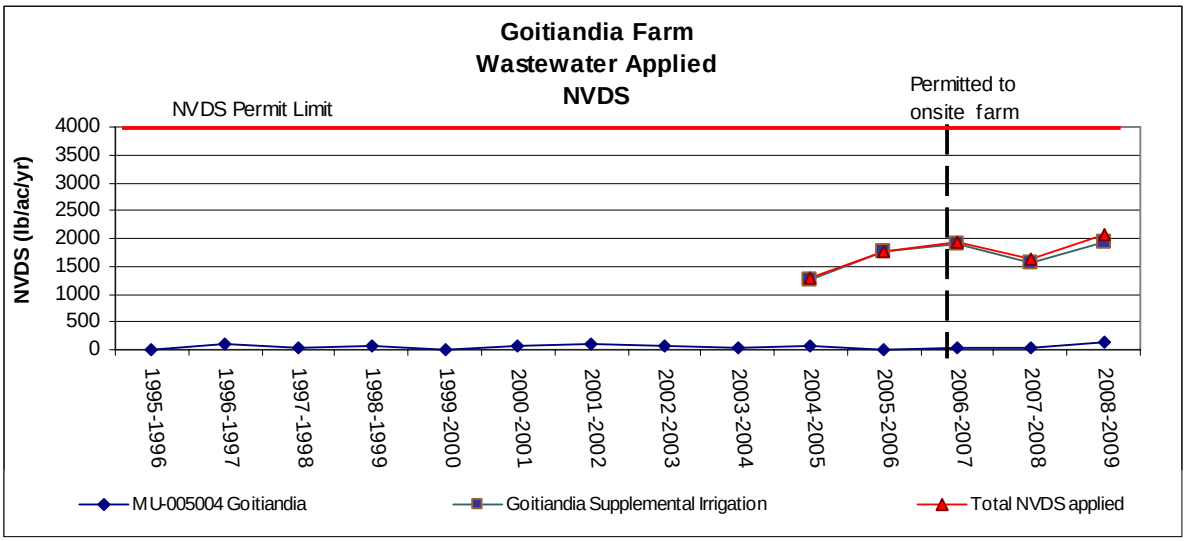
This MU has historically only received condensate water and the NVDS load as seen in Figure 5-5 shows annual loads of less than 150 lbs/ac/yr. The soil EC is generally around 800 umhos/cm occasionally fluctuating +/- 100 umhos/cm. Through 15 years of application of high quality condensate subsequent to incorporation into the wastewater land application program, the trend charts show how a field taken from normal farming practices reacts to minimal dissolved solids applications.

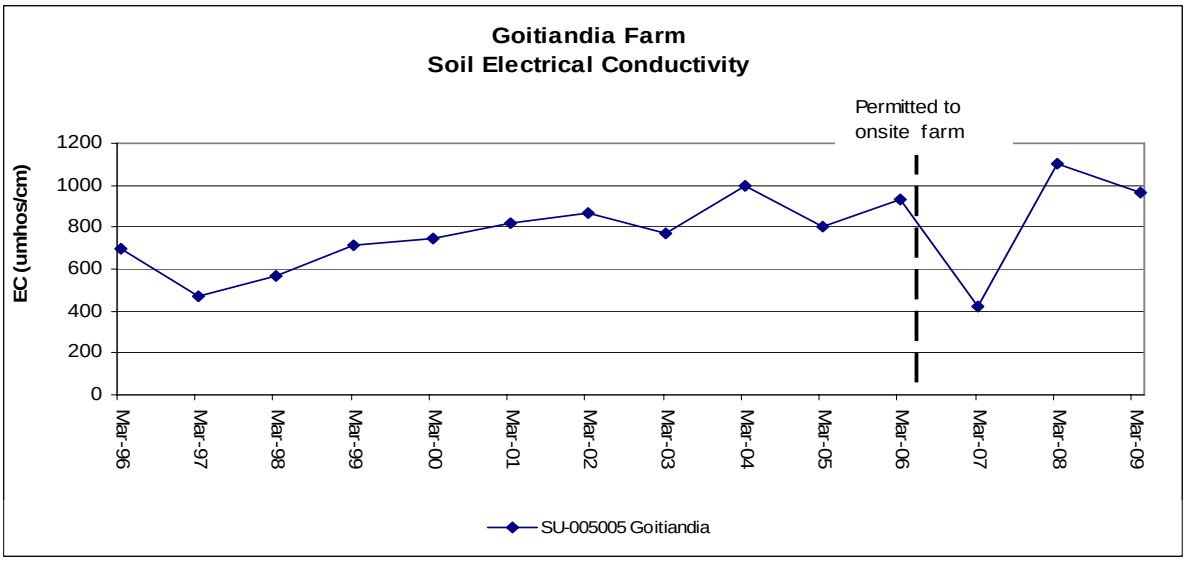
With the transfer of the Goitiandia MU to onsite status, TASCO was granted the opportunity to apply not only condensate but process water as well. This authorization included the requirement to install additional monitoring wells. Thus well 120 was installed immediately downgradient of the Goitiandia MU. As can be seen, TDS levels in this well are lower than the side gradient monitoring well 102 which is not influenced by TASCO wastewater land application operations.

Since the transfer to onsite management, the permitted NVDS loading to the Goitiandia is limited based on total load (wastewater and supplemental irrigation) and NGS loading. While TASCO thinks limiting the total NVDS load 4000 lbs/ac/yr including supplemental irrigation restricts the ability to utilize the land, loadings have remained below the permitted 4,000 lbs/ac/year total load and the 642 lbs/ac/yr NGS. Figure 5-5 shows the significant disparity between the NVDS load from wastewater applications and the NVDS load from supplemental irrigation.

TASCO requests the flexibility to utilize this field for process water application but inclusion of supplemental irrigation NVDS loads into the permit limit presents difficulties especially when process water is applied early in the growing season and the quality of supplemental irrigation varies through the crop year. Ground water modeling presented in Section 4 (see Table 4-24) suggest that wastewater NVDS loading limits of 2,000 lbs/ac/yr on the Goitiandia and East Gillette properties would be protective of groundwater quality.

Figure 5-5 Dissolved Solids Analysis - Goitiandia Farm



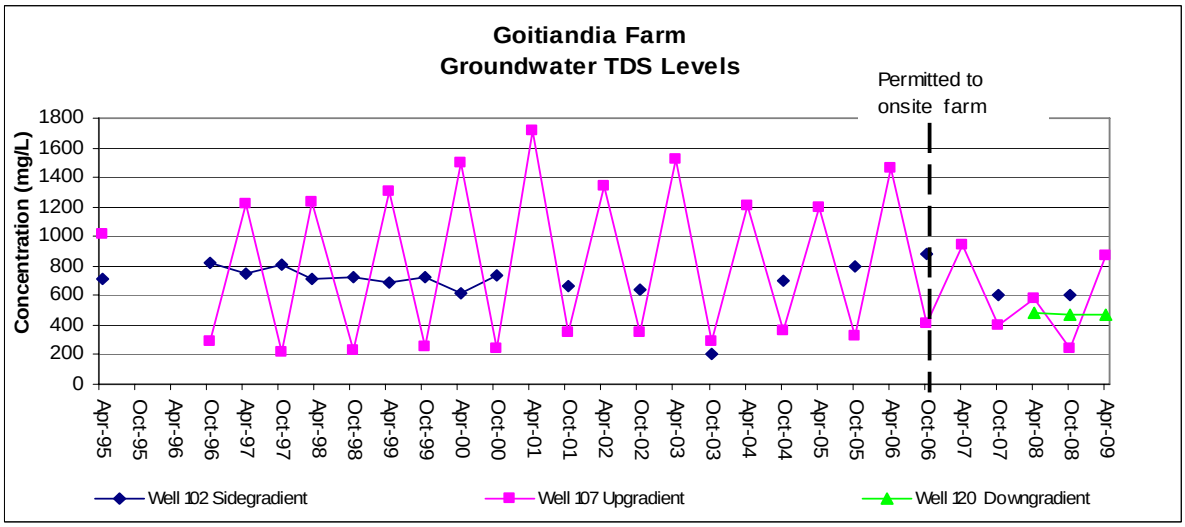
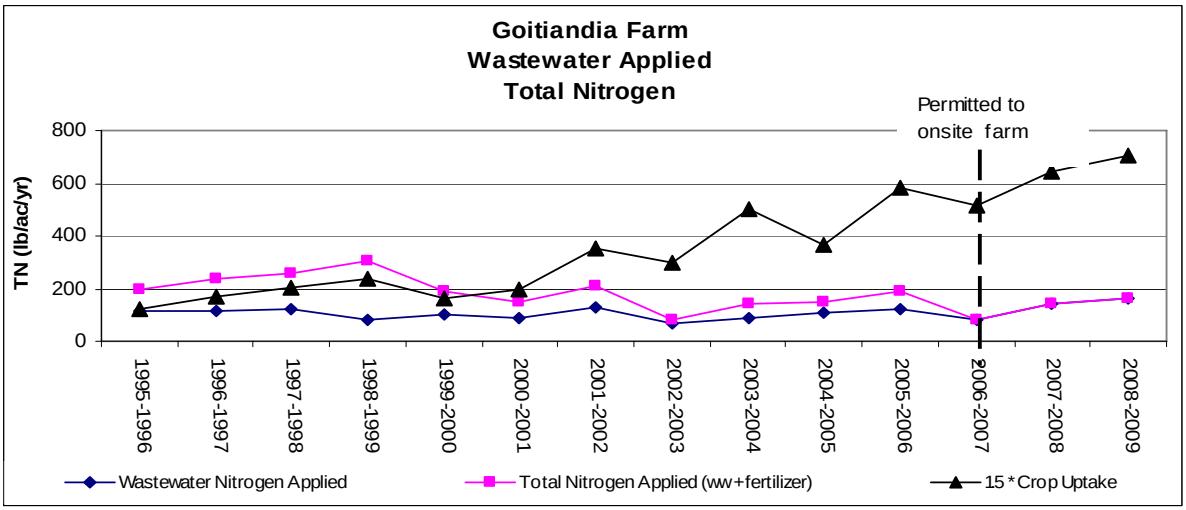
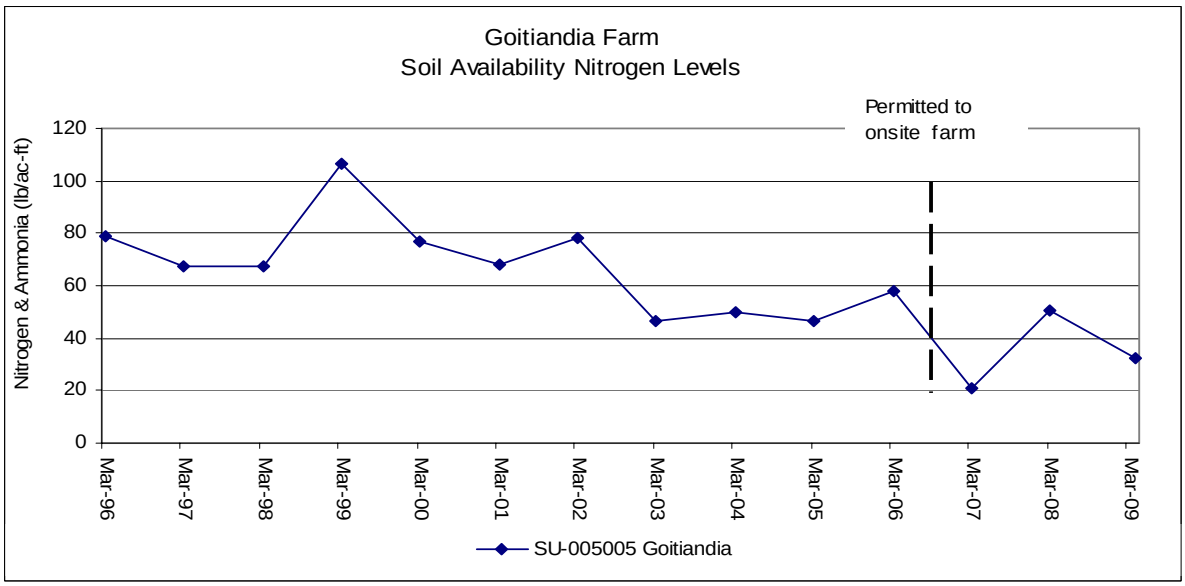
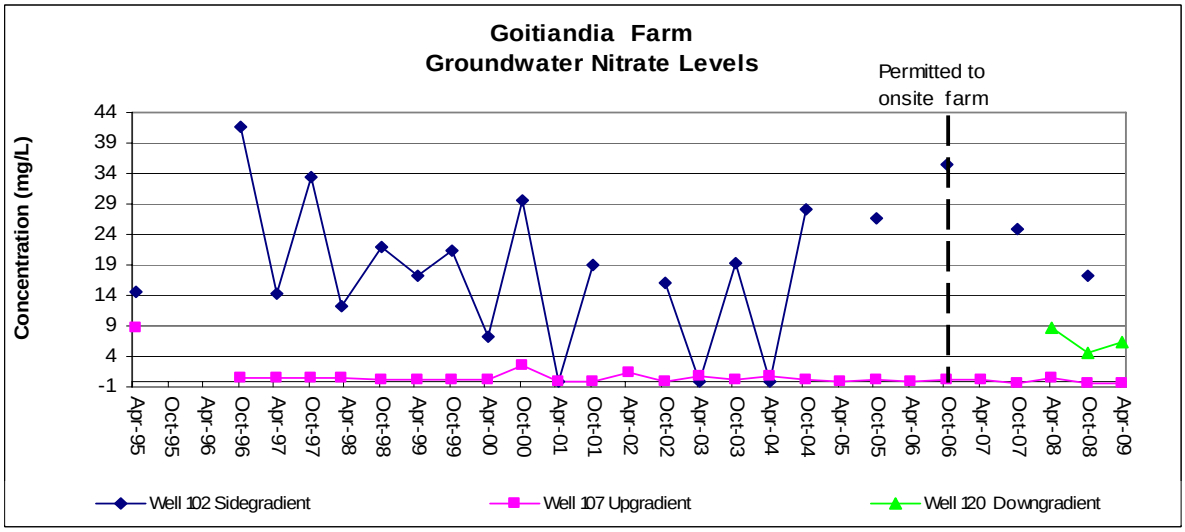



Figure 5-6 Nitrate Analysis - Goitiandia Farm



**Nitrogen**

As mentioned, this MU has historically received only high quality condensate and this condensate is high in ammonia nitrogen. Thus the primary controlling factor for loading this MU is the nitrogen load. Until TASCO purchased the MU, farmers used their own agronomist to judge the nitrogen needed to cultivate a crop. It was always difficult to convince the farmer to lower his nitrogen application when consultants were saying to add. The advent of greater TASCO control of the nitrogen loading can be seen in Figure 5-6 (previous page). The wider separation of the crop uptake vs. the total nitrogen load shows the benefits of tighter control of nitrogen applications. The soil nitrogen levels show a steady decline and the nitrate levels in MW 120 are at an acceptable level.

