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This paper examines the environmental factors influencing the die-off and transport of fecal coliform bacteria present in wastes applied to the land surface. These factors are examined specifically for dairy waste management systems and the net effect each system has on runoff water quality. A model is developed that considers the effects of precipitation, season, method of wastes storage and application, die-off of the bacteria in storage, die-off of the bacteria on the land surface, infiltration of bacteria into the soil profile, soil characteristics, overland transport of bacteria (runoff), and buffer zones. The model is then applied to the Tillamook basin in northwestern Oregon to evaluate which waste management procedures significantly decrease bacterial pollution potential in agricultural runoff.

Evaluating Dairy Waste Management Systems Influence on Fecal Coliform Concentration in Runoff

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I. INTRODUCTION

The need to understand the interrelationships between land application of bacterial-laden agricultural wastes and adjacent stream water quality is evidenced by the many bacteria-laden streams found in agricultural watersheds. Evaluating, specifically, dairy waste management systems requires modeling of these interrelationships, and analysis of each system's influence on the quantity of bacteria entering the stream. The bacteria of primary concern are of the fecal coliform group, which serve as indicator organisms for potential human pathogens, and are produced only in the gut of warm-blooded animals.

The problem of stream contamination with fecal coliforms (FC) is manifested in the Tillamook Bay watershed in northwestern Oregon which has numerous dairies. Maintaining the water quality of these watershed streams is crucial towards maintaining the bay water quality at levels enabling oyster harvesting and alleviation of public health concerns (see Appendix A). Stream contamination occurs after precipitation instigates runoff which removes land applied dairy wastes containing FC and deposits them in nearby waterways. Modeling waste management systems with regards to storage, application, precipitation, infiltration, and runoff of FC provides the necessary information to evaluate the bacterial contribution of different manure management practices.

II. REVIEW OF THE LITERATURE

Fecal Coliforms as Indicator Organisms

Fecal coliform bacteria are the most common indicators of surface water pollution from warm-blooded animal (including human) sources. These bacteria are present in the animals' excretion products and their detection is relatively inexpensive. Monitoring for all the actual pathogenic bacteria requires lengthy and elaborate laboratory techniques and equipment, as well as the skilled personnel to perform the analyses. Fecal coliforms have been chosen as one of the best indicators of fecal contamination after several studies showed that other indicators such as total coliforms and fecal streptococci remained at high concentrations in runoff from pasture with, or without, applied wastes, due to the background sources of bacteria in soil and from wildlife, (Doran and Linn, 1979; Kunkle, 1979; Schepers and Doran, 1979). These investigators also noted that FC were the best index of actual fecal contamination in runoff. In choosing FC as the indicator organisms, it is essential to understand environmental effects on these bacteria to provide the basis for formulation of a model.

Environmental Factors Affecting Bacteria Die-off

When the FC bacteria are in the intestines of a warm-blooded animal, they are in their optimum environment. After passing from the animal, the bacteria are placed into a harsh environment and they begin to die off. This die-off is a result of adverse temperatures, soil and water pH, moisture content, sunlight, and low nutrient supply. Several studies and reviews of the environmental effects on FC have been written and these include: Burge and Marsh (1978); Dunlop (1968); Ellis and McColla (1978); Gerba et al. (1975); Krone (1968); Lance (1976); Menzies (1977); Mitchell and Starzyk (1975); Morrison and Martin (1977); Rudolfs et al. (1950); Van Donsel et al. (1967). Temperatures from 7 to 12°C tend to increase microbial survival, whereas freezing temperatures and temperatures above 45°C cause rapid die-off as demonstrated by Jones (1971); Kibbey et al. (1978); Klein and Casida (1967); McFeters et al. (1972); Mitchell and Starzyk (1975); Zibilske and Weaver (1978). High temperatures combined with arid conditions significantly decrease bacteria survival (Van Donsel et al. 1967). Calcott (1976) and Kibbey et al. (1978) found that freezing and thawing also reduces microbial populations.

The effect of spreading bacteria in solid or semi-solid wastes on dry soil may be more dramatic with regards to die-off, because the water present in the wastes enters the soil profile leaving the bacteria in a dry condition. Extremes in pH are detrimental to bacteria survival. Acid conditions may greatly increase die-off rates (Kibbey et al., 1978; Cuthbert et al., 1955) as well as basic conditions (Kovacs and Tamasi, 1979). Neutral pH conditions generally extend bacteria survival (McFeters et al., 1978). Increasing soil moisture increases the survival of some bacteria (Kibbey et al., 1978). Soil moisture plays a less significant role when the bacteria are applied from a liquid manure system due to their aqueous environment.

The effect of solar radiation on reducing bacterial numbers on vegetation sprayed with liquid manure was demonstrated by Bell (1976), Bell and Bole (1976), and Brown et al. (1979); and in the laboratory by Crane et al., (1980). Finally, die-off may come to the organisms due to a shortage of nutrients and the organisms' inability to decrease metabolic activity to match the nutrient supply (Klein and Casida, 1967). Bacterial survival in aquatic systems may be enhanced by increasing the nutrient supply (Hendricks, 1972; and Slanetz and Bartley, 1965). The nutrient supply on the soil normally is organic matter present in the soil humus, or in the wastes (Klein and Casida, 1967; Mollman and Litsky, 1951; Tate, 1978; and Zibilske and Weaver, 1978).

Solar radiation, temperature, soil moisture, and other predominant variables in bacterial die-off, tend to be sea-

seasonal along the Oregon northwest coast. Nutrient supply and soil pH are relatively constant throughout the year for a specified soil-waste management combination. Hot, dry summer months followed by cool, wet winter months are characteristic of the northwest coast; consequently, seasonal changes are the primary macroscopic factor influencing bacteria die-off rates. Edmonds (1976), Jones (1971), Kunkle (1970) and Van Donsel _et al_. (1967) noted that indicator organism survival and transport decreases with seasonal changes towards the summer months.

However, there are usually one or two predominating factors in the die-off, or survival of bacteria, and this concept may give insight into the phenomenon of bacteria aftergrowth experienced by Crane _et al_. (1980), Cuthbert _et al_. (1955), Guy and Small (1976), Kovacs and Tamasi (1979), and Van Donsel _et al_. (1967). The predominating factors necessary for regrowth of bacteria in the Tillamook basin are assumed not to exist.

Modeling Bacteria Die-off

Several investigators have developed models for predicting the die-off of bacteria. The earliest and simplest model was proposed by Chick (1908), known as Chick's law, and it is based on a first-order reaction in chemical kinetics. Chick's law may be expressed as

$$\frac{N_t}{N_o} = 10^{-kt} \tag{1}$$

where N_t = number of bacteria at time t,

N_o = initial number of bacteria at time zero,

k = first-order die-off rate constant (1/day),

t = time in days.

Data representing bacteria placed in an environment hostile to their survival is characterized by equation 1. A modification may be made to this model to account for a lag period before die-off begins by substituting $(t-t_1)$, where t_1=the time at the end of the lag period, for t in the equation above. Investigators Fair and Geyer (1954), Frost and Streeter (1924), Klock (1971), Mancini (1978), and Orlob (1956) made further modifications of Chick's law that include specific constants that more fully explain their respective data.

This investigation uses a first-order die-off model because of the relative ease with which this model can be adapted to the data of other researchers. The first-order model has been used with success in several studies of soil die-off of enteric bacteria by Crane _et al_. (1980), Dazzo _et al_. (1973), and Kehr and Butterfield (1943). It has also been used successfully when modeling die-off in aquatic environments as shown by Klock (1971), and Orlob (1956).

Chick's law can be adapted to the data of other researchers in either tabular or graphical form by rewriting equation 1 as

$$\log \frac{N_t}{N_o} = -kt \qquad (2)$$

or,

$$\ln \frac{N_t}{N_o} = -Kt \qquad (3)$$

where K = 2.3 k.

Equation 2 represents the common logarithmic form of Chick's law, and equation 3 the natural logarithmic form. The die-off constant as defined by equation 3 is used in this study to model bacteria die-off in storage and on the soil surface.

Several investigators have examined the die-off rates of FC bacteria in various conditions and they are tabulated in Table 1 with their respective rate constants and conditions. Some investigators have also examined the rate at which FC bacteria die-off on the soil surface after application for different soils and temperatures, and these are tabulated in Table 2. These two tables illustrate that increasing temperatures and deviances from neutral pH values (either in storage, or on soil) tend to increase the rate of bacteria die-off.

Table 1. Storage FC Die-off Constants.

Description	Study Time (days)	Temperature (°C)	pH	Type of Study	K(days^{-1})	Reference
Stormwater runoff	14	Summer	--	lab study	1.45	Geldreich *et al.* (1968)
		Winter			0.25	
Dairy manure slurry anaerobic	84	Jan-Apr	7.0	lab tank study of *E. coli*	0.11	Rankin and Taylor (1969)
Dairy manure slurry	77	--	--	lab study of *E. coli*	0.1-0.29	Burrows and Rankin (1970)
Stacked dairy manure	150	2-8	--	field study		Jones (1971)
uncovered					0.066	
covered					0.027	
Beef manure lagoon slurry	10		--	lab study		Coles (1973)
aerobic		7			0.557	
		25			0.83-1.76	
anaerobic		25			0.368	
aerobic		21-33		field study	1.35	
anaerobic		21-33			0.375	
Innoculated well-water	4	10-12	7.48	field study	2.285	McFeters *et al.* (1974)
Swine lagoon anaerobic effluent	--	23-28	--	lab column	2.277	Krieger *et al.* (1976)
Swine manure slurry	35	4	7.0	lab study of *E. coli*	0.686	Kovacs and Tamasi (1979)
			8.0		0.867	
			9.0		0.931	
		20	7.0		0.588	
			8.0		0.816	
			9.0		1.079	

Table 2. Surface FC die-off constants.

Description	Soil Moisture	Soil pH	Soil type	Temperature (°C)	Study period (days)	K(days^{-1})	Reference
Cell suspension added to soil--lab study of *E. coli*	50-70 %	7.4	silty clay loam	10 26 37	22	0.195 0.342 0.697	Klein and Casida (1967)
Dairy slurry applied to pasture--field study of *E. coli*	moist	7.4	--	7-18	12	0.659	Taylor and Burrows (1971)
Animal lagoon wastes irrigated on soil field plots	--	--	clay	Sept-Oct	35	0.230	Smallbeck and Brommel (1975)
Swine manure-surface applied to grass field plots	24 %	6.4	fine sandy loam	0-25	28	0.47	Crane *et al.* (1978)
Poultry manure--surface applied to bare lab plots, no water added	dry to field capacity	5.0-8.0 4.5-6.5	loamy fine sand clay loam	25	7	0.26 0.34	Crane *et al.* (1980)
Swine wastes--surface applied	10-50 %	--	silty clay loam	7-15	42	0.286	Watson (1980)

Infiltration of Bacteria

Following waste application to the soil, bacteria present in the wastes may be removed from the soil surface by infiltration into the soil and/or overland runoff. The researchers have approached the study of bacteria infiltration by examining the distance the bacteria travel from their source through the soil in efforts to determine a safe distance between bacteria sources and groundwater supplies. This research is tabulated in Table 3. The ability of the soil to remove, or adsorb bacteria is dependent upon such factors as the soil pH, soil type and the soil's cation exchange capacity. Weaver et al. (1978) demonstrated that clay soils are more effective in adsorbing bacteria than sandy soils due to more adsorption sites, and lower soil porosity. Generally, bacteria movement into subsurface drainage waters is minimal except when the soil is saturated with water and heavy application rates are used (Evans and Owens, 1972; and Klock, 1971).

Runoff of Bacteria

The researchers have approached the study of bacteria transport in runoff macroscopically by examining the runoff water quality from pastures receiving a known amount of animal, or domestic wastes. Rubbins et al. (1971) determined that between 3 and 23 percent of the FC remaining on fields

Table 3. Infiltration of coliforms.