## 5.4 East Gillette Farm (MU-005005)

In February of 2003, TASCO notified the Department of the purchase of the East Gillette (MU-005005) management unit. In fall of 2006, TASCO requested a modification to the permit reflecting the East Gillette Management Unit (MU) be transferred from offsite to onsite and on November 30, 2006 IDEQ granted that request.

Dissolved solids and nitrogen monitoring results for the East Gillette Farm are shown on Figures 5-7 and 5-8, respectively. Along with wastewater and soils data, wastewater land application performance on the Goitiandia Farm is monitored using the following groundwater wells:

- Well 107 (upgradient of the acreage)
- Well A (upgradient of the acreage)
- Well 121 (downgradient of the acreage)

**Dissolved Solids**

This MU has historically only received condensate water and the NVDS load as seen in Figure 5-7 shows minimal annual loads of less than 250 lbs/ac/yr. The soil EC is generally around 1000 umhos/cm with occasionally fluctuations as high as 1400 umhos/cm. Through 15 years of application of high quality condensate subsequent to incorporation into the wastewater land application program, we can see how a field taken from normal farming practices would react with minimal dissolved solids applications.

With the transfer of the Goitiandia MU to onsite status, TASCO was granted the opportunity to apply not only condensate but process water as well. This authorization included the requirement to install additional monitoring wells. Thus well 121 was installed immediately downgradient of the Goitiandia MU. As can be seen, TDS levels in this well are much lower than the seasonal high and just slightly higher than the seasonal lows of the upgradient monitoring well 107. They are significantly lower than monitoring well A. It should also be noted that both of these upgradient wells show decreasing TDS trends reflecting management improvements at the TASCO facility (see LOWESS trend plots in Table 4-18). Both upgradient monitoring wells 107 and A show significant influence from the irrigation canal but the three samples taken from MW 121 are absent of this influence.

Figure 5-7 Dissolved Solids Analysis – East Gillette Farm

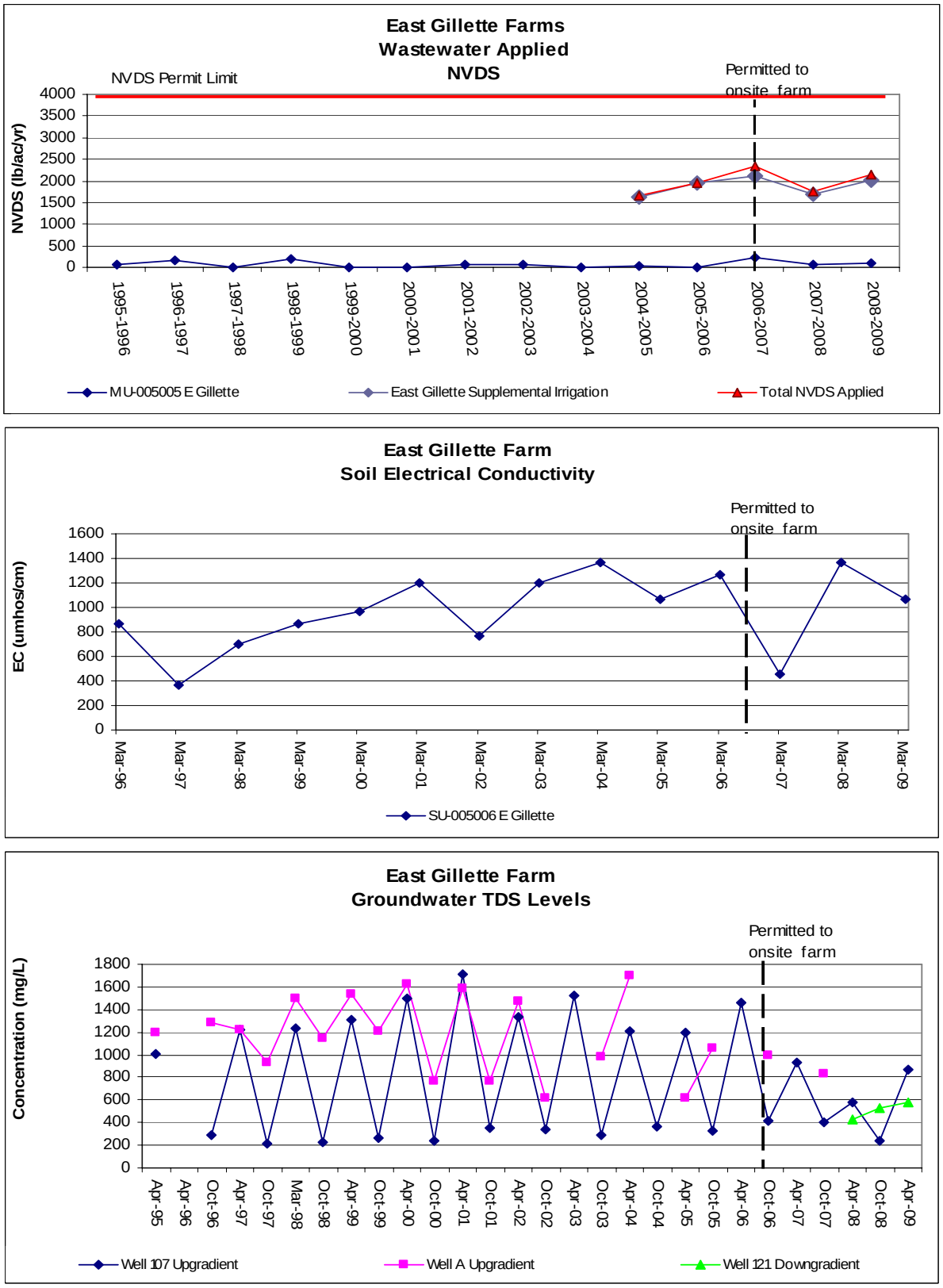
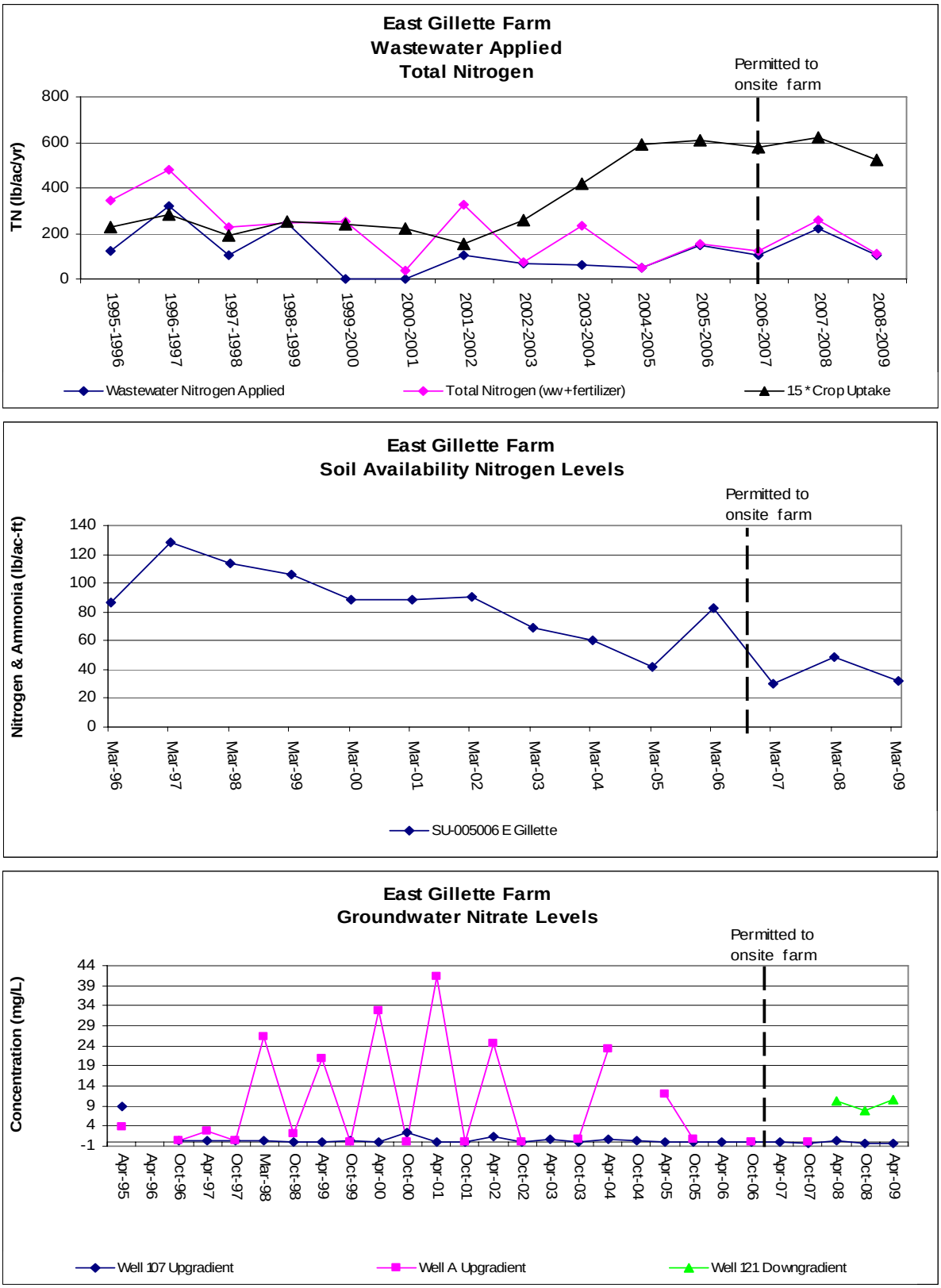


Figure 5-8 Nitrate Analysis – East Gillette Farm



TASCO requests the flexibility to utilize this field for process water application but inclusion of supplemental irrigation NVDS loads into the permit limit presents difficulties especially when process water is applied early in the growing season and the quality of supplemental irrigation varies through the crop year. As mentioned in the Goitiandia evaluation presented above, groundwater mixing zone models suggest that a wastewater application limit of 2,000 lbs/ac/yr of NVDS would be protective of the groundwater (see Section 4).

**Nitrogen**

With a similar history to the Goitiandia farm, this MU shows similar conditions. The effect of operating WLAP farms specifically as a nitrogen consumption tool can be seen by the plot of total nitrogen applied vs. the nitrogen crop uptake as seen in Figure 5-8. Like the Goitiandia, with the assumption of control, TASCO has been able to increase the separation between nitrogen application and nitrogen uptake. This effect is most notable in the soil available nitrogen levels showing a very evident reduction over the term of the permit. Lately, although the nitrate levels higher than desired, the decreased soil nitrogen and the significant difference between nitrogen application and crop uptake are expected to contribute to lower nitrate concentrations in the groundwater.

## 5.5 Seedall Farm (MU-005007)

The Seedall Management Unit has a good history of successful use for the application of process and condensate water. The dissolved solids and nitrogen monitoring results are shown in Figures 5-9 and 5-10 respectively. Along with wastewater and soils data, wastewater land application performance on the Seedall Farm is monitored using the following wells:

- Well 108 (¼ mile upgradient of the acreage)
- Well 109 (upgradient of the acreage)
- Seedall Well (downgradient of the acreage)

**Dissolved Solids**

NVDS loading on the Seedall property has consistently been below the permitted level. With the exception of four years with very low rates of NVDS loading, the Seedall averaged close to 1,800 lbs/ac/yr and on a few rare occasions solids loadings have approached but never exceeded the 2,500 lbs/ac/yr loading limit. Because the Seedall has an established NVDS loading limit not tied to irrigation water NVDS loads, the facility has been able to utilize the field for process water application relieving some of the NVDS load usually place on the East or South farms.

The soil EC concentrations on the Seedall are very similar to those found on the Goitiandia site which as previously mentioned has had very low NVDS loads applied. The salts in the soil show no adverse affect from the application of process and condensate water at the prescribed 2,500 lbs/ac/yr loading rates and continue to remain under 1,000 umhos/cm, which as mentioned earlier, is ideal for salt sensitive crops like alfalfa.

Figure 5-9 Dissolved Solids Analysis – Seedall Farm

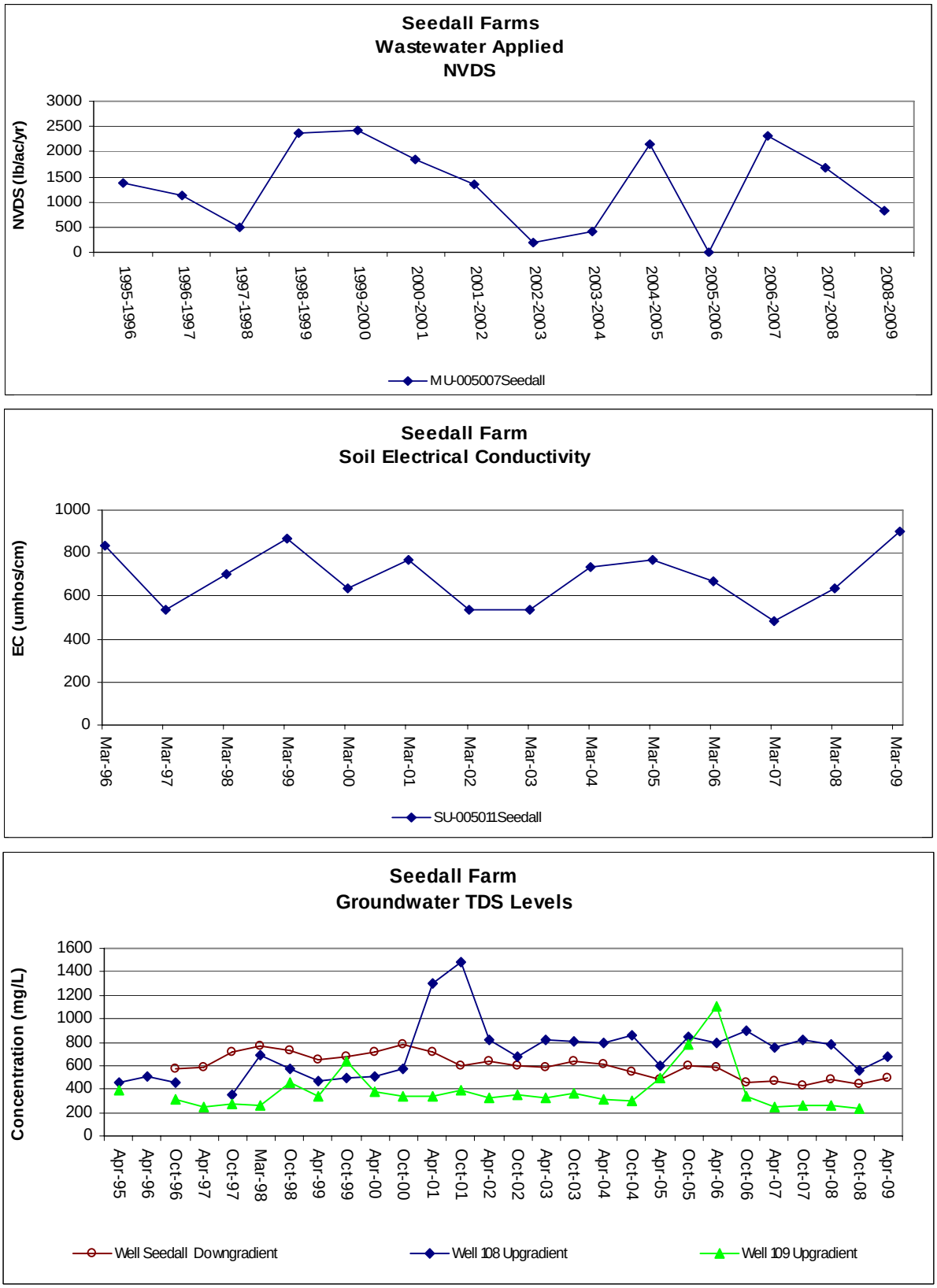
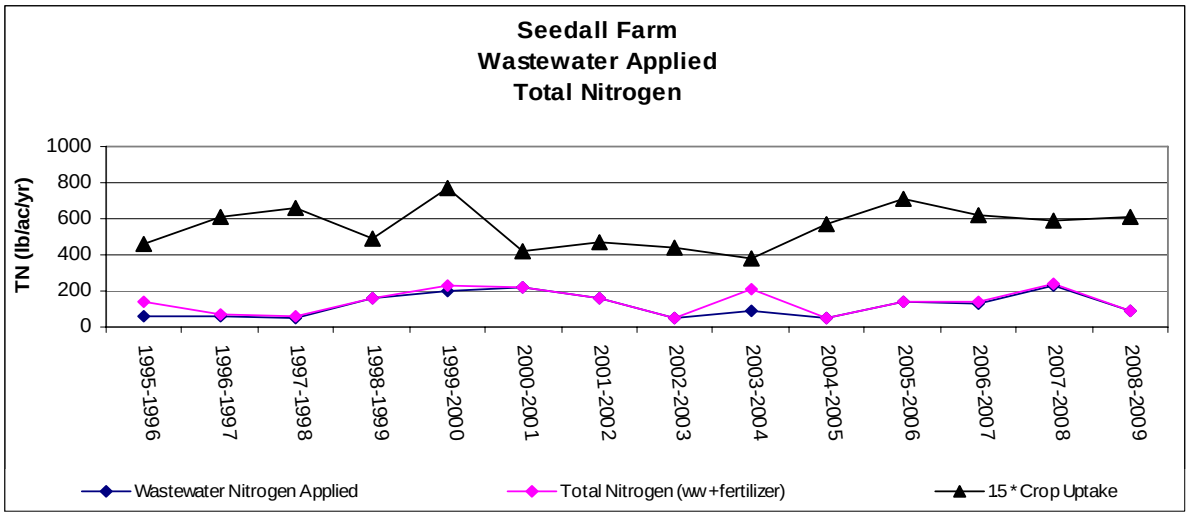
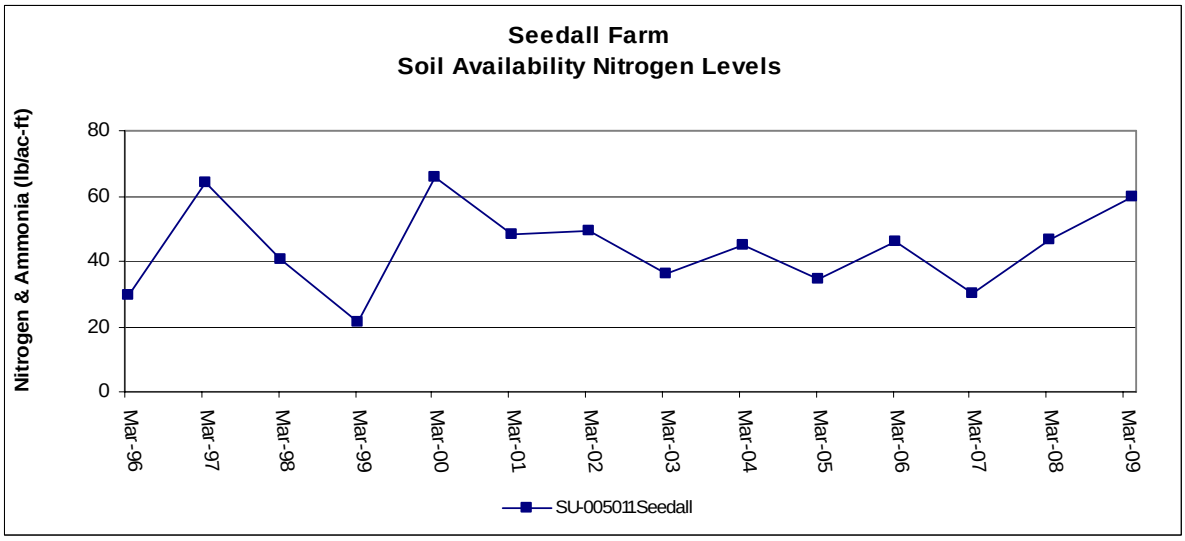
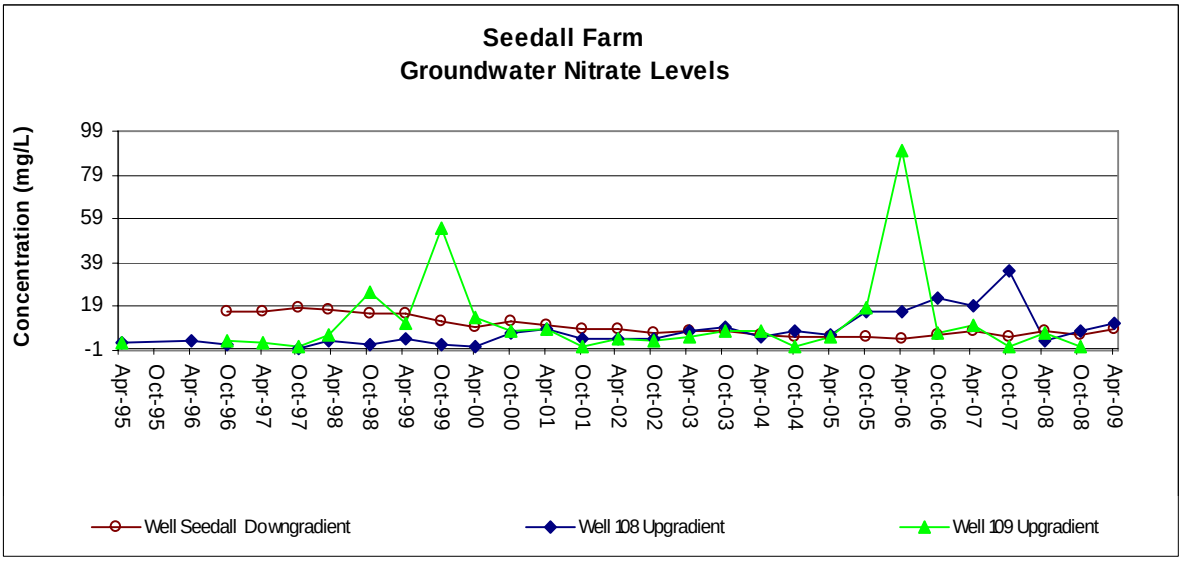


Figure 5-10 Nitrate Analysis – Seedall Farm



Background water quality is well documented for this property. Two monitoring wells are used to compare downgradient concentrations. One (Well 108) is about ¼ mile upgradient and slightly side gradient and Well 109 is directly upgradient of the site. TDS sample results for the downgradient Seedall well place it solidly between these two upgradient wells. There appears to be no discernable difference between upgradient and downgradient concentrations at the loading rates established for the Seedall farm. This data supports the opinion that the current average loading rate of 1,800 lbs/ac/yr (not the limit) has not impacted groundwater and that the field could assimilate a higher load further supporting a facility wide limit of 2,500 lbs/ac/yr as being protective of groundwater. Furthermore, the downgradient well (Seedall) shows a statistically significant decreasing trend for TDS reflecting a decreasing trend in the upgradient well (109) and also provides support that current management practices are not impacted groundwater for NVDS.

**Nitrogen**

The nitrogen load on the Seedall farm has consistently been below the permitted rates of 150% of crop uptake or 300 lbs/ac/yr. As a point of reference, soil nitrogen levels are generally higher than those found on the South farm or either the Goitiandia or East Gillette farms. However, as can be seen by the comparison of nitrate levels in the upgradient and downgradient monitoring wells, TASCO operations are improving local groundwater conditions. All three upgradient monitoring wells show significant variability with nitrate concentrations significantly higher than the 10 mg/L nitrate-N groundwater standard while the downgradient Seedall monitoring well shows significant improvement from early levels of 16-18 mg/L to current levels that are below the groundwater standard. The Seedall loading rates are protective of groundwater.

## 5.6 South Schow Farm (MU-005009)

The South Schow Farm (65 acres) was purchased in 1998 to replace field capacity lost with conversion of about 30 acres of the East Farm to wastewater storage lagoons. Dissolved solids and nitrogen monitoring results for both the South and North Schow Farms are shown on Figures 5-11a, 5-11b, 5-12a and 5-12b. For the South Schow, two monitoring wells (MW 114 and 115) were developed to sample groundwater before application started. The first groundwater samples were collected in April 1999 and initial wastewater application started in August 1999. The monitoring wells and their relative location to the application field are listed below.

- Monitoring Well 114 (upgradient of South Schow)
- Monitoring Well 115 (downgradient of South Schow-Upgradient of North Schow)

**Dissolved Solids**

Permitted NVDS loading to the South Schow is limited based on total load (NVDS from wastewater and supplemental irrigation) and NGS loading. As mentioned, the South Schow was purchased with the intent to replace lost land with the lagoon installations which would include the application of process water. While TASCO thinks limiting the total NVDS load 4000 lbs/ac/yr including supplemental irrigation restricts the ability to utilize the land, loadings have remained below the permitted 4,000 lbs/ac/year total load and the 642 lbs/ac/yr NGS

through the entire term of the permit. Figure 5-11a shows the significant disparity between the NVDS load from wastewater applications and the NVDS load from supplemental irrigation.

Soil EC levels are at or below EC levels found in the Goitiandia or the East Gillette which as mentioned, has received very low NVDS loads (condensate wastewater application) and EC levels recorded on the South Schow are considered to be in the normal range for agricultural sites. An interesting note is that although the South Schow has received heavier loads than what has been applied to the North Schow, the soil EC levels on the North and South Schow farms are very comparable and closely mirror each other.

The groundwater was sampled three times before any application of wastewater to the farm showing TDS upgradient was between 648 and 718 for the three samples while downgradient samples were between 575 and 668 mg/L. Initially, TASCO applied only condensate wastewater and the TDS in downgradient monitoring well 115 started declining immediately. Currently, both up and downgradient monitoring wells produce TDS samples below the secondary groundwater standard of 500 mg/L. As illustrated in the LOWESS trend lines (Table 4-20), there is a decreasing trend for both MW-114 and MW-115; data in the 5 years shows a consistent downgradient TDS concentration below 500 mg/L.

**Nitrogen**

Nitrogen loading to the South Schow has been below the 250 lbs/ac/yr limit established in the permit.