Description	Soil type	Measured Travel Distance (m/ft)	Travel time (hr)	Reference
Sewage trenches intersecting groundwater	--	70.7 (232)	--	Warrick and Muegge (1930)
Primary and treated sewage in infiltration basins	fine sandy loam	0.6-4 (2-13)	--	Butler *et al.* (1954)
Dilutes primary sewage subsurface injected	aquifer	30 (98)	33	McGauhey and Krone (1954)
Secondary sewage in infiltration basins	sandy gravels	0.9 (3)	--	McMichael and McKee (1956)
Primary sewage subsurface injected	aquifer	30.5 (100)	35	Krone *et al.* (1958)
Secondary sewage subsurface injected (FC)*	aquifer	30.5 (100)	--	Wesner and Baier (1970)
Tertiary sewage in percolation beds	sand and gravel	830 (2723)	--	Anan'ev and Demin (1971)
Tertiary sewage in infiltration basins	sand	6.1 (20)	--	Young (1973)
Secondary sewage in infiltration basins (FC)	loamy sand to gravel	9.1 (30)	--	Bower *et al.* (1974)
Septic tile effluent (FC)	fine loamy sand	13.5 (44)	--	Renlow and Pettry (1975)
Secondary sewage in infiltration basins (FC)	fine loamy sand	9 (29)	--	Gilbert *et al.* (1976)

*(FC) refers to fecal coliforms as differentiated from all other coliforms.

following manure application from various livestock operations were removed in the runoff when averaged over the entire year. Kunkle (1979) reported that during the summer (temperatures ranging from 25^{o}-30^{o} C) in Vermont, total losses of FC in runoff during a 23 day period of simulated rainfall were 6.73 percent of those applied with 99 percent of the 6.73 percent removed by the first simulated rainfall event of 38 mm initiated a few hours following application.

Crane et al. (1978) reported that when applying swine wastes to pasture plots, the residence time of the wastes on the soil surface was the controlling factor determining runoff water quality. If runoff occurred during the day of application, 58 to 90 percent of the FC applied with the wastes were removed. As the residence time increased one to three days, the percentage of FC removed decreased substantially. The decreased removal was not due strictly to die-off, and the authors suggested that this may be due another time dependent variable such as adsorption to the soil. A similar effect on the removal of bacteria into runoff from lands applied with sewage sludge was observed by Dunigan and Dick (1980). They reported that high FC counts were found in the runoff until a period of sufficient length to dry the sludge occurred.

The manure management practices, or lack thereof, also plays a role in determining runoff water quality. McCaskey et al. (1971) when investigating dairy waste management systems (solid, semi-liquid and liquid application), found that the maximum percentage of FC removed in runoff was 0.008 percent of those applied for a year's duration. Bacteria losses were the greatest for the solids application and least for the liquid application due to dry soil conditions allowing for infiltration of irrigated manure slurry. Table 4 summarizes the runoff water quality data regarding FC found in the literature for lands receiving animal wastes.

Buffer Zone Effects on Bacterial Concentration in Runoff

Research on the use of buffer strips and vegetative filters for bacterial removal have shown conflicting results. Jenkins *et al*. (1978) using an overland flow system for treatment of primary and secondary wastewater effluents found that 96 to 99 percent of FC in the effluents were removed in the summer. This was reduced, however, to less than 65 percent during the winter due to decreased infiltration into the frozen soil. Peters and Lee (1978) reported opposite results, and their investigation indicated that FC concentrations in the runoff increased during the summer, and that the maximum removal during the winter was only 60 percent on a concentration basis. All of the above investigators suggested that the removal of bacteria is unrelated to the removal of chemical constituents in the

Table 4. FC in runoff from lands applied with agricultural wastes.

Description	Grazed or Applied Lands (org./100 ml)	Ungrazed Control (org./100 ml)	Reference
Land applied dairy wastes			
irrigated	$1.1 - 4 \times 10^6$	9.9×10^5	McCaskey et al. (1971)
tanker applied	$1.4 - 71.7 \times 10^6$		
solids spread	$1.1 - 38.5 \times 10^6$		
Land disposal of beef manure	3.07×10^5	1.0×10^4	Rubbins et al. (1971)
Cattle pasture (Idaho)	2984	58	Dixon et al. (1977)
Snowmelt runoff from cattle pasture (Nebraska)	0-110	0-220	Doran and Linn (1979)
Manure applied to grass pasture (Vermont)	$100-2 \times 10^6$	10-100	Kunkle (1979)
Cattle pasture (Nebraska)	121,000	11,000	Schepers and Doran (1979)
Feedlot (Kansas)			
concrete lot	1.3×10^8 2.4×10^8	--	Miner et al. (1966)
dirt lot	3.3×10^7 7.9×10^7		
Partially grayed pasture	4460	--	Kunkle (1970)
Slurry irrigation of crops (Tennessee)	12,000 9,200 28,500	--	Barker and Sewell (1973)
Land applied wastes from animal production units (South Carolina) liquid	50,000		Janzen et al. (1974)
solids	30,000		
Feedlot (Minnesota)	9.92×10^6 5.31×10^6		Young et al. (1980)

effluents. Doyle et al. (1975) applied fresh dairy wastes to pasture plots and used a forested strip as a buffer zone. He found that FC were effectively removed from the runoff (over 99 percent) within four meters from the edge of the application site. However, bacterial concentrations on the order of 10^4/100 ml were still found in many samples of the runoff. The work of Johnson and Moore (1978) indicated that vegetative filters are reliable and effective when the wastes applied have FC concentrations greater than 10^5/100 ml. The bacterial concentration in the runoff appears to stabilize at 10^4 to 10^5 organisms per 100 ml regardless of experimental conditions. Young et al. (1980) suggested a statistical relationship, based on the length of the buffer zone, to predict the total coliform removal from feedlot runoff. They suggested from this relationship that 36 meters of buffer zone would be sufficient to reduce bacterial concentrations in the runoff below 10^3/100 ml. However, the buffer distance used in this study was only 27 meters and at this length the FC concentration was still on the order of 10^5 to 10^6 organisms per 100 ml, hence such extrapolation may be inappropriate. Generally, it seems that buffer zones are advantageous in reducing bacterial concentrations in runoff from waste applied lands.

Modeling the overall process of FC survival and transport requires the incorporation of the environmental effects on die-off into quantifiable relationships that can be used to model bacteria survival at each stage from collection to runoff. Die-off begins immediately following defecation and generally continues in storage and on the land surface after application. The bacteria surviving on the soil are further reduced in numbers by infiltration into the soil and overland transport with runoff. A mass balance of bacteria survival will provide the basis for modeling the effects of different waste handling practices on runoff water quality.

III. MODEL SYNTHESIS

The synthesis of the model in this investigation is based upon a "mass balance," or deterministic approach, where the significant events are quantified and summed for a specified time increment. These events include wastes storage, bacterial die-off in storage, wastes application, bacteria die-off on surface, precipitation, infiltration of water and bacteria, and finally, runoff. The waste management system determines the number of bacteria that are stored and applied and influences the number that run off; while climatological effects and soil characteristics determine the rate bacteria die-off on the surface, and the quantity of bacteria finally transported by rainfall water. Assembling these events together in a daily time increment, enables a prediction to be made of the concentration of FC in runoff from applied lands. This macroscopic view is enhanced by examining each event separately for its contribution to the runoff concentration.

Storage and Application

The waste handling practice determines the volume of wastes and the concentration of FC in storage. The practice of storing the manure, with the animal's bedding (i.e.

stacking the wastes) yields a waste that is more concentrated with FC than wastes that have been diluted by milking parlor waste water, and/or flush system water. These wastes are normally loaded by a front end loader into a manure wagon, taken to the field and spread. A second management practice is to gather the manure (i.e. scrape the alleys) and dilute the manure with milking parlor waste water to sufficient dilution such that the wastes can be pumped into a liquid tanker and land applied. A third common practice has been the installation of sloped alleys combined with a flush system. The flushing waters clean the alleys and flow into a storage unit from which they are pumped out and sprinkled on pasture, or crops. Each of these different management practices influences the quantity of FC bacteria that are applied to the land. These three management systems are summarized in Table 5. (One AU is the equivalent of one 1400 lb mature cow.)

Manure is added to storage on a daily basis, and with each increment in storage volume, there is a corresponding increment in the quantity of bacteria found in storage. The bacteria die-off in storage daily as calculated by equation 3. Because of the one-dimensional nature of the mathematical quantification of these daily events, it is necessary to specify an order the events, or calculations, are to follow. The storage-application daily sequence is:

Table 5. Daily waste production and application methods using various waste management practices.*

Description[a]	Practice 1[b]	Practice 2[c]	Practice 3[d]
% TS (wet basis)	16.5	6.10	0.65
ft^3/AU day	2.85	4.35	36.0
FC/ft^3	$1.89\ (10)^9$	$1.24\ (10)^9$	$1.50\ (10)^8$
lb N/ft^3	0.211	0.138	0.0167
FC/AU day	$5.39\ (10)^9$	$5.39\ (10)^9$	$5.39\ (10)^9$
Application Method	dry haul	liquid tanker	sprinkler

*Data from Midwest Plan Service bulletin MWPS-18.

[a]Assumes no bedding added in Practices 2 and 3; that negligible solids are added with milking parlor wastes; that bedding adds no N to storage; that N losses in storage are insignificant; and the water is not recycled in the flush system.

[b]dry bedding stacked wastes.

[c]scraped alleys, parlor wastes added to dilute to 6% total solids (TS).

[d]flushed system.

1) begin with the previous day's storage volume and quantity of FC,
2) add fresh wastes and increment both volume and FC quantity in storage,
3) reduce FC quantity in storage due to die-off, and
4) withdraw wastes with bacteria, if land application of wastes is to be done that day.

When a specified volume of wastes are withdrawn, the number of FC taken to the field can be calculated by assuming the wastes are well-mixed.

Surface Die-off

Surface die-off is the next event in the sequential order of the model. When the FC are applied to the land they are subject to adverse environmental conditions and the number of viable bacteria on the land surface will decline. The rate constant for surface die-off is a function of several climatic and soil factors as identified and summarized in the literature review. The soil factors do not vary substantially for the soils in the Tillamook basin, and the climatic factors are accounted for by seasonal variations. Consequently, only two surface die-off rate constants (summer and winter) are defined in the model. The summer season is defined as June through September, and the winter season is the remainder of the year. It is assumed that no regrowth of FC bacteria occurs on the land surface because the environmental factors necessary for regrowth are not likely to occur in the Tillamook basin. If regrowth is shown to occur under certain conditions, the model can be modified by reversing the sign and changing the magnitude of the die-off term. After the FC bacteria have been land applied and suffer application and die-off losses, the remaining viable bacteria are available to move with infiltration and runoff waters.

Infiltration

Some FC bacteria are lost from overland transport when they enter the soil profile during a precipitation or irrigation event. When the bacteria enter the soil profile, they are adsorbed to the soil, and the model assumes they are lost from the system (they may be considered dead).

The ability of soil to adsorb bacteria in this scheme is dependent upon the infiltration characteristics of the soil. The majority of the farmlands in the Tillamook basin are on Coquille and Nehelam soil associations covered by pasture (see Appendix C). The Coquille soils are poorly drained clay soils and the Nehelam soils are moderately well drained silt loam soils. Because the vegetative cover in the land receiving manure is predominantly pasture, the ability of different soils to hold bacteria is related only to their soil profile water capacity and internal drainage rate (at a macroscopic level). The internal drainage rate decreases slightly as the water table height decreases, but it is relatively constant for a given soil. The soil profile water holding capacity is the quantity of water that can infiltrate into the soil before saturation and runoff, and it is dependent on water table height. This capacity is increased by reducing the water table level with the addition of subsurface drainlines. This parameter varies seasonally as the water table fluctuates in the Tillamook basin. Consequently, the soils can hold more bacteria (water) in the summer than in the winter. Furthermore, the ability of infiltrating water to partition the bacteria from the wastes is assumed to be constant across the basin. When the soil profile is saturated, additional water removes some of the remaining bacteria into overland runoff.

Runoff

The final process considered in the model is the transport of FC bacteria with runoff. The number of bacteria removed in runoff is a function of the number remaining on the soil surface after die-off and infiltration have occurred, the quantity of runoff, and the rate at which the FC bacteria partition into the runoff. Field slope is not a factor in the Tillamook basin because the agricultural lands generally have 0-3 percent slopes. It is assumed that no die-off occurs enroute to the streams due to the short time and distance involved. And it is also assumed that the runoff immediately forms channels across the land surface and that it transports all of the partitioned FC to the stream, unless there is an adequate buffer zone which effectively removes some of the FC from the runoff.

Modeling FC Infiltration and Runoff--The Percentage Reduction Method

It is necessary to model the partitioning of FC bacteria from land applied wastes into infiltration or runoff waters to successfully describe the overall process of land disposal of wastes and runoff water quality. The review of the literature indicates that no such modeling has been developed. Consequently, the model used here is based on first-order kinetics and may be represented by

$$F = F_o (1 - P)^r \qquad (4)$$

where F = the number of bacteria remaining on the soil surface after infiltration, or runoff;

F_o = the original number available on the soil;

P = the percentage reduction factor (as decimal) characteristic of infiltration, or runoff;

r = the runoff, or infiltration water depth, which is a function of the soil profile water capacity and precipitation depth.

The number of bacteria actually removed by the infiltration, or runoff events may be calculated by subtracting the number remaining from the original quantity (i.e. $F_o - F$). The percentage reduction term (P) is a function of the ability of the infiltration, or runoff, waters to partition the FC from the wastes, and the environmental factors that influence this process. The (P) term for infiltration is less than that for runoff because the infiltration water must partition the FC from the wastes and also distribute them into the soil matrix (i.e. the soil "environment"). The value of (P) for runoff needs only to consider the effects governing the rate at which FC becomes suspended in the runoff water.

The soil profile water holding capacity determines the amount of water that can infiltrate before saturating the soil and causing a runoff event. Internal drainage partially restores the water holding capacity of the soil on a daily basis. The capacity of a soil profile to hold water is dependent upon the depth of the water table, and the water table depth varies seasonally in the Tillamook basin. For a further discussion of soil characteristics and parameters see Appendix C. This capacity and the rainfall on any given day determines the value of (r) for infiltration, or runoff, in equation 4.

Examining equation 4 as the infiltration, or runoff, depth increases illustrates that the greater the precipitation event, the more bacteria that are removed. However, it is the first inch of rainfall that removes the most bacteria, subsequent additional rainfall removes fewer bacteria per inch than the initial inch. Equation 4 does not consider rainfall intensity because rainfall intensity data is not always available, so the model has a daily precipitation data base and equation 4 is applied once daily for infiltration and runoff.

Model Coefficients

The coefficients used in the model to describe FC bacteria survival and transport are developed from and are representative of the information found in the literature. The specific die-off rate constants and percentage reduction terms used in the model are tabulated in Table 6.

The storage die-off constant was chosen to be the same for all storage systems because of the lack of consistent data for different storage conditions (see Table 1). The storage die-off rate constant is an average value of the data presented in Table 1. The surface die-off rate of FC bacteria varies with climatic changes and the soil pH (see

Table 6. Die-off and percentage reduction constants.

Description	Constants K (day^{-1})	P
Storage die-off (all systems)	0.30	--
Surface die-off		
- summer	0.51	--
- winter	0.36	--
FC infiltration		
- solid wastes (>14% TS)	--	0.05
- semi-liquid wastes (5-10% TS)	--	0.05
- liquid wastes (<5% TS)*	--	0.20
FC runoff		
- solid wastes	--	0.40
- semi-liquid wastes	--	0.40
- liquid wastes (only those FC applied)*	--	1.00

*These infiltration and runoff values refer to when the wastes are applied only. FC bacteria remaining in wastes on the surface from the previous day have values of P=0.05 for infiltration, and P=0.40 for runoff. Consequently, the net quantity of FC bacteria infiltrating, or running off is the sum of the applied and already present infiltration, or runoff losses.

Table 2). The soils in the Tillamook basin are mostly acidic (pH 4.4-5.2), and the climate is characterized by two seasons, summer and winter. With this information, the most appropriate die-off constants were ascertained from the literature summarized in Table 2. Die-off rates are expected to increase during the summer months due to increased solar radiation and temperatures, and this is reflected in the constants chosen.

The movement of FC bacteria depends upon the level of suspension of the bacteria in the wastes that are applied. The bacteria are assumed to be diluted in the liquid wastes, hence, the bacteria are ready to infiltrate, or runoff. This condition is reflected in the larger P values given to liquid waste application. Semi-liquid wastes are given an "application loss" of 25 percent to account for the binding of bacteria in the wastes to the soil by the liquid present. Solid wastes are given no application loss. The actual P values used are the result of best estimates from the literature summarized in Tables 3 and 4, and from comparison of the model output to actual data collected by the Oregon Department of Environmental Quality (DEQ) for streams in the Tillamook basin.

Another parameter that needs to be identified is the effect of buffer zones between applied lands and streams. A buffer zone effectively cleanses the runoff water of many of its pollutants with the degree of cleansing dependent upon the length, or area of the buffer zone. Here, a buffer zone is defined as approximately 30 meters of clean grass pasture between applied land and adjacent streams which effectively removes 60 percent of the FC in the runoff before the runoff enters the stream. This represents a conservative estimate based on the information presented in the literature review.

The physical characteristics of the different waste management practices examined are tabulated in Table 6, and the quantification of the Tillamook basin soil characteristics are contained in Appendix C.

A flowchart of the model is contained in appendix E.

IV. MODEL APPLICATION

In addition to the physical characteristics of the basin previously identified, the model requires the specifications of the different management procedures to be compared. The model program asks for the following information (see Appendix D for program).

1. The number of days to run (the precipitation record must be of equal, or greater length),
2. the total field size allowed for waste application (acres),
3. whether, or not, this field has subsurface drainage,
4. whether, or not, there is a buffer zone between field and stream,
5. the soil type (Nehelam or Coquille),
6. the number of AU, and the number of days this herd size is maintained,
7. the management practice (dry, semi-liquid, or liquid), and the number of days this practice is used,
8. the volume of wastes spread (ft^3),
9. the number of days to spread at the above date, and

10. the new field size covered with each day of spreading (acres).

And the computer prints the following output.

1. the day of record,
2. the precipitation plus irrigation water depth (in),
3. the soil moisture level (in),
4. the storage volume (ft^3),
5. the storage concentration of FC (FC/ft^3),
6. the application rate (lb N/ac),
7. the application rate (FC/ft^2 of field surface),
8. the runoff FC concentration (FC/100 ml),
9. the runoff FC concentration (FC/ac),
10. the net runoff FC (number of bacteria).

With the input information listed above, the computer proceeds through the computations illustrated in the following examples.

Example 1: A dairy farmer uses bedding for his 100 AU herd and stacks the wastes. Determine the concentration of FC in storage and number of FC/acre when emptying 7 days of storage on a 3 acre field.

Solution:

1. Using table 5, the necessary information for

calculating the daily waste volume and quantity of bacteria can be found under practice 1.

daily waste volume = $(2.85\ ft^3/AU)(100\ AU) = 285\ ft^3/day$

daily bacteria addition = $(5.39 \times 10^9\ FC/AU)(100\ AU) =$

$$5.39 \times 10^{11}\ FC/day$$

2. Utilizing the sequencing previously specified, Table 7 summarizes the iterative daily calculations. Representative calculations for day 2 of Table 7 are given below:

   column 2 - two days of waste stored;

$$= (2\ days)(285\ ft^3/day) = 570\ ft^3$$

   column 3 - the quantity of FC in the wastes at the end of day 2;

$$= e^{-0.30}(4.00 + 5.39)\ 10^{11} = 6.96 \times 10^{11}\ FC$$

   column 4 - the ratio of column 3 to column 2;

$$= (6.96 \times 10^{11}\ FC)/(570\ ft^2) = 1.22 \times 10^9\ FC/ft^3$$

3. The concentration of FC in storage at the end of day 7 is $0.68\ (10)^9\ FC/ft^3$.

4. Dry haul application incurs no application loss of

Table 7. Storage example.

Days of Storage	Volume in storage (ft^3)	FC in storage (# of bacteria	FC concentration in storage (FC/ft^3)
1[1]	285	4.00×10^{11}	1.40×10^{9}
2	570	6.96×10^{11}	1.22×10^{9}
3	855	9.15×10^{11}	1.07×10^{9}
4	1140	10.8×10^{11}	0.95×10^{9}
5	1425	12.0×10^{11}	0.84×10^{9}
6	1710	12.9×10^{11}	0.75×10^{9}
7	1995	13.5×10^{11}	0.68×10^{9}

[1]The tabulated values correspond to the end of the day conditions.

bacteria, hence the field concentration of FC after application is:

$$(13.5 \times 10^{11} \text{ FC})/(3 \text{ ac}) = 4.5 \times 10^{11} \text{ FC/acre}$$

These FC bacteria on the soil are now subject to surface die-off, infiltration into the soil, and runoff.

Example 2: The dairy producer in example 1 has now spread his wastes on the 3 acre field at a concentration of 4.5×10^{11} FC/acre. Given the following data, determine the concentration of FC in the runoff water for each of the 5-day rainfall record.

1. The 3 acre pasture is on Nehelam soil adjacent to a stream.
2. The following rainfall data applies:

date	precipitation (in)
December 1	0.00
December 2	1.02
December 3	0.60
December 4	0.76
December 5	0.40

Solution:

1. The 3 acre pasture adjacent to the stream implies that there is no buffer zone. There are no drainlines in the field.
2. The Nehelam soil has the following soil water characteristics (see Appendix C):
   a. the internal profile drainage rate = 0.08 in/day; and
   b. the soil profile water holding capacity = 0.60 inches during the winter.
3. Table 8 summarizes the results. Examining each column for the first two days illustrates the computational procedure used in the FORTRAN program.

   column 3 - the soil water level is the depth of saturation;

   day 1 - the soil is dry, hence, no water depth in the profile,

   day 2 - the soil is saturated at 0.60 inches (quantity of water infiltrating = 0.60 inches) and drains 0.08 inches by the end of the day, yielding a level of 0.52 inches.

   column 4 - the concentration of FC bacteria applied to the field;

   day 1 - the wastes are applied at 4.5×10^{11} FC/ac (see example 1),

Table 8. Example 2 - Model Computational Example.

(1) Day	(2) Precip. (in)	(3) Soil Water Level (in)	(4) Applied FC (FC/ac)	(5) Infiltrated FC (FC/ac)	(6) Runoff FC (FC/ac)	(7) Remaining FC (FC/ac)
1	0.00	0.00	450×10^9	0	0	315×10^9
2	1.02	0.52	0	6.7×10^9	41.3×10^9	173×10^9
3	0.60	0.52	0	0.35×10^9	19.6×10^9	64.6×10^9
4	0.76	0.52	0	0.19×10^9	31.8×10^9	13.2×10^9
5	0.40	0.52	0	0.04×10^9	7.82×10^9	1.39×10^9
			Totals	7.28×10^9	101×10^9	

day 2 - no wastes are applied on the remaining days.

column 5 - the concentration of FC bacteria entering the soil profile;

day 1 - there is no rainfall, hence, no infiltration,

day 2 - rainfall occurs and saturates the soil and from equation (4); the number of FC infiltrating = $F_o - F_o (1-P)^r$ where F_o = the number of FC bacteria remaining after surface die-off on day 2 = $e^{-0.36}(3.16 \times 10^{11}$ FC/ac) =

$$2.205 \times 10^{11} \text{ FC/ac},$$

the number of FC infiltrating =

$$2.205\ (10)^{11} - 2.205\ (10)^{11}\ (0.95)^{0.6} = 6.7 \times 19^{9} \text{ FC/ac}.$$

column 6 - the contribution of FC bacteria from the field into runoff;

day 1 - there is no rainfall, hence, no runoff,

day 2 - sufficient rainfall occurs to cause runoff (quantity of runoff = 1.02 - 0.60 = 0.42 inches), again using equation (4); the number of FC in runoff = $F_o - F_o (1-P)^r$ where F_o = the number of FC bacteria remaining after surface die-off and infiltration (see day 2 above), =

$$2.205 \times 10^{11} - 0.067 \times 10^{11} = 2.138 \times 10^{11} \text{ FC/ac},$$

the number of FC in runoff =

$2.138\ (10)^{11} - 2.138\ (10)^{11}\ (0.6)^{0.42} =$

41.3×19^{9} FC/ac.

column 7 - the concentration of FC bacteria remaining on the field after the surface die-off, infiltration, and runoff events have occurred,

day 1 - no rainfall, consequently only surface die-off occurs; the concentration of FC remaining $= e^{-0.36}(4.5 \times 10^{11}) = 3.15 \times 10^{9}$ FC/ac,

day 2 - the concentration remaining after all the events have occurred (see above columns for day 2), =

$e^{-0.36}(3.15 \times 10^{11}) - 6.7 \times 19^{9} -$

$41.3 \times 10^{9} = 1.73 \times 10^{11}$ FC/ac =

173×10^{9} FC/ac.