Soil available nitrogen concentrations are generally around 30 lbs/ac with occasional fluctuations of +/- 10 lbs/ac. The soil available nitrogen levels are lower than the Goitiandia, East Gillette and the Seedall which are all considered very effectively managed units.

As mentioned previously, samples (upgradient and downgradient) were collected prior to applying any wastewater to the site. Nitrate concentrations in the initial samples were 5 mg/L in the upgradient well and 15 mg/L in the downgradient well. After TASCO purchased and started managing the unit as a nitrogen consuming wastewater land application farm, nitrates in the downgradient well 115 started declining. Curiously, upgradient monitoring well 114 appeared to be taking the opposite direction. By October 2002, MW 114 had a nitrate level of 20 mg/L (four times the initial sample) and this elevated nitrate concentration did not actually start dropping until October 2004. TASCO understands that the reduction in upgradient nitrate coincided with the local high school connecting their sewers to the local municipality operated wastewater treatment plant. Currently both upgradient and downgradient monitoring wells (MW 114 & 115) are below 5 mg/L. Wastewater land application has proven successful on the South Schow. This is illustrated in the LOWESS trend plots (Table 4-20) for nitrate-N, where there is a very strong decreasing trend in nitrate-N concentrations.

## 5.7 North Schow Farm (MU-005010)

The North Schow Farm (155 acres) was purchased in 1999 to augment field capacity and to assist in spreading the process wastewater application over a greater area to reduce the potential

impact to ground water. Four monitoring wells (MW 116, 117, 118 and 119) were developed to sample groundwater before application started. In addition to the installation of four new wells, downgradient monitoring well (MW 115) developed for the South Schow is directly upgradient of the North Schow and is used in comparative evaluations of groundwater quality.

The first groundwater samples were collected in October 1999 and initial wastewater application started in February 2000. The monitoring wells and their relative location to the application field are listed below.

- Monitoring Well 115 (upgradient of the North Schow)
- Monitoring Well 116 (sidegradient to upgradient North Schow)
- Monitoring Well 117 (downgradient of North Schow)
- Monitoring Well 118 (downgradient of North Schow)
- Monitoring Well 119 (sidegradient to downgradient of North Schow)

In addition to the for wells listed, the downgradient monitoring well (MW 115) for the South Schow is directly upgradient of the North Schow and is used in comparative evaluations of groundwater quality.

**Dissolved Solids**

Permitted NVDS loading to the North Schow is limited based on total load (wastewater and supplemental irrigation) and NGS loading. While TASCO thinks limiting the total NVDS load 4000 lbs/ac/yr including supplemental irrigation restricts the ability to utilize the land, loadings have remained below the permitted 4,000 lbs/ac/year total load and the 642 lbs/ac/yr NGS through the entire term of the permit. Figure 5-11a shows the significant disparity between the NVDS load from wastewater applications and the NVDS load from supplemental irrigation.

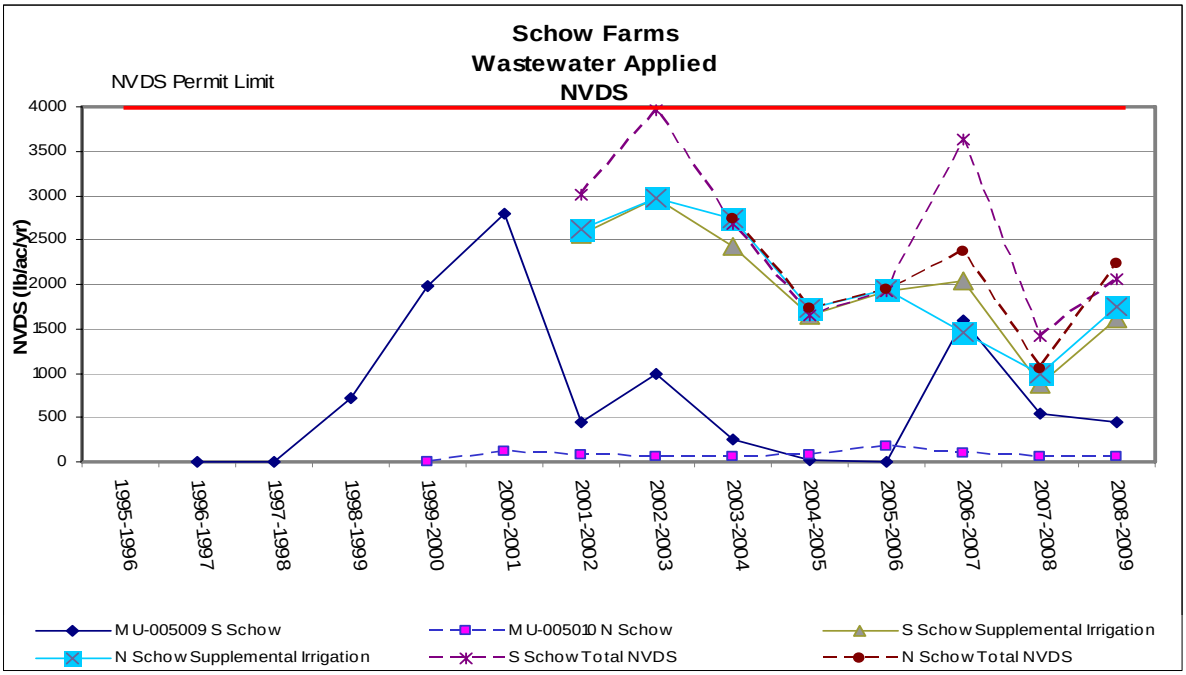
Soil EC levels are at or below EC levels found in the Goitiandia or the East Gillette which as mentioned, has received very load NVDS loads (condensate wastewater application) and EC levels recorded on the North Schow are considered to be in the normal range for agricultural sites.

NVDS loadings to the North Schow have been low. TASCO wants the flexibility to utilize this field for process water application but inclusion of supplemental irrigation NVDS loads into the permit limit presents difficulties especially when process water is applied early in the growing season and the quality of supplemental irrigation varies through the crop year. Because of the large volumes of supplemental irrigation required, small changes in canal water NVDS concentrations can have significant consequences with regard to the permit limit as it is currently structured.

The groundwater was sampled prior to any application of wastewater to the farm and TDS values up and side gradient were between 605 and 688 mg/L prior to any application of wastewater. To date, TASCO has applied only condensate wastewater and the TDS in the downgradient monitoring wells (117, 118 & 119) have decreased dramatically to concentrations in the range of 300 to 500 mg/L (Figure 5-11b) (also see the LOWESS trend lines in Table 4-22). Currently, both up, side and downgradient monitoring wells produce TDS samples below the secondary groundwater standard of 500 mg/L.

A groundwater mixing zone models were performed (see Section 4 Table 4-24) on the North Schow. The analysis concludes that the North and South Schow Farms could accommodate wastewater NVDS loading rates of 2,500 lbs/ac/yr and still be protective of groundwater quality.

Figure 5-11a Dissolved Solids Analysis - Schow Farms



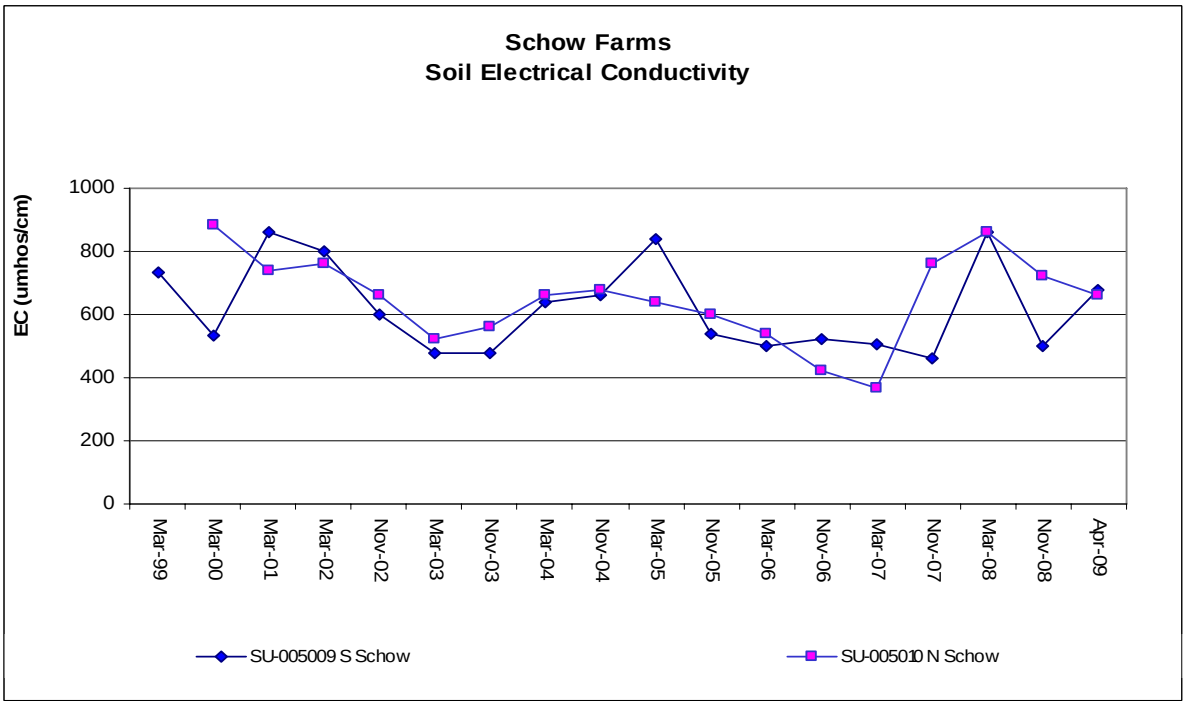
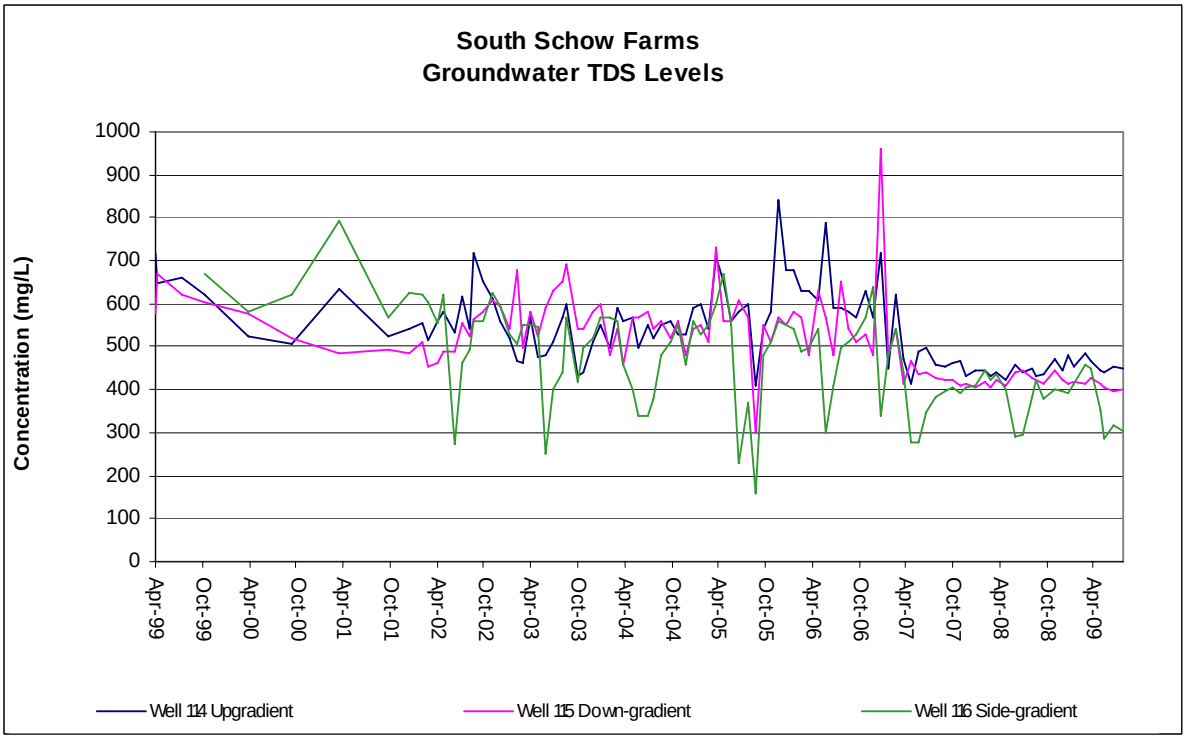