This example hopefully will leave the reader with some insight into the total synthesis of the model.

V. MODEL EVALUATION

The evaluation of this model includes a comparison to actual water quality data collected by the state DEQ for the Tillamook basin, and a sensitivity analysis of die-off, infiltration and runoff parameters. It is necessary to compare the model's predictions to actual conditions to be sure these predictions are realistic. The sensitivity analysis identifies the processes most significant of those analyzed by indicating which parameters have the greatest influence on the final runoff water quality.

When validating a model with actual data, it is necessary to keep sight of the purpose of the model; in this case that purpose is the comparison of different waste management practices based upon their runoff water quality over a set period of time. Consequently, the model is not verified in the traditional sense, however, the comparisons are valid as long as the predictions are realistic.

The DEQ has been sampling at many stations in the Tillamook basin for FC concentrations in the rivers during different winter storms (see Appendix A). The DEQ data was scrutinized for the information necessary for comparison with model predictions. The necessary data was identified as a 24-hour storm, during which sampling was taken at two points over a known watershed, and the streamflow was gauged at the upstream point. The particular stream locations chosen covered the drainage area between Kurl bridge and U.S. highway 101 bridge near Idaville. The characteristics of the watershed were identified by the Soil Conservation Service surveys and are given in Table 9.

In analyzing these data, it was assumed that the streamflow and FC concentration in the stream may be represented by a straightline hydrograph (pollutograph) so that average streamflows and FC concentrations over the different time periods can be determined. It was also assumed that the streamflow remained relatively constant between the two sampling locations and that the river is well mixed with respect to FC. With the above information, the net contribution of FC to the river by the runoff water can be calculated, as outlined below.

1. upstream location;

ΣFC = Σ(average concentration of FC)(average streamflow) (over the time period)(conversion factor)

= (55 FC/100 ml)(2180 cfs)(315 min) (16980 sec 100 ml/ft^3 min) + (35 FC/100 ml) (4175 cfs)(625 min)(16980) + (25 FC/100 ml) (4220 cfs)(490 min)(16980)

= 3.07×10^{12} FC

Table 9. Model Validation Data.

Sampling Time (minutes after streamflow increases)		Upstream Location Streamflow (cfs)	FC Concentration at Upstream Location (FC/100 ml)	FC Concentration at Downstream Location (FC/100 ml)
Upstream	Downstream			
0	0	1160	50	190
315	325	3100	60	300
940	950	5250	10	100
1430	1425	3190	40	80

Total precipitation = 2.53 inches at the nearby gaging station for the day
Net runoff depth ~2.46 inches
Total drainage area = 4.50 mi^2 or 2880 acres on Nehelam soil
Estimated agricultural pasture land = 720 acres
Estimated stock = 600 adult cows + 300 young cows (~700 AU)

2. downstream location (similar to above);

$\Sigma FC = (245)(2180)(325)(16890) +$

$(200)(4175)(625)(16890) +$

$(90)(4220)(475)(16890)$

$= 14.87 \times 10^{12}$ FC

3. The net contribution of FC by runoff between these two stations is equal to;

   $(14.87 - 3.07) \times 10^{12}$ FC $= 11.80 \times 10^{12}$ FC.

4. Assuming the background FC levels are negligible (i.e. at least three orders of magnitude lower) and the entire contribution of FC into the river is from agricultural lands, the FC concentration in the agricultural runoff is;

   runoff volume $= (720 \text{ acres})(43560 \text{ ft}^2/\text{ac})(2.46 \text{ in})$
   $(1/12 \text{ ft/in})$

   $= (6.45 \times 10^6 \text{ ft}^3)(283 \text{ 100 ml/ft}^3)$

   $= 1.82 \times 10^9$ 100 ml,

   runoff concentration $= 11.80 \times 10^{12}$ FC/1.82×10^9 100 ml $=$ 6.48×10^3 FC/100 ml.

5. The above runoff concentration was then compared to model predictions. The dairy producers in this drainage area generally irrigate their wastes after some storage time. The model was applied using a 10 day storage of liquid wastes from 700 AU which was then irrigated over the 720 acres. The initial prediction

was 10 percent of the above value, so the infiltration and runoff P values were decreased and increased, respectively, until the prediction was similar to the value obtained above for a similar storm (i.e. 5×10^3 FC/100 ml vs. 6.5×10^3 FC/100 ml). If background FC levels were to be included, these values would be nearly the same.

The above analysis shows that the model predicts realistic runoff concentrations from applied lands. This type of validation is of sufficient accuracy for the purposes of this model, consequently, it may be used to compare and evaluate different waste management procedures.

The sensitivity of the parameters identified in Table 6 aids in the understanding of the main processes involved in the runoff water quality from applied lands. Analyzing for sensitivity is accomplished by examining what effects changes in individual constants have on the final prediction of interest, while all other parameters are held constant. The effects of changes in the die-off, infiltration, and runoff constants are examined, and are shown in Table 10.

Table 10 illustrates that the infiltration parameter has the least sensitivity to change, and the runoff and storage parameters have the greatest sensitivity. The runoff parameter can be expected to have the greatest effect on the final FC concentration, since it is directly related,

Table 10. Sensitivity analysis.

Parameter	Value Examined	Percent Change Examined	Percent change in Runoff FC Concentration
K (storage)	0.30	--	--
	0.20	-33.3	+30.0
	0.40	+33.3	-27.0
K (surface)	0.36	--	--
	0.12	-66.7	+14.0
	0.24	-33.3	+12.0
	0.48	+33.3	-12.0
P (infiltration)	0.050	--	--
	0.033	-33.3	+0.46
	0.066	+33.3	-0.46
	0.100	+100	-0.50
	0.200	+300	-1.50
	0.400	+700	-3.60
P (runoff)	0.40	--	--
	0.20	-50	-50[1]
	0.60	+50	+50

[1] The percent change in runoff FC concentration from irrigated wastes decreases with increasing runoff depth and is less than the value tabulated above which is for 0.9 inches of runoff depth. This is due to the dilution water added by the irrigation to the runoff.

and applied at the end of the model computations to determine the runoff FC concentration. The storage parameter determines the number of FC that may be applied, consequently, it too is sensitive to change. The infiltration and surface parameters are less sensitive to change because they only modify the number of FC on the field. All of the parameters' effects are independent of the soil moisture levels, excepting irrigation as noted.

Table 10 identifies the importance of determining the rate at which FC partition from different wastes into the liquid runoff. Understanding this partitioning process would lead to more refined values for describing the number of FC moving from applied wastes into both infiltrating and runoff waters. In addition to these parameters, the effects of different management procedures on the FC concentration in the runoff must be examined.

VI. COMPARISON OF DIFFERENT WASTE MANAGEMENT PROCEDURES

The management procedures were compared using three 40-day precipitation records that represented a heavy (30. 38 in), average (18.2 in), and light (11.79 in) rainfall period. The comparison is based upon examination of the 40-day net total of FC in the runoff. The computer printout of the tables examined is contained in Appendix D. Table 11 summarizes the different management procedures evaluated.

Table 11 illustrates that storage has the primary influence in minimizing the net runoff FC total (examples 4-7, 18 and 19) and that the semi-liquid management practice is consistently the better of the three practices. Irrigation and dry-haul had similar values of net runoff FC, except when the soil is able to hold some water (i.e. the water table height is lowered by drainlines). Clearly, tanker spreading, or irrigation is preferred when the soils are dry. For liquid and dry wastes application to match semi-liquid wastes application requires that the net runoff FC quantities decrease by 33 percent. Reducing the semi-liquid application loss from 25 to 5 percent does not affect its relative comparison to the liquid and dry systems.

An increase or decrease in the application rate results in a proportional increase or decrease in the net

Table 11. Model comparison of different management procedures (each examined using a 100 acre field of pasture during the winter with the specified characteristics).

Example	Storage (days)	Management System D=dry; S=semi; L=liquid	Application Rate (tons/ac)	Buffer Strip (yes,no)	Drainage Tile (yes,no)	Soil Type (loam,clay)	Avg. ppt. Net Runoff FC ($x10^9$ org)	Avg. ppt. Rank	Dry ppt. Net Runoff FC ($x10^9$ org)	Dry ppt. Rank	Heavy ppt. Net Runoff FC ($x10^9$ org)	Heavy ppt. Rank
1	0	D	10	Y	N	L	1,848.5	15	1,186.8	3	2,685.6	3
2	0	S	10	Y	N	L	1,388.2	10	891.1	1	2,016.8	1
3	0	L	10	Y	N	L	1,829.9	14	1,188.1	2	2,647.0	2
4	20	D	10	Y	N	L	440.0	4				
5	20	S	10	Y	N	L	330.3	2				
6	20	L	10	Y	N	L	453.2	6				
7	40	D	10	Y	N	L	154.3	1				
8	0	D	40	Y	N	L	7,393.8	19				
9	0	D	10	Y	N	C	2,128.8	16				
10	0	S	10	Y	N	C	1,598.6	11				
11	0	L	10	Y	N	C	2,157.8	17				
12	0	D	10	N	N	L	4,261.2	18				
13	0	D	10	Y	Y	L	838.3	9				
14	0	S	10	Y	Y	L	616.8	7				
15	0	L	10	Y	Y	L	696.3	8				
16	0	D	10	Y	Y	C	1,697.9	13				
17	0	L	10	Y	Y	C	1,624.9	12				
18	20	D	10	Y	Y	C	440.5	5				
19	20	L	10	Y	Y	C	439.7	3				
20	0	D	400	N	N	C	212,873.0	20				

runoff FC total when the remaining variables are held constant. For example, increasing the application rate from 10 to 40 tons/acre results in a four-fold increase in the net runoff FC for dry and semi-liquid wastes. Liquid wastes application may result in greater than a four-fold increase because more of the FC applied runoff. Conversely, applying liquid wastes at low application rates on dry soils would show a greater decrease in the net runoff FC total than dry or semi-liquid wastes because more of the FC applied infiltrate. Soil characteristics, specifically, profile water holding capacity and internal drainage rate have the greatest influence on the net runoff FC quantity when applying liquid wastes.

Applying wastes on poorer draining soils (i.e. the clay soil in Table 11) results in a greater net quantity of FC in the runoff for all of the management systems. Liquid wastes application shows the greatest increase of 19 percent when changing from the loam to the clay soil with all other variables held constant (examples 3 and 11 in Table 11). Similarly, dry and semi-liquid wastes showed a 10 percent and 14 percent increase respectively (see examples 1 and 2 versus 9 and 10). The addition of subsurface drainage to the loam soil results in a 90 percent decrease in the net runoff FC quantity for liquid wastes application, and 75 percent and 72 percent decreases for dry and semi-liquid wastes respectively (see examples 1, 2 and 3 versus 13, 14 and 15). Finally, the buffer strip is effective in reducing the net runoff FC quantities by 60 percent (see examples 1 and 12).

Comparison of the tabulated values for the three precipitation records used in Table 11 illustrates the dramatic effect of rainfall on the net quantity of FC removed in the runoff. A decrease of 40 percent in the 40-day rainfall total results in a decrease of approximately 43 percent in the next runoff FC totals when compared to the column for an average amount of precipitation. Increasing the rainfall total by 50 percent results in only a 37 percent increase in the net runoff FC totals. A different choice of rainfall records may produce a slightly different comparison depending on how the rainfall is distributed over the 40-day period; however, the relative increases and decreases will be similar. Large quantities of rainfall also dilute the quantity of FC removed in the runoff such that the runoff FC concentration (i.e. organisms/100 ml) may not show an increase when compared to the runoff from a lighter rainfall. However, there is more runoff from the heavier rainfall, hence more FC are deposited in the waterways.