Figure 5-11b  Dissolved Solids Analysis - Schow Farms



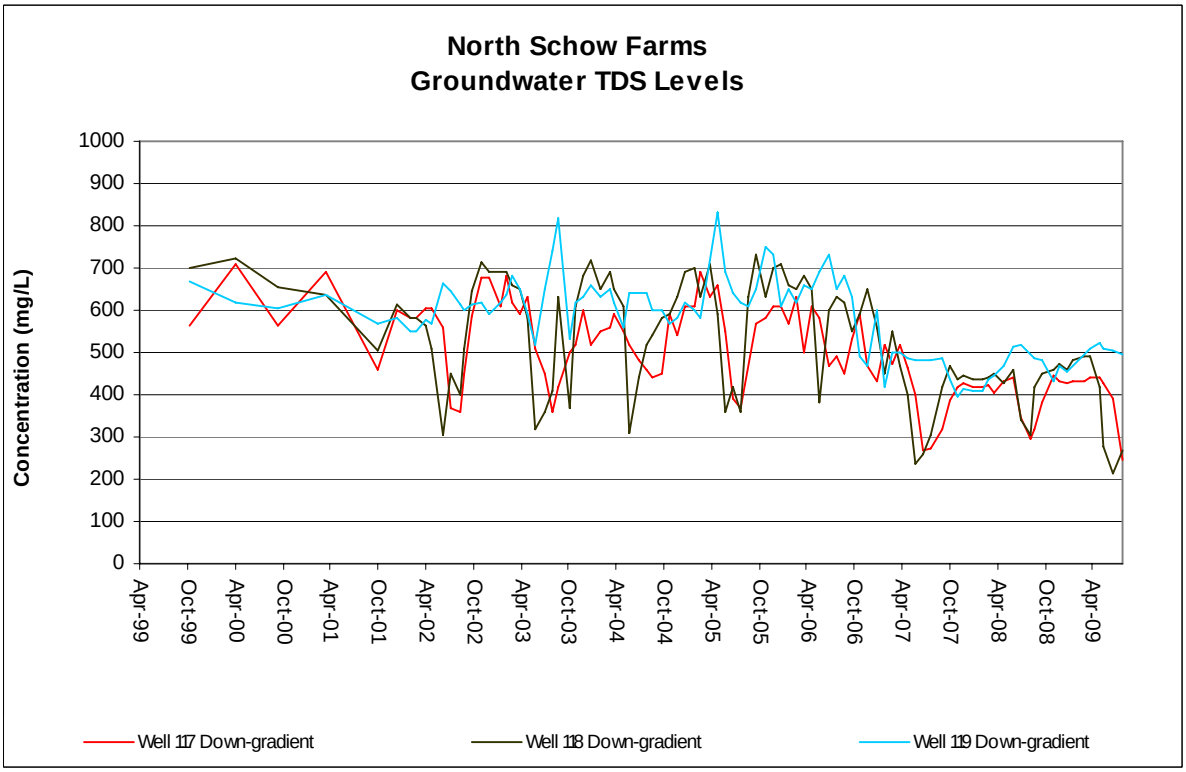
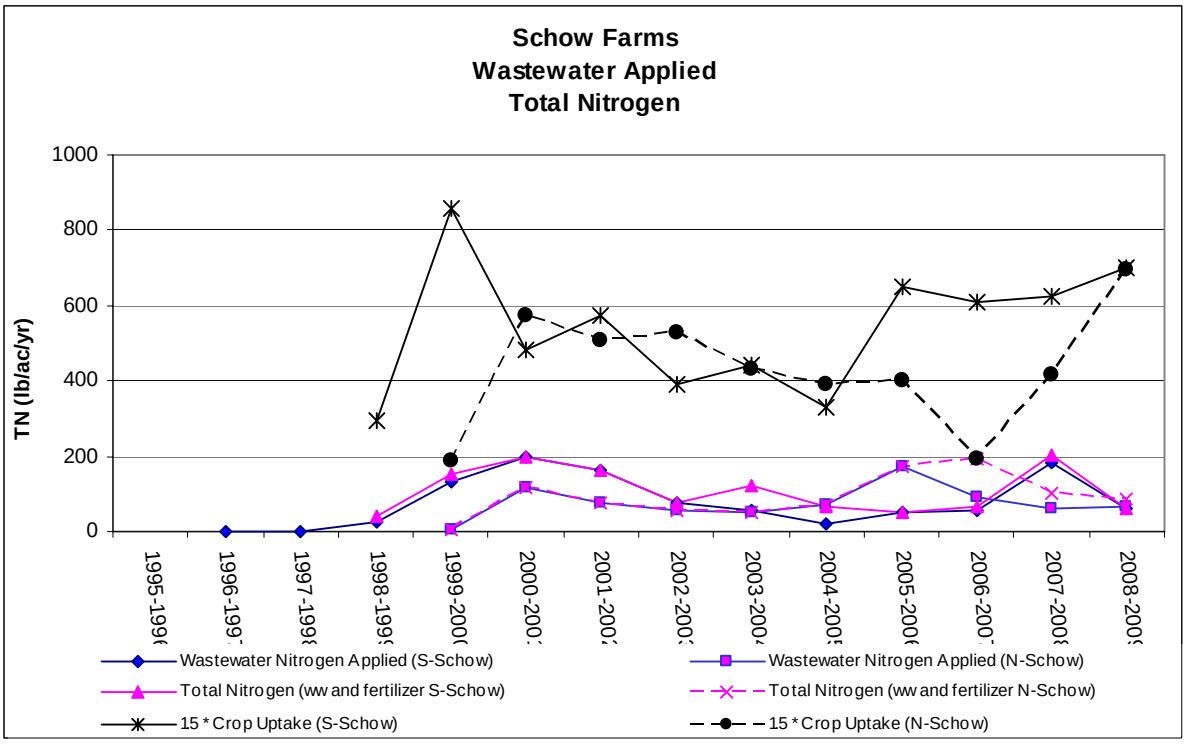



Figure 5-12a  Nitrate Analysis - Schow Farms



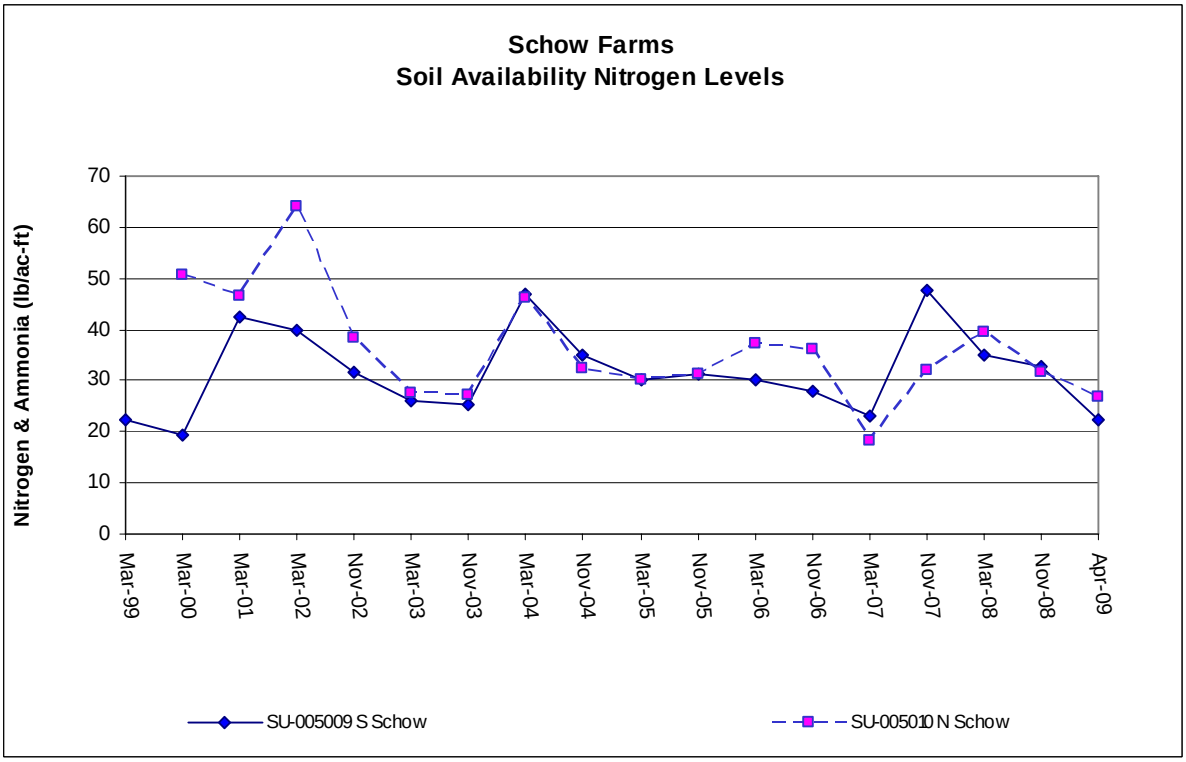
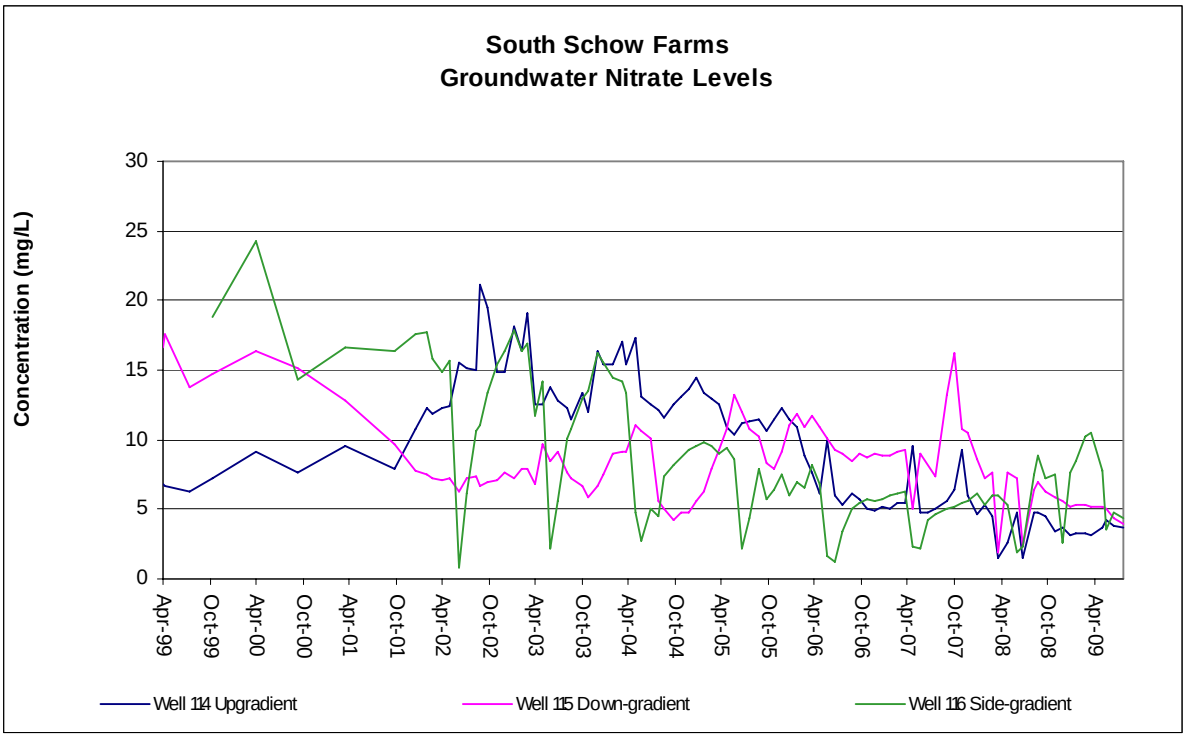
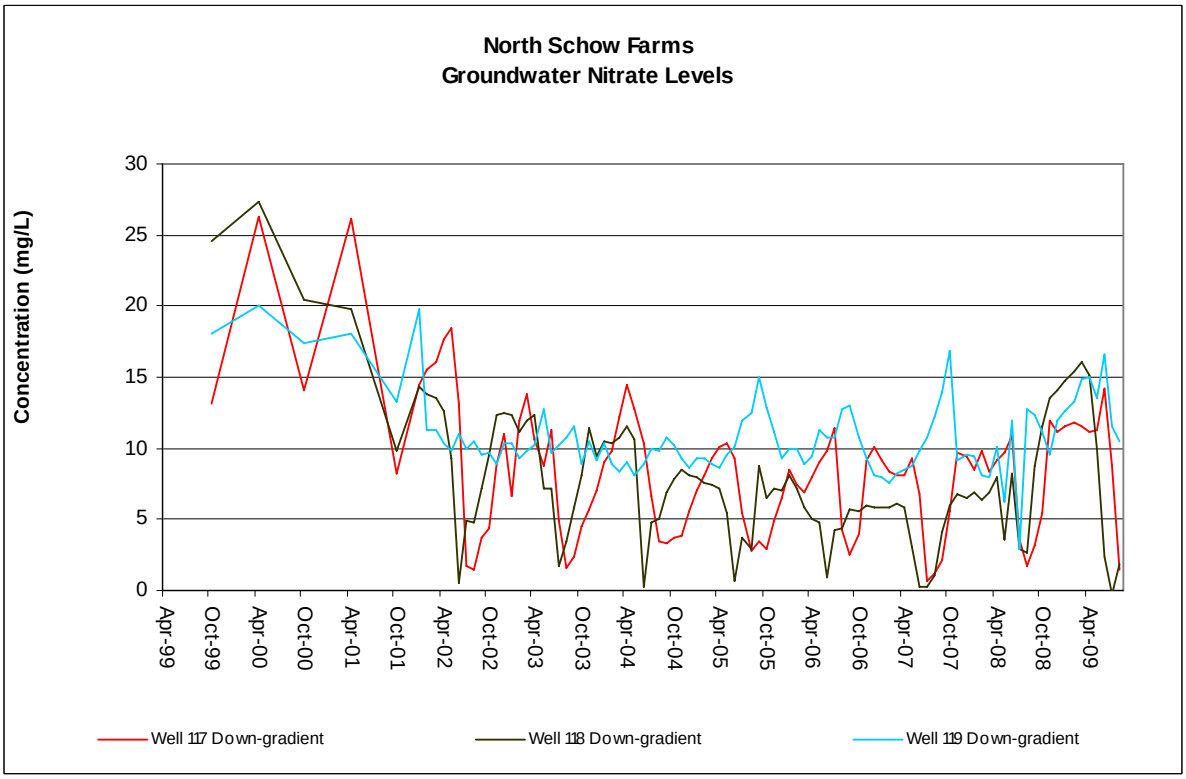



Figure 5-12b  Nitrate Analysis - Schow Farms



**Nitrogen**

Since its inclusion into the permit, nitrogen loading to the North Schow has been below the 250 lbs/ac/yr limit established in the permit.

Soil available nitrogen concentrations show values generally around 30 lbs/ac with occasional fluctuations of +/- 10 lbs/ac. The soil available nitrogen levels are lower than the Goitiandia, East Gillette and the Seedall which are all considered very effectively managed units.

As mentioned previously, samples (upgradient and downgradient) were collected prior to applying any wastewater to the site. Initial samples showed nitrate levels were 15 mg/L in the upgradient well (MW 115) and 15 to 25 mg/L in the downgradient wells (MW 117-118 & 119). After TASCO purchased and started managing the unit as a nitrogen consuming wastewater land application farm, nitrates in the downgradient wells immediately started declining. Wastewater land application has proven successful on the North Schow and TASCO management of the farm has contributed to improved groundwater conditions.

## 5.8 Offsite Farm

Some significant changes have been made to the offsite farm wastewater land application system. On November 27, 1996 the West Gillette property (155 acres) was added to the farms permitted as an offsite management unit (MU005008). After the 1997-98 crop year, the owners of the Fisk/Blacker acreage (MU 005006) had decided that wastewater from the TASCO facility did not fit their needs and have declined further opportunities. In February 2003 and again in January 2004, TASCO purchased the East Gillette (MU-005005) and the Goitiandia properties (MU-005004). These farms were part of the original 1996 WLAP and in November 2006 were administratively moved from offsite to onsite wastewater applications. This section will address those properties still listed as offsite management units.

Dissolved solids and nitrate monitoring results for the Offsite Farm are shown on Figures 5-13 and 5-14, respectively. Along with wastewater and soils data, wastewater land application performance on the Offsite Farm is monitored using the following groundwater wells:

- Well 107 (upgradient of the acreage)
- Well 102 (upgradient to West Gillette and Wilkins and Side Gradient to Fisk/Blacker)
- Well 112 (downgradient of the Offsite farm system)

The use of offsite farms for land application began in 1992. With the exception of the 1997-98 crop year when the Fisk/Blacker acreage was reduced to ½ its original size, TASCO applies less than the permitted hydraulic capacity (high-quality excess condensate) to offsite acreage. As these farms are private systems, TASCO has very limited control over the application of supplemental irrigation and chemical fertilizers. We are limited to reporting to the private owner, the total nitrogen load already applied and are subject to the production pressures the farmer is under to insure a viable crop and his desire to apply additional nitrogen fertilizer.

**Dissolved Solids**

During the current permit term, wastewater NVDS loadings have been very low. The highest loading rate was 120 lbs/ac/yr on the Wilkins (1998-99) and the West Gillette (2006-07). This is less than 20% of the permit limit. For the same period, the soil EC has fluctuated between 400 and 2000 *u*mhos/cm. As has been noted, we have applied very little wastewater to the offsite farms and the soil EC should be reflective of normal farming practices. As a comparison, TASCO's operation on the Seedall with a permitted loading rate of 2,500 lbs/ac/yr has an EC consistently between 500 and 900 *u*mhos/cm.

Upgradient wells 102 and 107 have the highest measured TDS concentrations. TDS concentrations decrease from the upgradient wells to downgradient well 112. Upgradient well 107 appears to be influenced by the facility grounds and canal. Little impact is expected from wastewater application due to the minimal volume and NVDS concentration of the condensate water applied to the offsite farming system.

Because of it limited potential for use, TASCO requests the Fisk/Blacker Management Unit be removed from the permit.

**Nitrogen**

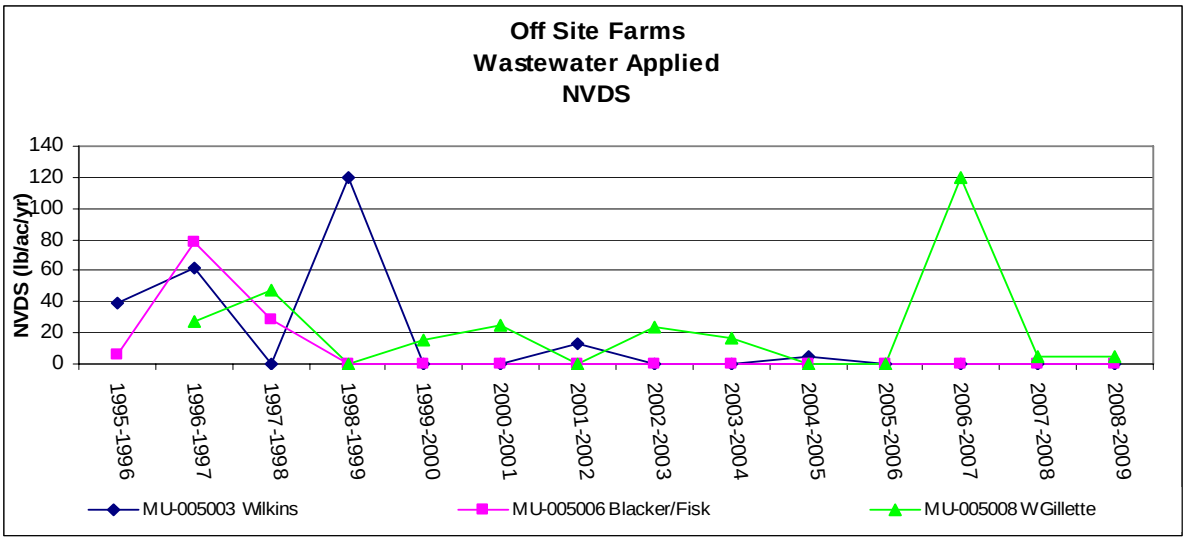
In the early part of this permit term, wastewater nitrogen loading levels varied between 50 to 250 lb/ac-yr but for the last 10 years wastewater nitrogen loading has been less than 100 lbs/ac/yr. Even though TASCO has only limited influence on the amount of nitrogen the farmers wish to apply, the available nitrogen in the soil has continued to drop from a high of 100 lb/ac-ft to levels between 40 and 60 lb/ac-ft. The wastewater nitrogen applied to the offsite acreage is predominately ammonia and the amount of nitrogen applied is conservatively estimated using pond concentrations and quantity of water applied. A study was conducted by TASCO to determine the amount of ammonia loss during sprinkler irrigation by ammonia volatilization. Based on the study, approximately 56 percent of the ammonia reaches the soil.

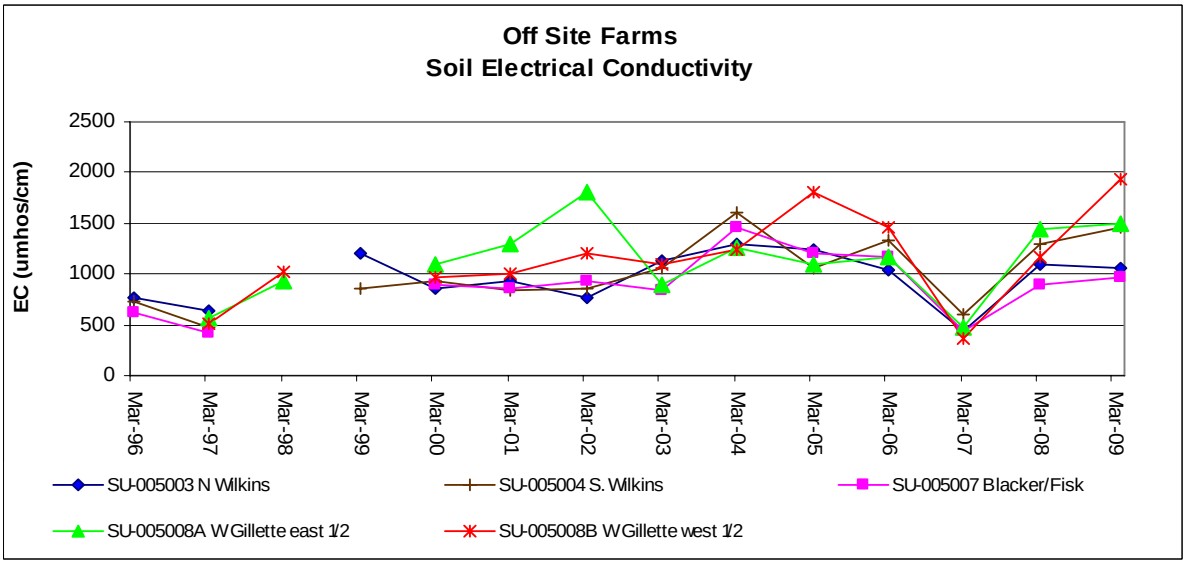
Offsite soil nitrogen levels include nitrogen from fertilizers and condensate. The fertilizer nitrogen is applied by the farmers and TASCO can only suggest limited nitrogen application.

In general, nitrate concentrations in upgradient (well 107) and downgradient of the Offsite Farm (well 112) are lower than upgradient (well 102).

- Upgradient well 107 has consistently low nitrate levels (generally less than 2 mg/L).
- Upgradient well 102 (sidegradient to Fisk/Blacker) has the highest nitrate concentrations, typically above the MCL of 10 mg/L. This well is adjacent to a small livestock feedlot.
- Downgradient well 112 shows nitrate concentrations similar to monitoring well 107 (generally less than 4 mg/L) and has been consistently below levels of concern.

Figure 5-13 Dissolved Solids Analysis - Off Site Farms



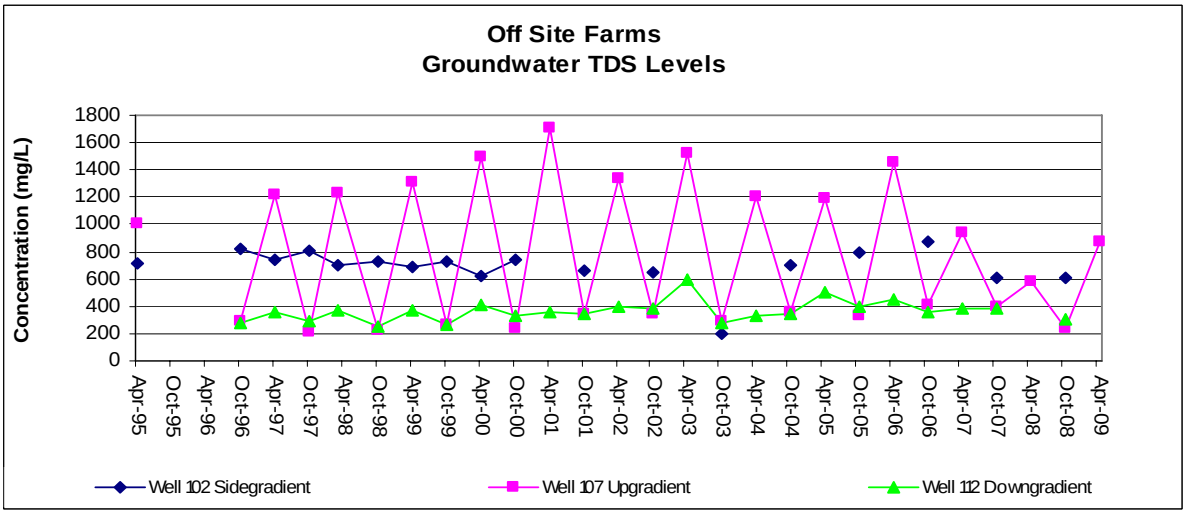
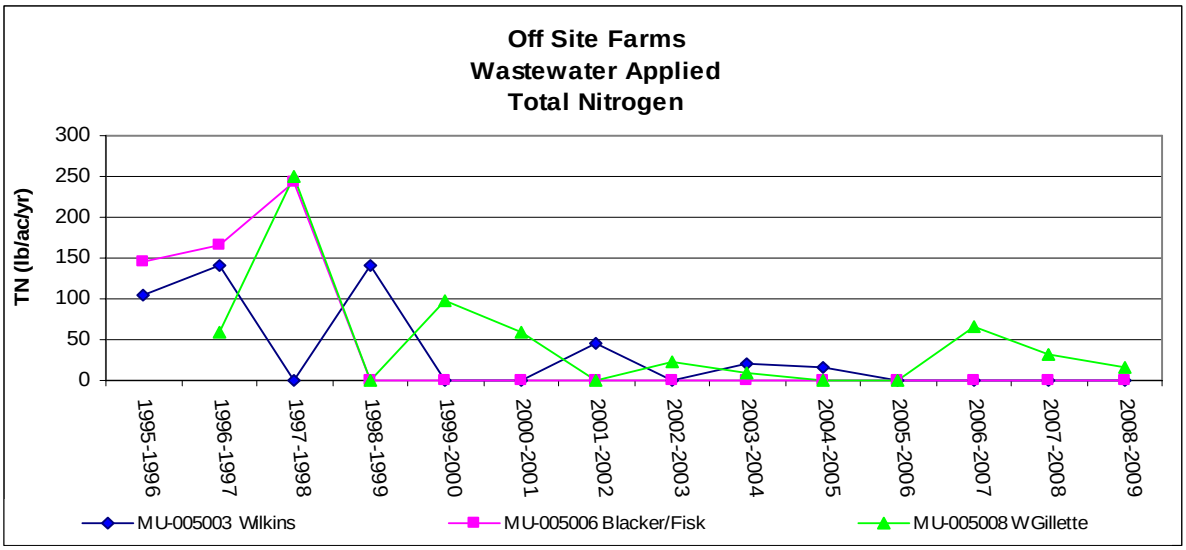
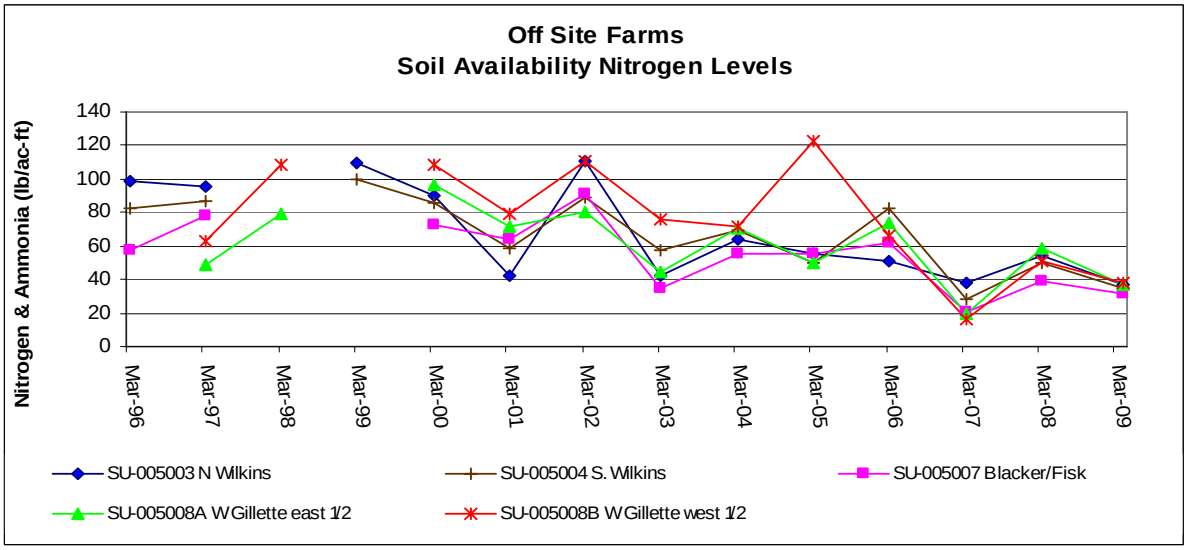
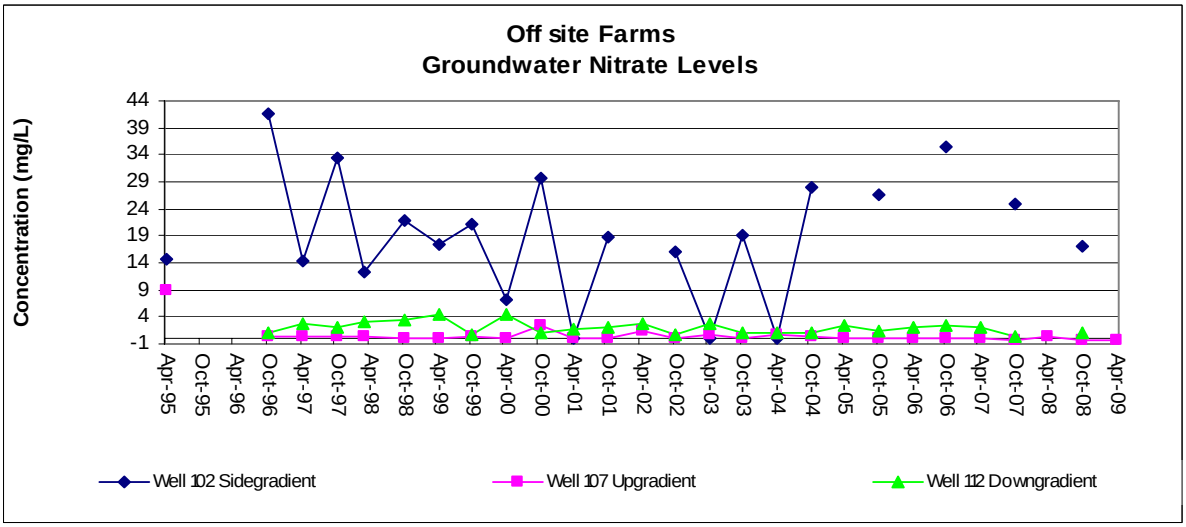