VII. SUMMARY

The information gathered from application of the model to the procedures tabulated in Table 11 can be summarized into guidelines for minimizing the bacterial pollution potential for land application of dairy wastes. These guidelines are listed below.

1. Storage will significantly decrease pollution of surface waters. The method and capacity of waste storage has a significant role in runoff water quality. The method of storage is determined by the economic situation of the dairy producer. However, storage capacity should be large enough to allow flexibility in when to spread wastes. With storage units of sufficient capacity, dairy producers can store wastes during wet periods of the year and then withdraw and spread wastes during the dry periods.
2. Drainlines will significantly reduce runoff and the transport of bacteria. Soils with subsurface drainage generally have larger profile water holding capacities during the winter than soils without drainage, consequently, they can hold more bacteria and water, which decreases transport and runoff.
3. Spreading wastes on well-draining soils in the winter

helps to decrease pollution potential.

4. Buffer zones are an effective waste management procedure in reducing the quantity of pollution entering streams.
5. Heavy application rates of wastes increase pollution potential.
6. Runoff from barnyards laden with stacked animal wastes posesses the greatest pollution potential. These last two situations should be avoided in an effort to maintain the water quality of surface waterways.

The incorporation of these guidelines into the waste management procedures adopted by the Tillamook basin dairy producers should significantly decrease the contribution of agricultural bacterial pollution to the Tillamook Bay watershed.

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APPENDICES

APPENDIX A

History of the Tillamook Bay Water Quality Problem

The following information is condensed from the 1972 and 1974 Tillamook Bay water quality reports by the U.S. Food and Drug Administration (FDA).

Monitoring the quality of growing waters as well as inspection of seafood processing facilities and implementation of the Oregon Shellfish Sanitation Program was administered by the Oregon State Department of Health, General Sanitation Section, prior to 1969. In 1969 the state legislature created the Health Division (HD) and the Department of Environmental Quality (DEQ). The newly formed DEQ then took responsibility for functions previously mentioned except for seafood processing inspection which was pursued by the HD. This change in organization resulted in failure to conduct an adequate shellfish sanitation program at the state level. The threat of federal intervention by the Food and Drug Administration with a possible loss of endorsement of the State Shellfish Sanitation Program led to an accelerated effort by the DEQ during 1972 to 1974 to upgrade their program. This effort, however, was short-lived and the program again lagged significantly during the period from 1975 to 1977. In 1977 the FDA intervened by conducting an independent evaluation of fecal contamination in the bay. They strongly recommended temporary closure of the bay to shellfishing and development of appropriate controls and procedures to reduce bay contamination or they would withdraw endorsement of the state program. This caused the formation of a task force by the Oregon HD and DEQ to deal with the problem.

The first indication of problems due to fecal bacterial contamination were revealed through routine monitoring of the bay waters in 1969-71. These data implied a problem might exist at times of heavy rainfall in the Tillamook Basin. In 1972 state monitoring was intensified at sewage treatment plant discharges, and in the oyster beds themselves during wet weather periods. These activities demonstrated high levels of total and fecal coliform bacteria in the oyster beds under flooding conditions. Following FDA recommendations, the state conducted a second survey study during fall and winter of 1973. This study indicated that the area did not meet the National Shellfish Sanitation Program (NSSP) guidelines and standards and that a potential hazard situation existed unless further research could demonstrate that the high bacterial counts were not of direct fecal origin and therefore not indicative of a public health hazard.

The FDA in cooperation with the state of Oregon conducted further comprehensive monitoring studies in November of 1974 and May of 1976 and again in November of 1977.

The purpose of these studies was to quantify the seasonal effect of bay pollution as well as to identify major contributing sources of fecal bacteria. Several of their more significant conclusions follow:

1) Tillamook Bay and its tributary streams are contaminated by fecal waste regardless of weather and tidal conditions.
2) Field observations and bacterial tests indicate that a substantial percentage of the total of fecal coliform organisms recovered from the water samples were of human and bovine origin.
3) The recovery of Salmonella organisms at two sampling stations in the conditionally approved area for oyster harvest indicated fecal contamination and a potential health hazard.
4) Levels of indicator organisms found in shellfish harvested from conditionally approved areas in the bay exceed NSSP wholesale market bacteriological standards.
5) In order to utilize shellfish for fresh or frozen use directly from Tillamook Bay, the lower part of the bay must be classified as conditionally approved according to criteria of NSSP.
6) The water quality in the lower part of Tillamook Bay is good under conditions of low rainfall and ideal sewage treatment plant operation in the

area. This combination, however, has not been shown to be typical in the bay area.

As can be summarized from the conclusions, the "conditionally approved" concept of the area is of great importance. This concept allows the utilization of shellfish for fresh or frozen use from areas that would have to be classified as prohibited to shellfishing otherwise. Conditional approval designates an area where pollution sources exist, but through adequate control or knowledge of these sources, management authorities are able to predict when a growing area will become polluted so that appropriate measures can be taken to prevent harvest of shellfish during these periods. In the Tillamook Bay area these sources are both of the point (i.e. sewage treatment plant outfalls) and nonpoint (i.e. rainfall runoff) variety.

Beside the public health concerns, there are several legal concerns present in the basin. First, the FDA standards for water quality, as previously mentioned, are presently not complied with for much of the year in the Tillamook Bay. Alternatively, compliance with FDA criteria for conditionally approved waters means closure of the area to shellfish harvesting or loss of state control over their shellfish program and subsequent compliance forced under federal jurisdiction. This is not a very popular alternative to the state or the local people.

A second legal consideration is Public Law 90.500, section 504 which states "notwithstanding any other provision of this act, the administration, upon receipt of evidence that a pollution source or combination of sources is presenting an eminent and substantial endangerment to the health of persons or the welfare of persons where such endangerment is to the livelihood of such persons, such as the inability to market shellfish, may bring suit on behalf of the United States in the appropriate District Court to immediately restrain any person causing or contributing to the alleged pollution, to stop the discharge of pollutants causing or contributing to such a problem, or take other action as may be necessary." This act may enable a legal confrontation to occur between the shellfish industry and the sources of fecal pollution in the bay. Presently, the shellfish industry has refrained from this approach and has chosen to cooperate with local industry and state agencies to reduce bay pollution. In the fall of 1977, however, after an extensive period of flooding, the bay was closed by the state to shellfishing. If repeated such episodes occur, it is forseeable that the shellfish industry would pursue its legal option, due to the economic burden they would undergo during these periods, and shutdown the source discharges (i.e. local dairies).

APPENDIX B

Tillamook Bay Area Description

The following information was supplied by the U.S. Soil Conservation Service.

The Tillamook Bay drainage basin is located in northwestern Oregon and is bounded on the east by the crest of the coast mountain range and on the west by the Pacific Ocean. The basin covers a total of 363,520 acres, of which 323,050 acres are bush, cutover, and forested land on moderate to steep slopes and deeply incised canyons; 29,490 acres are non-forest and flat to gently sloping urban, agricultural, and miscellaneous land; the remaining 10,980 acres include the rivers and the bay area.

The bay is about six miles long in a southeast to northwest direction, two miles wide, less than six feet in average depth and barred with only a 1200 foot opening to the ocean. Steep uplands surround the estuary to the northeast and southwest. To the southeast is a broad flood plain created by four rivers: the Tillamook, Wilson, Trask, and Kilchis. A fifth river, the Miami, enters the estuary at Miami Cove east of the town of Garibaldi on a narrow flood plain. These five rivers drain the 363,520 acre area on the west slopes of the Coast Range. Elevations range from sea level to over 3000 feet.

Climate in the Tillamook area is under a strong marine influence from the Pacific Ocean. Wet winters and dry summers are typical with comparatively narrow ranges in seasonal temperatures. Frequent storms from the southwest during November to May drop large amounts of precipitation in short periods. Average annual precipitation for the basin is 115 inches, with a 90 inch average at Tillamook and up to 150 inches at higher elevations. At Tillamook, the average January temperature is $42^{o}F$ and the average July temperature is $58^{o}F$. Temperatures seldom drop below freezing near the estuary shoreline, resulting in a growing season of 190 days without a killing frost. Fog is common throughout the year, particularly during the night and morning hours.

The Tillamook area suffers annual winter flooding on the Tillamook floodplain. The causes are numerous and include heavy rainfall, rapid surface runoff, low bedrock permeability, extensive floodplain area, high water tables, log jams, high tides, gravel and silt-clogged rivers and estuary, and strong winds.

APPENDIX C

Soils Description

The soils present in the agricultural production areas of the Tillamook basin are chiefly flood plain bottomlands. The Soil Conservation Service (SCS) soil surveys have identified the following soil associations as those present. These soils are all predominantly used for hay and pasture production.

1) Coquille-Brailler Association (0-3% slopes) - The Coquille series is a very deep, very poorly drained soil subject to tidal overwash. The surface layer is a very dark brown mottled silt loam. The subsoil is a dark grayish brown silty clay loam. The Brailler series is a very deep, very poorly drained peat soil subject to tidal or stream flooding. The surface is dark brown peat and the subsoil is dark brown peat underlain by layers of peat and muck.

2) Chitwood-Brenner Association (0-12% slopes) - The Chitwood series is a very deep somewhat poorly to moderate well-drained soil. The surface layer is a dark grayish brown silt loam over a mottled yellowish brown silty clay.

The Brenner series is a very deep, poorly drained soil, subject to flooding. The surface layer is a dark grayish brown silt loam. The subsoil is a dark grayish brown mottled silty clay.

3) Nehalem-Brenner Association (0-3% slopes) - The Nehalem series is a very deep, well to moderately-well drained soil, subject to flooding. The surface layer is a very dark brown silt loam. The subsoil is a dark brown silty clay loam. The Brenner series has been identified above.

4) Knappa-Gauldy Association (0-12% slopes) - The Knappa series is a very deep well-drained soil. The surface layer is a very dark brown silt-loam. The subsoil is a dark yellowish brown silty clay loam. The Gauldy series is a deep, excessively drained soil, subject to flooding. The surface layer is a dark brown loam. The subsoil is dark yellowish brown loam. The substratum is very gravelly sand.

5) Quillayute-Guiger Association (0-12% slopes) - The Quillayute series is a very deep, well-drained soil. The surface layer is a black silt loam. The subsoil is a yellowish brown silty clay loam. The Guiger series is a deep, somewhat

poorly drained soil. The surface layer is a black silt loam and the subsoil is a mottled grayish brown silty clay.

These agricultural soils are placed into hydrologic groups according to their potential to yield runoff and transmit water. The runoff potential of the soils in various hydrologic groups varies from those that shed almost no precipitation (group I) to those that shed nearly all the precipitation (group IV).

Group I - Coarse and moderately coarse textured soils and peat soils that transmit water through their profile and substratum at a high rate. These soils have the lowest runoff potential, include the Gauldy and Gardiner series and comprise 6 percent of the study area.

Group II - Medium to fine textures, moderately deep to very deep soils having a moderate rate of water transmission through the profile. These soils have a low runoff potential, include the Nehalem, Quillayute, and Knappa series, and comprise 84.3 percent of the study area.

Group III - Fine textured, deep and very deep soils that have a slow rate of water transmission through the subsoil. These soils have a high runoff potential, include the Guiger, Coquille, Brenner, and Chitwood series, and comprise 6.2 percent of the study area.

Group IV - Fine textured, deep soils, with impervious material exposed or covered by a thin mantle of soil. These soils have the highest runoff potential, include the tidal flats, rockland and the Hebo series, and comprise 2.9 percent of the study area.

The following table further characterizes the above mentioned soils.

Table 12. Tillamook Basin Soil Characteristics.

Group	Series Name	Infiltration Rate (in/hr.)	Water Table Depth (ft)	Available Water (in/in)
I	Gardiner	2.0-6.0	6	0.16
	Gauldy	2.0-6.0	6	0.16
II	Nehalem	0.6-2.0	3.0-6.0	0.20
	Quillayute	0.6-2.0	6	0.24
	Knappa	0.6-2.0	6	0.20
III*	Guiger	0.6-2.0	1.0-1.5	0.21
	Brenner	0.6-2.0	1.0-3.5	0.20
	Chitwood	0.2-0.6	1.0-3.0	0.18
IV	Hebo	0.2-0.6	0.0-1.0	0.18

*Groups III and IV may also have problems of high or perched water tables.

The Nehelam and Coquille soils were chosen as representative soils to study in the Tillamook Basin, as together these soils comprise about 90 percent of the basin's soils. The data for these soils was obtained from SCS soil data and studies by J. A. Vomicil of the Oregon State University Soil Science Department.

The soil profile water capacity is dependent upon the depth of the water table and the specific data for Nehelam soil is graphically displayed in Figure 1.

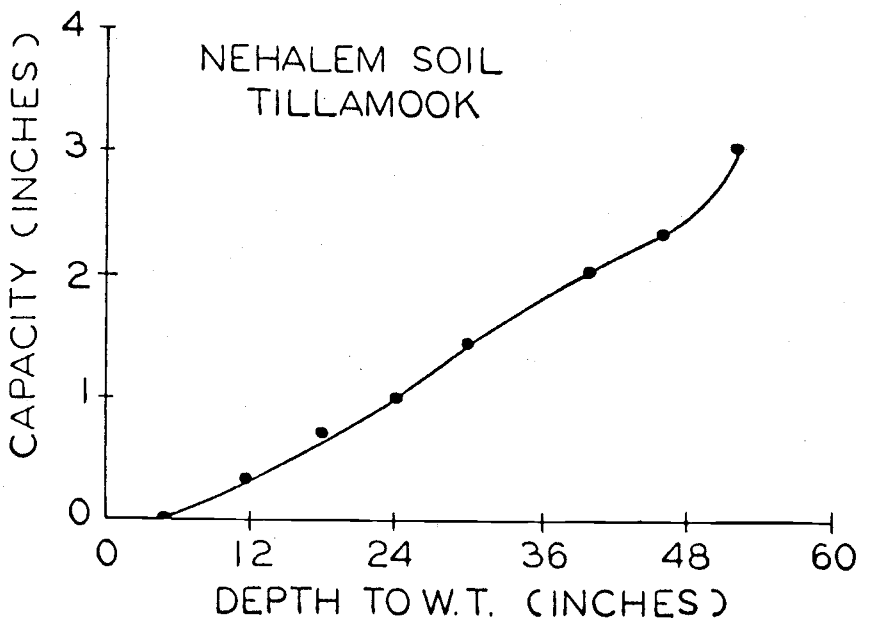

Figure 1. Water table depth vs. water capacity.

The water capacity was chosen based upon the average water table depths for summer and winter and these were identified by the SCS as at least three feet and eighteen inches, respectively. From Figure 1 above, it can be seen that these values correspond to water capacities of two inches and 0.6 inches. Similar observations were made for the Coquille soil, and these values were chosen to represent a soil that would be "worse" than the Nehelam. The drainage rates of these soils with and without drainlines were also identified by J. A. Vomicil and are tabulated below with profile water capacities.

Identifying these two soil varieties enabled a comparison to be made between different soil types and their effect upon the runoff water quality of waste applied lands.

Table 13. Nehelam and Coquille Soil Parameters.

Description	Parameter
Nehelam soil water capacity	
- summer	2.00 in
- winter	0.60
drainage rate without drainlines	0.08 in/day
drainage rate with drainlines	0.60
Coquille soil water capacity	
- summer	0.90 in
- winter	0.20
drainage rate without drainlines	0.02 in/day
drainage rate with drainlines	0.20

APPENDIX D

Model FORTRAN Program and Table 11 Data Results

The following FORTRAN program was used to evaluate the management procedures listed in Table 11. The computer output tables for the examples in Table 11 follow the FORTRAN program.

```
*MO ... PREDICTION OF MICRO-ORGANISM (FECAL COLIFORM) LEVELS
*   IN MANURE, STORAGE TANK, AND ON FIELD WHERE APPLIED IN BULK (DRY)
*   OR BY SPRAYING OR IRRIGATING (WET WITH DILUTION ACCOUNTED FOR)
*
      PROGRAM MO(INPUT,OUTPUT,REPORT,WETHR,
     +  TAPE1=INPUT,TAPE2=OUTPUT,TAPE3=REPORT,TAPE4=WETHR)
      DIMENSION AUVOL(3),FCVOL(3),SCAPY(2,2),DR(2),
     +  APPLY(3),APRATE(3),DOFF(2)
      DATA AUVOL/2.85,4.35,36.0/,
     +  FCVOL/1.89E9,1.24E9,1.5E8/,
     +  ((SCAPY(NSOIL,NSEASN),NSEASN=1,2),NSOIL=1,2)/2.0,0.6,0.9,0.2/,
     +  ((DR(NSOIL),NSEASN=1,2),NSOIL=1,2)/0.08,0.02/,
     +  DOFF/0.6,0.7/,APRATE/0.211,0.138,0.0167/,NPER0,NPER1,NPER2/3*0/,
     +  APPLY/1.0,0.75,1.0/
      DATA AREA,TVOL,TMO,FMO,SWTR/5*0.0/,
     +  NAU,NAU2,MGMT,MGMT2/100,3*0/,
     +  NDOUT/1HN/
      NAMELIST/INL/TVOL,TMO,FMO,SWTR
      NAMELIST/DAY/NDAY,NTOT,NSEASN,DR,MGMT,NAU
      NAMELIST/TANK/TVOL,TMO,CONCMO
      NAMELIST/FIELD/SPRED,AREA,AREASP,AREATOT,ACONC,RCONC,
     +  DEPTH,PRECIP,SPRAY,SCAPY,SWTR,SOAK,RUNOFF,AMO,DMO,SMO,RMO,
     +  FMO,XNITRO
      PRINT INL
      PRINT*,
     +  "ABOVE VALUES MAY BE CHANGED BY NAMELIST ENTRY (CR=O.K.)"
      READ INL  $  IF(EOF(1).NE.0)CONTINUE
*
*
*  ACONC - CONCENTRATION OF M.O.PER UNIT AREA OF FIELD (#/SQ.FT)
*  AMO - NO.OF M.O.APPLIED TO FIELD
*  APPLY - APPLICATION CODE - APPLY(MGMT)
*     (1=DRY HAUL, 2=LIQUID TANKER, 3=IRRIGATION)
*  APRATE - NITROGEN APPLIC.RAT (LB/CU.FT) - APRATE(MGMT)
*  AREA - AREA (ACRES) AFFECTED BY SPREADING
*  AREASP - AREA BY WHICH TO INCREMENT CURRENTLY SPREAD AREA (ACRES)
*  AREATOT - FIELD SIZE (I/O IN ACRES, CALC.USING SQ.FT)
*  AUVOL - VOL.OF MANURE PER AU PER DAY (CU.FT/AU) - AUVOL(MGMT)
*  CONCMO - CONCENTRATION IN TANK (#/CU.FT)
*  DEPTH - DEPTH OF SPREAD OVER FIELD (FT)
*  DMO - NO.OF M.O.REMAINING ON FIELD AFTER DIE-OFF
*  DOFF - M.O.DIE-OFF RATE ON FIELD SURFACE - DOFF(NSEASN)
*  DR - SOIL DRAINAGE RATE (IN/DAY) - DR(NSOIL)
*  FCVOL - M.O./CU.FT OF TANK VOLUME - FCVOL(MGMT)
*  FMO - NO.OF M.O.ON FIELD SURFACE AT END OF DAY
*  IBUFFR - BUFFER ZONE INDEX (YES=BUFFER ZONE EXISTS BETWEEN FIELD & STREAM)
*  IDRAIN - DRAINAGE INDEX (YES=DRAINLINES USED IN FIELD)
*  MGMT - MANAGEMENT PRACTICE CODE (1-3)
*  NAU - NO.OF ANIMAL UNITS (COWS,ETC.)
*  NDAY - CURRENT DAY NO.
*  NPER1 - NO.OF DAYS AT GIVEN CODE (MGMT)
*  NPER2 - NO.OF DAYS TO CONTINUE SPREADING RATE
*  NSEASN - SEASON INDEX DETERMINED BY MONTH (FR.PRECIP.FILE)
*  NSOIL - SOIL TYPE (1=NEHALEM, 2=COQUILLE)
```

```
*  NTOT - SIMULATION SPAN (DAYS)
*  PRECIP - PRECIPITATION (IN)
*  RACONC - CONCENTRATION OF M.O. IN RUNOFF AT END OF DAY (#/ACRE)
*  RCONC - CONCENTRATION OF M.O.IN RUNOFF AT END OF DAY (#/100ML)
*  RMO - NO.OF M.O.IN FIELD RUNOFF
*  RUNOFF - AMOUNT OF PRECIP REMAINING ON SURFACE FOR RUNOFF (IN)
*  SCAPY - TOTAL SOIL WATER CAPACITY (IN) - SCAPY(NSOIL,NSEASN)
*  SMO - NO.OF M.O.REMAINING ON FIELD AFTER INFILTRATION
*  SOAK - AMOUNT OF WATER SOIL CAN ACCEPT FROM PRECIP (IN)
*  SPRAY - FIELD DEPTH OF IRRIGATED APPLICATION (IN)
*  SPRED - VOLUME SPREAD OVER FIELD FROM TANK (CU.FT)
*  SWTR - WATER CURRENTLY IN SOIL (IN)
*  TMO - NO.OF MICRO-ORGANISMS IN TANK
*  TVOL - STORAGE TANK VOLUME (CU.FT)
*  XNITRO - NITROGEN APPLIED (LB/A)
*
      PRINT*,"ENTER NO.OF DAYS TO RUN:K"
      READ*,NTOT  $  IF(EOF(1).NE.0)NTOT=1
      PRINT*,"DO YOU WANT DAILY OUTPUT AT THE TERMINAL :K"
      READ 33,NDOUT  $  IF(EOF(1).NE.0)NDOUT=1HN
      IF(NDOUT.NE.1HY)NDOUT=1HN
      PRINT*,"ENTER FIELD AREA (ACRES) :K"
      READ*,AREATOT  $  IF(EOF(1).EQ.0)GOTO 3
    2 PRINT*,"**INSUFFICIENT INITIAL DATA"
      STOP
    3 AREATOT=43560.*AREATOT
      PRINT*,"IS FIELD DRAINED WITH DRAINLINES (Y/N) :K"
      READ 33,IDRAIN  $  IF(EOF(1).NE.0)IDRAIN=1HN
   33 FORMAT(A1)
      PRINT*,"IS THERE A BUFFER ZONE BETWEEN FIELD & STREAM (Y/N):K"
      READ 33,IBUFFR  $  IF(EOF(1).NE.0)IBUFFR=1HN
      PRINT*,"ENTER SOIL TYPE (1=NEHALEM, 2=COQUILLE):K"
      READ*,NSOIL  $  IF(EOF(1).NE.0)GOTO 2
*
* DAILY LOOP ...
      PRINT 100
      REWIND 3  $  WRITE(3,300)
  300 FORMAT(1H1/
     + /16X,"PRECIP",5X,"SOIL",5X,"STORAGE",
     + 4X,"STORAGE",5X,"NITROGEN"
     + /10X,"DAY",3X,"+IRRIG",3X,"MOISTURE",4X,"VOLUME",
     + 3X,"CONC(X1E6)",5X,"RATE",5X,"APPLIED FC",
     + 2(5X,"RUNOFF FC"),5X,"RUNOFF FC"
     + /17X,"(IN)",6X,"(IN)",5X,"(CU.FT)",3X,"(FC/CU.FT)",
     + 3X,"(LB-N/A)",2X."(X1E3/SQ.FT)",
     + 2X,"(X1E3/100ML)",3X,"(X1E6/ACRE)",5X,"(X1E9)"
     + /9X,114(1H.)/)
*
      DO 4 NDAY=1.NTOT
      IF(NPERO.GT.0)GOTO 1
      PRINT*."ENTER NO.OF COWS & PERIOD (CR=NO CHANGE)"
      PRINT*,"COWS :K"
      READ*.XXIN
      IF(EOF(1).EQ.0)NAU=XXIN
```

```
      PRINT*,"DAYS :K"
      READ*.NPERO
      IF(EOF(1).NE.0)NPERO=1
    1 NPERO=NPERO-1
      READ(4,401)MONTH,PRECIP  $  IF(EOF(4).EQ.0)GOTO 101
401   FORMAT(T9,I2,T23,F4.2)
      PRINT*,"PRECIP.FILE ERROR--EOF"  $  STOP"PRECIP.FILE ERROR--EOF"
101   NSEASN=2
      IF(MONTH.GE.6.AND.MONTH.LE.9)NSEASN=1
      IF(NPER1.GT.0)GOTO 44
      PRINT*,"ENTER MGMT.PRACT.CODE (1-3) & PERIOD (DAYS)"
      PRINT*,"   (1=DRY HAUL, 2=LIQUID TANKER, 3=IRRIGATION)"
      PRINT*,"CODE :K"
      READ*,MGMT  $  IF(EOF(1).NE.0)GOTO 2
      PRINT*,"DAYS :K"
      READ*,NPER1  $  IF(EOF(1).NE.0)NPER1=1
   44 NPER1=NPER1-1
      IF(NPER2.GT.0)GOTO 46
      PRINT*,"ENTER AMOUNT SPREAD (CU.FT):K"
      READ*,SPRED  $  IF(EOF(1).NE.0)SPRED=0.0
      IF(MGMT.NE.3)GOTO 450
      AREASP=AREA=AREATOT
      GOTO 451
  450 PRINT*,"ENTER NEW AREA (ACRES) TO BE COVERED :K"
      READ*,AREASP  $  IF(EOF(1).NE.0)AREASP=AREATOT/43560.
      AREASP=AREASP*43560.
  451 PRINT*,"ENTER NO.OF DAYS TO SPREAD AT THIS RATE:K"
      READ*,NPER2  $  IF(EOF(1).NE.0)NPER2=1
   46 NPER2=NPER2-1
*
      CALL STORE
     + (TVOL,NAU,AUVOL,TMO,CONCMO,SPRED,MGMT,FCVOL)
*
      CALL SPREAD
     + (DEPTH,SPRED,AREA,AREASP,AREATOT,ACONC,CONCMO,AMO,SPRAY,APPLY,
     + XNITRO,APRATE,MGMT)
*
      CALL INFILT(IDRAIN,IBUFFR,
     + AMO,SMO,RMO,DMO,FMO,PRECIP,SOAK,SCAPY,SWTR,RUNOFF,DR,
     + DOFF,NSOIL,NSEASN,SPRAY,RCONC,RACONC,AREA,MGMT)
*
*
      IF(NDOUT.NE.1HY)GOTO 99
      PRINT*," "  $  PRINT DAY
      PRINT*," "  $  PRINT TANK
      PRINT*," "  $  PRINT FIELD
   99 PRINT 100
  100 FORMAT(/10(5H   ==)/)
*
      IF(NAU.NE.NAU2.OR.MGMT.NE.MGMT2)
     + WRITE(3,302)NAU,MGMT
  302 FORMAT(/15X,"[ NO. OF ANIMAL UNITS =",I5,
     + " / MANAGEMENT PRACTICE CODE =",I2,2H ]/)
      WRITE(3,301)NDAY,PRECIP+SPRAY,SWTR,TVOL,CONCMO/1.E6,
```

```
     +  XNITRO,ACONC/1.E3,RCONC/1.E3,RACONC/1.E6,RMO/1.E9
 301  FORMAT(9X,I4.3,3X,F6.2,4X,F6.2,3X,F8.0,2X,F9.1,5X,F8.2,2X,
     +  4(3X,F9.1,2X))
      NAU2=NAU
      MGMT2=MGMT
*
  4   CONTINUE
*
*
      REWIND 3
      STOP
      END
*STORE
      SUBROUTINE STORE
     +  (TVOL,NAU,AUVOL,TMO,CONCMO,SPRED,MGMT,FCVOL)
      DIMENSION AUVOL(3),FCVOL(3)
CALC.NEW TANK VOL.WITH ADDED MANURE (MAY BE DILUTED)
CALC.NEW TANK M.O.LEVEL AFTER DIE-OFF + MANURE ADDITION
CALC.TANK CONC.OF M.O.
CALC.NEW TANK VOL.AFTER SPREADING
CALC.NEW TANK M.O.LEVEL AFTER SPREADING
      TVOL=TVOL+NAU*AUVOL(MGMT)
      TMO=TMO*0.741+FCVOL(MGMT)*NAU*AUVOL(MGMT)
      CONCMO=TMO/TVOL
CHECK FOR ATTEMPT TO SPREAD MORE THAN AVAILABLE VOLUME (ADJUST)
      IF(SPRED.GT.TVOL)SPRED=TVOL
      TVOL=TVOL-SPRED
      TMO=TVOL*CONCMO
*
      RETURN
      END
*SPREAD
      SUBROUTINE SPREAD
     +  (DEPTH,SPRED,AREA,AREASP,AREATOT,ACONC,CONCMO,AMO,SPRAY,APPLY,
     +  XNITRO,APRATE,MGMT)
      DIMENSION APPLY(3),APRATE(3)
* ADD NEW AREA IN CASE SPREADING IS ROTATED
      IF(SPRED.GT.0)AREA=AREA+AREASP
      IF(AREA.GT.AREATOT)AREA=AREATOT
CALC.DEPTH OF MANURE SPREAD OVER FIELD
CALC.FIELD CONC.PER UNIT AREA AND NO.OF M.O.APPLIED
      DEPTH=SPRAY=XNITRO=0.0
      IF(AREA.GT.0)DEPTH=SPRED/AREA
      IF(MGMT.EQ.3)SPRAY=DEPTH*12.
      ACONC=DEPTH*CONCMO*APPLY(MGMT)
      IF(AREASP.GT.0)XNITRO=APRATE(MGMT)*SPRED*43560./AREASP
      AMO=SPRED*CONCMO*APPLY(MGMT)
*
      RETURN
      END
*INFILT
      SUBROUTINE INFILT(IDRAIN,IBUFFR,
     +  AMO,SMO,RMO,DMO,FMO,PRECIP,SOAK,SCAPY,SWTR,RUNOFF,DR,
     +  DOFF,NSOIL,NSEASN,SPRAY,RCONC,RACONC,AREA,MGMT)
```

```
      DIMENSION SCAPY(2,2),DR(2),DOFF(2)
CALC.SOIL MOIST.LEVEL, RUNOFF & INFILTRATION
CALC.NO.OF M.O.ON FIELD SURFACE AFTER INFILT.
CALC.NO.OF M.O.ON SURFACE AT END OF DAY
      FMO=FMO+AMO
      DMO=FMO=FMO*DOFF(NSEASN)
      SMO=RMO=SOAK=RUNOFF=RCONC=RACONC=0.0
*
      IF(PRECIP+SPRAY.EQ.0)GOTO 3
      SOAK=SCAPY(NSOIL,NSEASN)-SWTR
      RUNOFF=PRECIP+SPRAY-SOAK
      IF(RUNOFF.LT.0.0)RUNOFF=0.0
      SOAK=PRECIP+SPRAY-RUNOFF
*
      IF(MGMT.EQ.3.AND.SOAK.GT.DR(NSOIL))GOTO 1
      SMO=FMO=FMO-0.05*SOAK*FMO
      GOTO 2
   1  SMO=FMO=FMO-0.2*SOAK*FMO
*
   2  IRUN=INT(RUNOFF)
      FRUN=RUNOFF-IRUN
      FMO2=FMO*(1.-.4)**IRUN*(1.-FRUN*.4)
      RMO=FMO-FMO2
      FMO=FMO2
*             (SATURATED SOIL)
      IF(MGMT.EQ.3.AND.SOAK.EQ.DR(NSOIL))
     +  RMO=AMO-0.2*SOAK*AMO+RMO
      IF(RUNOFF.LE.0)GOTO 3
      IF(IBUFFR.EQ.1HY)RMO=0.4*RMO
      RCONC=RACONC=0.0
      IF(AREA.LE.0)GOTO 3
      RCONC=RMO/(AREA*RUNOFF*23.6)
      RACONC=RMO/(AREA/43560.)
*
   3  IF(IDRAIN.EQ.1HY)SWTR=0.0
      IF(IDRAIN.NE.1HY)SWTR=SWTR+SOAK-DR(NSOIL)
      IF(SWTR.LT.0.0)SWTR=0.0
      RETURN
      END
```