Figure 5-14 Nitrate Analysis - Off Site Farms



Current permitted nitrogen and hydraulic loading limits are based on criteria designed to protect groundwater. In order to reduce the overall nitrogen loadings, TASCO purchased the North and South Schow Acreage as well as the Goitiandia and East Gillette properties. TASCO is looking further into the purchase of additional land to maintain consistent control over the application of nitrogen.

## 5.9 Facility Ponds/Facility Grounds

Groundwater quality in the vicinity of the facility grounds and wastewater treatment ponds is monitored utilizing upgradient well N midgradient well M and downgradient wells A and 107. Nitrate and TDS concentrations for these wells are plotted in Figure 5-15 and 5-16. The downgradient wells show seasonal fluctuations most likely influenced by the Minidoka Canal and potentially seepage from the facility ponds. However, each pond has been seepage tested in accordance with the requirements of the current permit and after excavation, the mud pond has been relined with bentonite and retested. The seepage test data demonstrate that the ponds are in compliance with the limits set forth in the current permit.

To decrease the potential for groundwater impacts, the facility has, during the current permit, installed a dry lime handling system, continued to increase recycling and reduce water usage and invested significant time, energy and capital in solids separation systems to reduce the TDS load to the mud ponds.

Coinciding with the implementation of the dry lime handling system, monitoring well M has shown a decrease in TDS. With focus now on reducing the solids load to the mud ponds, TASCO foresees a TDS decrease in the downgradient monitoring wells A and 107 and this decrease has already become evident (see TDS LOWESS trend lines in Table 4-18 for Wells 107 and A). TASCO addresses changes in mud and dry lime handling system in Section 6.0.

Section 4 further evaluates all groundwater monitoring wells including those up and downgradient of the facility. Dr. Michael R. Murray of HDR Inc performed a statistical analysis of each well using the Mann-Kendall test. His findings are reported in Table 4-13 and report that significant decreasing trends were identified in 14 wells and no wells showed a statistically significant increasing trend for TDS and only well 108 (upgradient of the East and Seedall Farms) and well E (downgradient of the East Farm) showed an increasing nitrate trend. As mentioned in the discussion on the East Farm, top soils from the western 20 acres were used to construct the lagoon complex and soils were replaced with reclaimed mud pond solids. Soil nitrate levels are declining and TASCO expects to see a corresponding decline in groundwater nitrate levels.

Figure 5-15 Dissolved Solids Analysis – Facility Wells

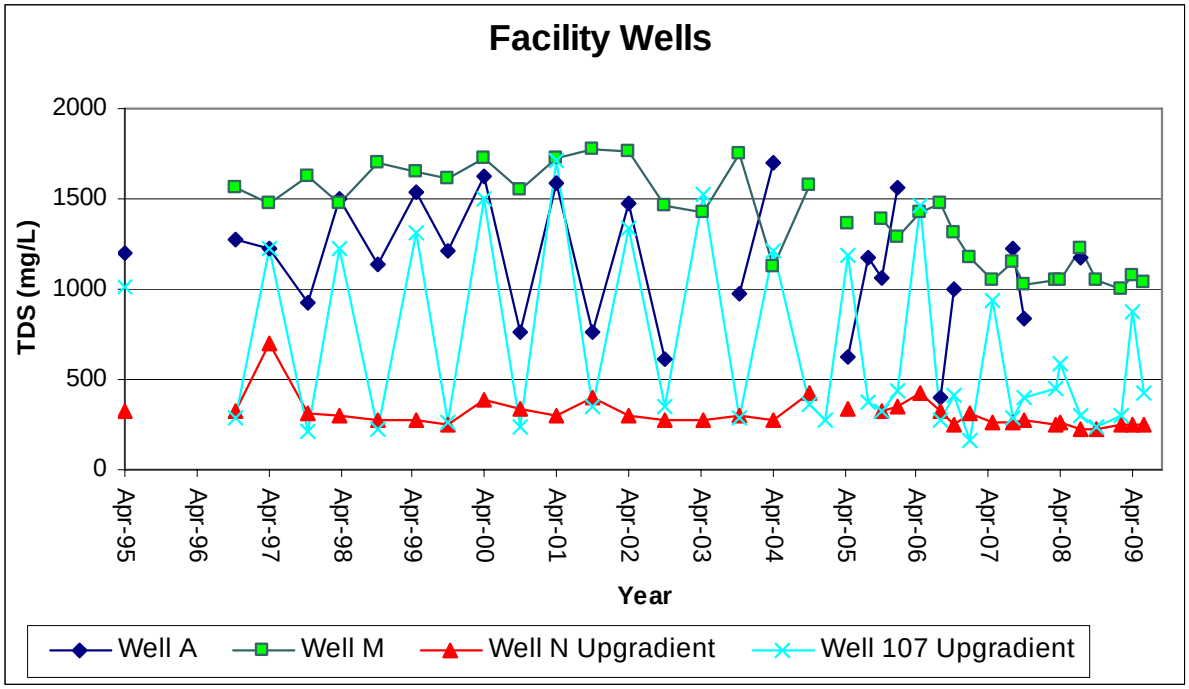
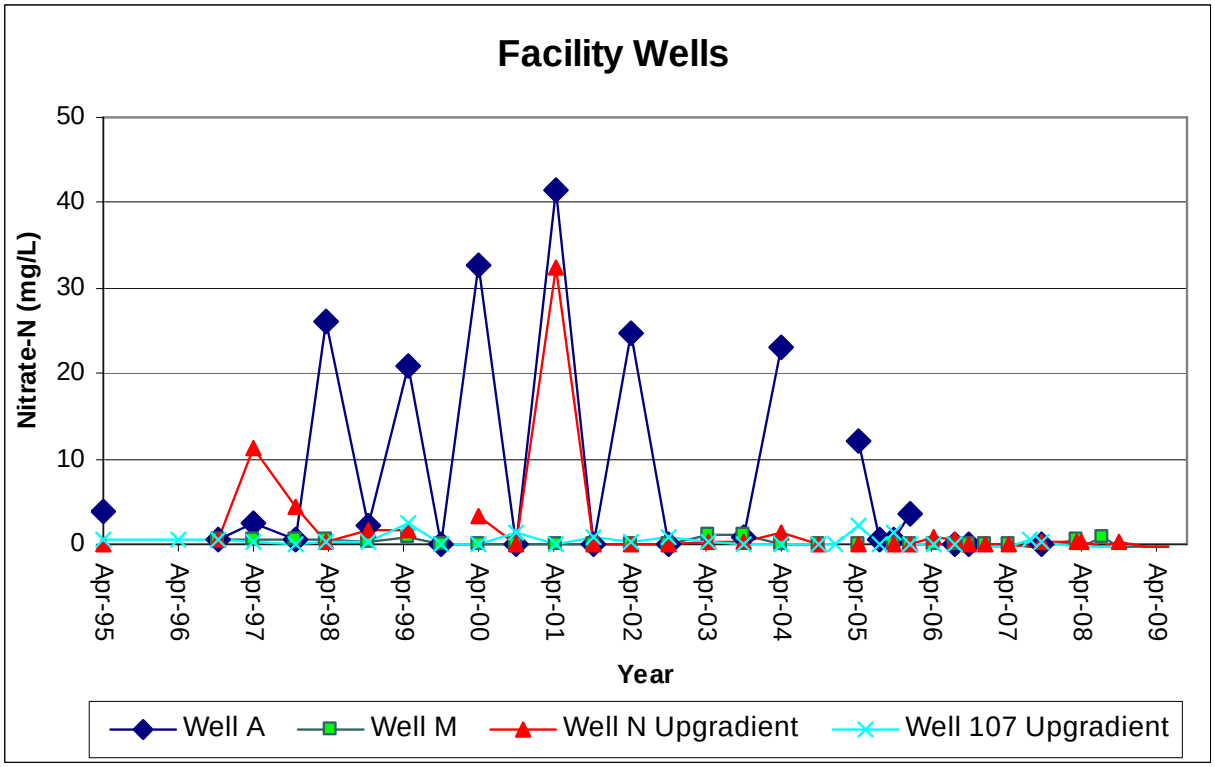



Figure 5-16 Nitrate Analysis – Facility Wells



# 6.0 Proposed Management and System Modifications

This section details the proposed loading rates for each farm or management unit, future improvements, and monitoring for the permit renewal for the Mini-Cassia facility. Most of the proposed loading rates remain unchanged because they are within or well below established guidelines and appear to be providing effective treatment of the wastewater. However, a few changes are being requested. Justification for the following changes will be discussed.

1. Define the NVDS loading to the North and South Schow management units as 2,500-lbs/ac/yr of wastewater application. (Not to include supplemental irrigation NVDS loading limits).
2. Define the NVDS loading to the Goitiandia and East Gillette management units as 2,000-lbs/ac/yr of wastewater application. (Not to include supplemental irrigation NVDS loading limits).
3. Define the nitrogen loading to the North and South Schow properties as 150% of crop uptake or maximum of 300 lbs/acre/year.
4. Set the non-growing season hydraulic loading rate at the values defined in Table 4-7.
5. Reduce groundwater sampling at the North and South Schow properties and the facility wells to semi-annual, consistent with the other management units. TASCO has been conducting monthly monitoring which is no longer justified in light of available data.
6. Reduce the soil monitoring requirements for the North and South Schow to once a year (April) and to a depth of 3 feet (similar to the other management units).
7. Update the permit to show the East Farm is 60 acres.
8. Remove the Fisk/Blacker management unit from the permit.
9. Request language in the permit to allow the summer time application of wastewater to solids storage piles and dirt roadways as a dust suppressant. The rate of application will not be more than the evaporation rate or ¼ inch per day which ever is lower.