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X1E6) (FC/CU.FT)	NITROGEN RATE (LB N/A)	APPLIED FC (X1E3/SQ.FT)	RUNOFF FC (X1E3/100ML)	RUNOFF FC (X1E6/ACRE)	RUNOFF FC (X1E9)
[NO. OF ANIMAL UNITS = 100 / MANAGEMENT PRACTICE CODE = 1]									
001	0.00	0.00	0.	1890.0	24.05	4746.3	0.0	0.0	0.0
002	1.02	.52	0.	1890.0	24.05	2473.1	17.4	6856.5	41.6
003	.60	.52	0.	1890.0	24.05	1618.8	15.3	8167.1	61.3
004	.76	.52	0.	1890.0	24.05	1206.6	12.2	6506.2	65.1
005	.40	.52	0.	1890.0	24.05	929.3	7.6	3164.1	59.6
006	0.00	.44	0.	1890.0	24.05	824.4	0.0	0.0	0.0
007	0.00	.36	0.	1890.0	24.05	706.6	0.0	0.0	0.0
008	0.00	.28	0.	1890.0	24.05	618.3	0.0	0.0	0.0
009	0.00	.20	0.	1890.0	24.05	549.6	0.0	0.0	0.0
010	0.00	.12	0.	1890.0	24.05	494.6	0.0	0.0	0.0
011	.25	.29	0.	1890.0	24.05	449.7	0.0	0.0	0.0
012	.20	.41	0.	1890.0	24.05	412.2	0.0	0.0	0.0
013	.66	.52	0.	1890.0	24.05	380.5	5.7	3945.3	128.2
014	.54	.52	0.	1890.0	24.05	353.3	4.4	2073.4	71.6
015	.65	.52	0.	1890.0	24.05	329.8	3.9	2277.5	75.4
016	.27	.52	0.	1890.0	24.05	309.1	3.4	666.5	26.7
017	0.00	.44	0.	1890.0	24.05	291.0	0.0	0.0	0.0
018	.47	.52	0.	1890.0	24.05	274.8	3.6	1136.3	51.1
019	1.40	.52	0.	1890.0	24.05	260.3	3.0	4636.0	171.7
020	2.70	.52	0.	1890.0	24.05	247.3	4.6	4330.2	216.5
021	1.18	.52	0.	1890.0	24.05	235.5	1.5	1465.3	37.5
022	.48	.52	0.	1890.0	24.05	224.8	1.6	678.0	37.3
023	.13	.52	0.	1890.0	24.05	215.1	1.7	139.6	5.0
024	0.00	.44	0.	1890.0	24.05	206.1	0.0	0.0	0.0
025	.65	.52	0.	1890.0	24.05	197.9	2.4	1722.4	76.4
026	.55	.52	0.	1890.0	24.05	190.2	2.2	617.6	59.8
027	0.00	.44	0.	1890.0	24.05	183.2	0.0	0.0	0.0
028	0.00	.36	0.	1890.0	24.05	176.7	0.0	0.0	0.0
029	.33	.52	0.	1890.0	24.05	170.6	2.3	217.4	15.0
030	.10	.52	0.	1890.0	24.05	164.9	2.7	47.4	3.6
031	0.00	.44	0.	1890.0	24.05	159.6	0.0	0.0	0.0
032	.12	.48	0.	1890.0	24.05	154.6	0.0	0.0	0.0
033	0.00	.40	0.	1890.0	24.05	149.9	0.0	0.0	0.0
034	.67	.52	0.	1890.0	24.05	145.5	2.2	1065.3	90.5
035	.63	.52	0.	1890.0	24.05	141.3	1.2	1192.2	101.5
036	1.05	.52	0.	1890.0	24.05	137.4	1.6	1613.6	145.2
037	1.06	.52	0.	1890.0	24.05	133.7	1.3	1513.4	121.5
038	1.21	.52	0.	1890.0	24.05	130.2	1.1	1278.1	121.4
039	0.00	.44	0.	1890.0	24.05	126.8	0.0	0.0	0.0
040	0.00	.36	0.	1890.0	24.05	123.7	0.0	0.0	0.0
									1848.5