## 6.1 Land Application System Loading Rates

Based on the evaluation of the site conditions (Section 4.0) and the results of the Land Application System Performance Assessment (Section 5.0), the following loading rates are proposed (Table 6-1). These proposed loading rates represent “best management practices” for the land application system. Growing season hydraulic loading rates are based on the crop consumptive use and irrigation efficiency. Non-growing season loading rates are conservatively based on the water holding capacity of the soils. Organic and phosphorus loading rates are based on IDEQ guidance. Proposed changes from the previous permit (shown in bold in Table 6-1) are as follows:

**Table 6-1 Proposed Loading Rates to the Management Units**
TASCO Mini-Cassia

| Acreage/Site Loading Limits | Onsite Acreage East Farm MU-005001 | Onsite Acreage South Farm MU-005002 | Onsite Acreage Goitiandia MU-005004 | Onsite Acreage East Gillette MU-005005 | Offsite Acreage Wilkins MU-005003 West Gillette MU-005008 | Onsite Seedall Acreage MU-005007 | Onsite South Schow MU-005009 | Onsite North Schow MU-005010 |
|---|---|---|---|---|---|---|---|---|
| Acres | 60 | 27 | 87 | 89 | 315 | 35 | 65 | 155 |
| WW Hydraulic Loading Total (in.) | Crop Consumptive Use Divided by Irrigation | Crop Consumptive Use Divided by Irrigation | Crop Consumptive Use Divided by Irrigation | Crop Consumptive Use Divided by Irrigation | 9.5 | Crop Consumptive Use Divided by Irrigation | Crop Consumptive Use Divided by Irrigation | Crop Consumptive Use Divided by Irrigation |
| WW Hydraulic Loading NGS (in.) | 7.8 | 8.5 | 10.2 | 10.2 | 10.2 | 8.2 | 7.9 | 9.4 |
| WW NVDS Loading lbs/ac/yr | 7,600 | 7,600 | 2,000 | 2,000 | 642 | 2500 | 2,500 | 2,500 |
| GS COD Loading lb/ac/day | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| NGS COD Loading lb/ac/day | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| Nitrogen Loading lbs/ac/yr (Includes fertilizer application and WW nitrogen loadings) | 150% of crop uptake or 300 lbs/ac/yr | 150% of crop uptake or 300 lbs/ac/yr | 150% of crop uptake or 300 lbs/ac/yr | 150% of crop uptake or 300 lbs/ac/yr | 150% of crop uptake or 300 lbs/ac/yr | 150% of crop uptake or 300 lbs/ac/yr | 150% of crop uptake or 300 lbs/ac/yr | 150% of crop uptake or 300 lbs/ac/yr |

**Manning Acreage**:
The Manning is not part of the land application permit. This acreage is used as a solids staging and beet storage area.

**Fisk/Blacker Acreage:**
TASCO is requesting to remove the 74 acre Fisk/Blacker property (MU-005006) from the land application permit. This property has not been utilized since 1998.

**Hydraulic Loading Limits**
After discussions with IDEQ, annual hydraulic loadings limits were removed because the facility's application rate is nitrogen and NVDS limited and as such additional constraints are unnecessary. The groundwater is adequately protected under these constraints. The proposed non-growing season hydraulic loading rates are calculated using the estimated available water holding capacity (AWC) of the soils, plus evaporation, minus precipitation. This was discussed in section 4.0 and non-growing season limits are listed in Table 4-8 of that section.

**Wastewater NVDS Limits**
**East and South Farm NVDS Limits**: Proposed limits for East and South management units were established in 1995 at 7,600 lbs/ac/yr. Although permitted at 7,600 lbs/ac/yr, the facility has never applied at this rate. Because the facility has separated recyclable condensate water from process water, the latter has increased in concentration. TASCO desires the ability to more evenly distribute this load across the entire WLAP system but with increased NVDS concentrations, smaller volumes are required to meet the NVDS limits as currently established.

Over the past 14 years, the South Farm has received an average of 1879 lbs/ac/yr and has never approached the limit. In the past 14 years, NVDS application to the South farm has exceeded 2,500 lbs/ac/yr four times yet data in Sections 4 and 5 show a decreasing trend in the groundwater TDS concentrations. Soil EC levels (Figure 5-3) have consistently been in the normal range for agricultural uses.

During the same time period, the East Farm has received an average of 1,080 lbs/ac/yr and has been over 2,000 lbs/ac/yr twice (never approaching the limit). Although the groundwater analysis in Section 4 is inconclusive and shows no change over the permit period, Figure 5-1 shows how utilizing the topsoil for lagoon construction and adding reclaimed mud pond soil has increased the salt load on the soils. No reclaimed soil was added to the eastern half of the property and the soil conductivity is in the normal range for agricultural sites.

Because other onsite management units currently do not have permit limits that allow flexibility when managing the significant NVDS loads from process water, TASCO needs to maintain the current NVDS limits on the East and South Farms. If IDEQ will allow the proposed NVDS loading limits, TASCO is willing to accept lower limits on the East and South Farms.

**North and South Schow Acreages**:
Because of their similarity and the proximity to each other, the North and South Schow management units will be discussed in common terms as will the Goitiandia and East Gillette farms.

Current loading limits on the Schow Farms are restrictive and tied to the NVDS applied with supplemental irrigation. Because the quality of supplemental irrigation water is quite variable, it is difficult if not impossible to effectively manage solids loading when the primary source is unknown, unreliable or inconsistent.

Proposed NVDS limits for North and South Schow are supported by the groundwater mixing zone analysis presented in Section 4. The output from the analysis is presented in Appendix 4-4. The results, presented in Table 4-23 suggests that at a normal leaching rate of 5 inches and the average hydraulic conductivity for the respective field will allow less than a 10% increase in TDS concentration at a loading rate of 2,500 lbs/ac/yr. The mixing zone analysis supports TASCO's contention that a NVDS limit of 2,500 lb/ac/yr can be applied on both management units without significant impact to the groundwater.

**Goitiandia and East Gillette Acreages:**
Current loading limits on the Goitiandia and the East Gillette are restrictive and tied to the NVDS applied with supplemental irrigation. Because the quality of supplemental irrigation water is quite variable, it is difficult if not impossible to effectively manage solids loading when the primary source is unknown, unreliable or inconsistent.

Proposed NVDS limits for the Goitiandia and East Gillette are supported by the groundwater mixing zone analysis presented in Section 4. The analysis is presented in Appendix 4-4. The results, presented in Table 4-24 suggest that at a normal leaching rate of 5 inches and the average hydraulic conductivity for the fields, a loading of 2,000 lbs/ac/yr will produce less than a 10% increase in TDS.

**Seedall:**
No changes in NVDS loading are requested for the Seedall acreage.

**Offsite (Wilkins and West Gillette) Acreages:**
These fields receive only high quality condensate water, no process water. Condensate water is very low in NVDS and the current limits are acceptable.

**Yearly Average COD Limits**
Yearly average COD limits will be calculated based on a seasonal average. No changes are requested for the growing or non-growing season COD loading rates.

**Nitrogen Loading Limits**
**Schow Acreages:** The current nitrogen loading limit for the Schow acreages are 250 lbs/ac/yr total nitrogen with the maximum of 150 lbs/ac/yr for the non-growing season. TASCO is proposing a nitrogen loading limit of 150% of crop uptake or 300 lbs/ac/yr. As stated in Section 4 statistical analysis of nitrogen levels in the groundwater, decreasing trends are occurring

across the Schow properties. Since TASCO purchased the properties in 1999 and 2000 respectively, the nitrate levels have decreased due to proper management of the land application sites.

**Phosphorous Loading Limits**

Wastewaters produced at TASCO's Mini-Cassia facility are very low in phosphorous. Actual phosphorous loadings at the WLAP management units are typically in the 10 to 20 lb/ac/year range. Crop uptake of phosphorous is normally in the 40 to 60 lb/ac/yr range. The liming process precipitates out phosphorous therefore, TASCO feels a phosphorous limit is not necessary. As such, TASCO feels a phosphorous limit is not necessary. It is understood that IDEQ follows the guidelines that limit phosphorous where there is the potential for elevated phosphorous in soils and the potential to impact surface water. The facility is not near a stream or river and the soils are not heavily loaded with phosphorous. TASCO requests the removal of a phosphorous limit from the permit.

## 6.2 Future System Improvements

As always, TASCO must carefully evaluate capital expenditures and develop innovative, cost effective solutions that provide the greatest environmental benefits. Capital expenditures must be planned for all three TASCO sugar beet processing facilities.

The Mini-Cassia facility has proactively improved the mud solids separation system and is actively investigating technology that will allow further reductions in the volume of mud solids held in the mud ponds. The facility has already implemented dry lime handling and is actively investigating further cost reducing environmental beneficial projects.

Early in the current permit term, TASCO purchased 35 acres of land (Manning Acreages) east of the mud pond. TASCO has used this land as a staging area to allow farmers access to good clean fill and top soil. This has allowed the Mini-Cassia facility to dispose of all mud/soil brought in with the beets.

TASCO is considering further land acquisition for inclusion into the WLAP program. If this is accomplished, TASCO will make appropriate contacts with IDEQ and follow the necessary application procedures to insure inclusion into the WLAP program.

## 6.3 Monitoring

**Groundwater Monitoring**

Monitoring of the land application system, including wastewater, soils, and groundwater has been conducted in accordance with the requirements of Schedule B of the current permit and the modifications to the permit. The monitoring frequency has been effective in collecting data to document groundwater conditions. However, monitoring has been more frequent than necessary. An example is the required monthly frequency of groundwater monitoring at the North and South Schow Farms. Monthly samples have been collected since 1999. The seasonal groundwater variations are well documented. In 2006, IDEQ required TASCO to

perform quarterly sampling on the facility wells when TASCO requested to use the entire mud pond.

TASCO requests that groundwater sampling at the North and South Schow along with the facility wells be reduced to a semi-annual frequency similar to the other management units.

**Soil Monitoring:**
Currently, soil monitoring at the North and South Schow is conducted on a semi-annual basis. Additionally, the soil is sampled to a depth of 5 feet and not the normal 3 foot depth. After 11 years, the soil has been well characterized and TASCO requests that soil sampling be reduced in frequency and depth more inline with normal sampling requirements.

Monitoring protocols will be submitted as part of the Plan of Operation.

## 6.4 Offsite Impacts

Regarding the IDEQ's domestic well acceptability analysis, TASCO has distributed all results and a copy of the drinking water standards to the domestic well owners who participated in the study. Domestic well owners have not expressed concerns regarding the results or water quality. However, if a neighbor were to complain; a discussion of TASCO's approach for addressing the neighbor's concerns is provided.

At the request of a property owner, TASCO will address the property owner's water supply for potential impacts from TASCO activities if beneficial uses are affected. To determine potential impacts and the level of appropriate actions, TASCO may evaluate the following:

- Site-specific, local, and regional groundwater conditions;
- Appropriateness of aquifer designation and impacts to beneficial use; and
- Applicability of groundwater standards.

Shallow groundwater in the Paul, Idaho, and area is currently designated for potable use even though groundwater in many wells exceeds primary and secondary drinking water standards. The IDEQ should assess all potential sources of groundwater quality variances in the area that may contribute to elevated levels of TDS, nitrate, and other contaminants. Local groundwater quality should be viewed in a regional context. The IDEQ needs to resolve several issues pertinent to regional groundwater quality, including whether the current aquifer designation is appropriate and whether health risks are present based on this designation.

TASCO would also support a regional review of groundwater conditions and management by the IDEQ. The review should include a determination of appropriate groundwater uses and designation and establishment of institutional controls to avoid inappropriate uses and impacts.

## 6.5 Updates to the Wastewater Land Application Permit

**East Farm**: As previously mentioned, a significant portion (20+ acres) of the East farm was removed from crop production (1998) to construct the East, West and South Lagoons. This has

allowed for better control of condensate application. However, the permit has not been modified to reflect this change. TASCO requests the permit reflect the East farm is now 60 acres.

**Fisk/Blacker:** The Fisk/Blacker management unit has not been used by TASCO since 1998 and is unlikely to receive wastewater in the future. TASCO requests removal of this management unit from the permit.

### 6.6 Process Water Management

TASCO has been using groundwater to wet roadways to control fugitive dust. The addition of water is not at a rate that allows for percolation to the groundwater but is a great benefit in controlling air born particulate matter. TASCO has other sources of fugitive dust that would greatly benefit from the application of water for dust suppression.

TASCO requests the Department's approval to apply process wastewater to the lime pile, FGD storage area, coal ash pile, limerock and coal storage areas. The application will be at less than the evaporation rate as determined by review with Agrimet data, or ¼ inch per day which ever is less. The application will only be applied in the summer and when wind conditions are such to preclude drift to offsite receptors.

### 6.7 Future Production

The Mini-Cassia facility air emissions permit limits the capacity to slice beets to 3.2 million tons of beets sliced per year or 19,500 tons sliced per day. Because of this operational limit, TASCO believes the current wastewater loads are representative of projected future loads to the WLAP system. If any changes affect the conditions of the permit, TASCO shall submit appropriate information to the IDEQ for review and approval.

## *Works Cited*


Allred, Steven. 2000. Modification of Land Application Permit Appendix "C" to Permit No. LA-000050-02. December 10, 1999.

CH2M HILL, INC. 1992. Land Application Report for Mini Cassia Facility, TASCO Mini-Cassia Factory. January, 1993.

CH2M HILL, INC. 1993. Technical Memorandum: Total Dissolved Solids Groundwater Evaluation, TASCO Mini-Cassia Factory. June 9, 1993.

CH2M HILL, Inc. and HDR. 1997. Well Acceptability Analysis for The Amalgamated Sugar Company Mini-Cassia Factory, Paul, Idaho. May 1, 1997.

Montgomery, J.M. 1986. Hydrogeological Study for The Amalgamated Sugar Company, Mini-Cassia Factory, Paul, Idaho. 23 pp.

Soil Conservation Service (SCS). 1975. Soil Survey of Minidoka Area, Idaho. United States Department of Agriculture, Washington DC.

Idaho Division of Environmental Quality (IDEQ) 1995. Wastewater Land Application Permit No. LA-000050-02. State of Idaho Division of Environmental Quality, Boise Idaho.

IDEQ. 1996. *Handbook for Land Application of Municipal and Industrial Wastewater.* April, 1996.

TASCO. 1992. Application for Wastewater Land Application Permit, Mini-Cassia. September, 1992.

Wright, J. L.. 1993. *Management of Irrigation and Drainage Systems.* Nongrowing Season ET from Irrigated Fields. July, 1993. Park City, UT.