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC.(X10^6) (FC/CU.FT)	NITROGEN RATE (LB-N/A)	APPLIED FC (X10^3/SQ.FT)	RUNOFF FC (X10^3/100ML)	RUNOFF FC (X10^6/ACRE)	RUNOFF FC (X10^9)
[NO. OF ANIMAL UNITS = 100 / MANAGEMENT PRACTICE CODE = 2]									
001	0.00	0.00	0.	1240.0	24.01	3714.9	0.0	0.0	0.0
002	1.02	.52	0.	1240.0	24.01	1357.4	14.3	6276.1	31.4
003	.60	.52	0.	1240.0	24.01	1038.3	11.5	6155.8	46.6
004	.76	.52	0.	1240.0	24.01	828.7	9.1	6336.6	63.9
005	.40	.52	0.	1240.0	24.01	745.0	7.2	2376.4	29.7
006	0.00	.44	0.	1240.0	24.01	613.1	0.0	0.0	0.0
007	0.00	.36	0.	1240.0	24.01	530.7	0.0	0.0	0.0
008	0.00	.28	0.	1240.0	24.01	464.4	0.0	0.0	0.0
009	0.00	.20	0.	1240.0	24.01	412.5	0.0	0.0	0.0
010	0.00	.12	0.	1240.0	24.01	371.5	0.0	0.0	0.0
011	.25	.29	0.	1240.0	24.01	337.7	0.0	0.0	0.0
012	.20	.41	0.	1240.0	24.01	309.6	0.0	0.0	0.0
013	.86	.52	0.	1240.0	24.01	285.8	4.0	2963.1	96.3
014	.54	.52	0.	1240.0	24.01	265.3	3.3	1557.2	54.5
015	.65	.52	0.	1240.0	24.01	247.7	2.9	1710.5	64.1
016	.27	.52	0.	1240.0	24.01	232.2	2.6	502.1	20.1
017	0.00	.44	0.	1240.0	24.01	218.5	0.0	0.0	0.0
018	.47	.52	0.	1240.0	24.01	206.4	2.7	853.4	38.4
019	1.40	.52	0.	1240.0	24.01	195.5	2.2	3031.2	144.0
020	2.70	.52	0.	1240.0	24.01	185.7	1.2	3252.2	162.6
021	1.18	.52	0.	1240.0	24.01	176.9	1.1	1251.1	65.7
022	.48	.52	0.	1240.0	24.01	168.9	1.2	509.2	20.0
023	.15	.52	0.	1240.0	24.01	161.5	1.5	104.9	6.0
024	0.00	.44	0.	1240.0	24.01	154.8	0.0	0.0	0.0
025	.65	.52	0.	1240.0	24.01	148.6	1.8	918.1	57.4
026	.35	.52	0.	1240.0	24.01	142.9	1.7	460.1	29.7
027	0.00	.44	0.	1240.0	24.01	137.6	0.0	0.0	0.0
028	0.00	.36	0.	1240.0	24.01	132.7	0.0	0.0	0.0
029	.33	.52	0.	1240.0	24.01	128.1	1.8	165.3	11.3
030	.10	.52	0.	1240.0	24.01	123.8	1.7	35.6	2.7
031	0.00	.44	0.	1240.0	24.01	119.8	0.0	0.0	0.0
032	.12	.48	0.	1240.0	24.01	116.1	0.0	0.0	0.0
033	0.00	.40	0.	1240.0	24.01	112.6	0.0	0.0	0.0
034	.67	.52	0.	1240.0	24.01	109.3	1.7	800.1	63.0
035	.68	.52	0.	1240.0	24.01	106.1	1.4	871.2	7[illegible].2
036	1.65	.52	0.	1240.0	24.01	103.2	1.2	1211.7	109.1
037	1.06	.52	0.	1240.0	24.01	100.4	1.0	986.4	91.7
038	1.21	.52	0.	1240.0	24.01	97.8	[illegible].8	359.7	91.2
039	0.00	.44	0.	1240.0	24.01	95.3	0.0	0.0	0.0
040	0.00	.36	0.	1240.0	24.01	92.9	0.0	0.0	0.0
									1388.2

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X1E6) (FC/CU.FT)	NITROGEN RATE (LB N/A)	APPLIED FC (X1E3/SQ.FT)	RUNOFF FC (X1E3/100ML)	RUNOFF FC (X1E6/ACRE)	RUNOFF FC (X1E9)
[NO. OF ANIMAL UNITS = 100 / MANAGEMENT PRACTICE CODE = 3]									
001	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
002	1.03	.52	0.	150.0	.60	124.0	.3	388.9	38.9
003	.61	.52	0.	150.0	.60	124.0	1.1	582.3	55.9
004	.77	.52	0.	150.0	.60	124.0	1.7	826.7	82.7
005	.41	.52	0.	150.0	.60	124.0	1.2	320.5	32.0
006	.01	.45	0.	150.0	.60	124.0	0.0	0.0	0.0
007	.01	.38	0.	150.0	.60	124.0	0.0	0.0	0.0
008	.01	.31	0.	150.0	.60	124.0	0.0	0.0	0.0
009	.01	.24	0.	150.0	.60	124.0	0.0	0.0	0.0
010	.01	.17	0.	150.0	.60	124.0	0.0	0.0	0.0
011	.26	.35	0.	150.0	.60	124.0	0.0	0.0	0.0
012	.21	.48	0.	150.0	.60	124.0	0.0	0.0	0.0
013	.87	.52	0.	150.0	.60	124.0	1.3	1356.8	135.7
014	.55	.52	0.	150.0	.60	124.0	1.4	620.1	62.0
015	.66	.52	0.	150.0	.60	124.0	1.4	321.5	32.1
016	.28	.52	0.	150.0	.60	124.0	1.5	266.8	26.7
017	.01	.45	0.	150.0	.60	124.0	0.0	0.0	0.0
018	.48	.52	0.	150.0	.60	124.0	1.5	522.7	52.3
019	1.41	.52	0.	150.0	.60	124.0	1.4	1048.0	104.8
020	2.71	.52	0.	150.0	.60	124.0	.8	2123.7	212.4
021	1.17	.52	0.	150.0	.60	124.0	.8	864.2	86.4
022	.49	.52	0.	150.0	.60	124.0	.9	379.8	38.0
023	.16	.52	0.	150.0	.60	124.0	1.1	90.2	9.0
024	.01	.45	0.	150.0	.60	124.0	0.0	0.0	0.0
025	.66	.52	0.	150.0	.60	124.0	1.5	773.0	77.3
026	.36	.52	0.	150.0	.60	124.0	1.4	399.3	39.9
027	.01	.45	0.	150.0	.60	124.0	0.0	0.0	0.0
028	.01	.38	0.	150.0	.60	124.0	0.0	0.0	0.0
029	.34	.52	0.	150.0	.60	124.0	1.6	201.3	20.1
030	.11	.52	0.	150.0	.60	124.0	1.7	50.8	5.1
031	.01	.45	0.	150.0	.60	124.0	0.0	0.0	0.0
032	.13	.50	0.	150.0	.60	124.0	0.0	0.0	0.0
033	.01	.43	0.	150.0	.60	124.0	0.0	0.0	0.0
034	.68	.52	0.	150.0	.60	124.0	1.6	740.4	74.0
035	.69	.52	0.	150.0	.60	124.0	1.6	380.1	38.0
036	1.06	.52	0.	150.0	.60	124.0	1.4	1405.7	140.6
037	1.07	.52	0.	150.0	.60	124.0	1.2	1197.2	119.7
038	1.72	.52	0.	150.0	.60	124.0	1.0	1170.5	117.1
039	.01	.45	0.	150.0	.60	124.0	0.0	0.0	0.0
040	.01	.38	0.	150.0	.60	124.0	0.0	0.0	0.0
									1829.9

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC.(X1E6) (FC/CU.FT)	NITROGEN RATE (LB N/A)	APPLIED FC (X1E3/SQ.FT)	RUNOFF FC (X1E3/100ML)	RUNOFF FC (X1E6/ACRE)	RUNOFF FC (X1E9)

[NO. OF ANIMAL UNITS = 100 / MANAGEMENT PRACTICE CODE = 1]

001	0.00	0.00	285.	346.7	24.05	307.3	0.0	0.0	0.0
002	1.02	.52	570.	1073.4	0.00	0.0	2.7	1766.3	88.1
003	.60	.52	855.	1160.3	0.00	0.0	1.7	964.5	45.3
004	.76	.52	1140.	1117.3	0.00	0.0	.9	654.6	32.7
005	.40	.52	1425.	1040.4	0.00	0.0	.5	156.4	7.8
006	0.00	.44	1710.	957.4	0.00	0.0	0.0	0.0	0.0
007	0.00	.36	1995.	878.1	0.00	0.0	0.0	0.0	0.0
008	0.00	.28	2280.	805.6	0.00	0.0	0.0	0.0	0.0
009	0.00	.20	2565.	740.6	0.00	0.0	0.0	0.0	0.0
010	0.00	.12	2850.	682.9	0.00	0.0	0.0	0.0	0.0
011	.25	.27	3135.	631.9	0.00	0.0	0.0	0.0	0.0
012	.20	.41	3420.	586.7	0.00	0.0	0.0	0.0	0.0
013	.86	.52	3705.	546.7	0.00	0.0	.0	15.9	.8
014	.54	.52	3990.	511.2	0.00	0.0	.0	5.6	.3
015	.65	.52	4275.	479.5	0.00	0.0	.0	3.9	.2
016	.27	.52	4560.	451.2	0.00	0.0	.0	.7	.0
017	0.00	.44	4845.	425.9	0.00	0.0	0.0	0.0	0.0
018	.47	.52	5130.	403.0	0.00	0.0	.0	.5	.0
019	1.40	.52	5415.	382.4	0.00	0.0	.0	1.2	.1
020	2.70	.52	5700.	363.7	0.00	0.0	.0	.7	.0
021	1.18	.52	285.	346.7	24.05	450.6	2.1	2306.6	230.7
022	.48	.52	570.	1073.4	0.00	0.0	.9	554.1	55.4
023	.15	.52	855.	1160.3	0.00	0.0	.5	36.0	3.6
024	0.00	.44	1140.	1117.3	0.00	0.0	0.0	0.0	0.0
025	.65	.52	1425.	1040.4	0.00	0.0	.2	120.0	12.0
026	.35	.52	1710.	957.4	0.00	0.0	.1	37.1	3.7
027	0.00	.44	1995.	878.1	0.00	0.0	0.0	0.0	0.0
028	0.00	.36	2280.	805.6	0.00	0.0	0.0	0.0	0.0
029	.38	.52	2565.	740.6	0.00	0.0	.0	3.7	.4
030	.10	.52	2850.	682.9	0.00	0.0	.0	.6	.1
031	0.00	.44	3135.	631.9	0.00	0.0	0.0	0.0	0.0
032	.12	.48	3420.	586.7	0.00	0.0	0.0	0.0	0.0
033	0.00	.40	3705.	546.7	0.00	0.0	0.0	0.0	0.0
034	.67	.52	3990.	511.2	0.00	0.0	.0	3.1	.3
035	.68	.52	4275.	479.5	0.00	0.0	.0	2.2	.2
036	1.05	.52	4560.	451.2	0.00	0.0	.0	1.9	.2
037	1.06	.52	4845.	425.9	0.00	0.0	.0	.8	.1
038	1.21	.52	5130.	403.0	0.00	0.0	.0	.4	.0
039	0.00	.44	5415.	382.4	0.00	0.0	0.0	0.0	0.0
040	0.00	.36	5700.	363.7	0.00	0.0	0.0	0.0	0.0
									440.0

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X.FC) (FC/CU.FT)	NITROGEN RATE (LB N/A)	APPLIED FC (X1E3/SQ.FT)	RUNOFF FC (X1E3/100ML)	RUNOFF FC (X1E6/ACRE)	RUNOFF FC (X1E9)
	[NO. OF ANIMAL UNITS = 100 / MANAGEMENT PRACTICE CODE = 2]								
001	0.00	0.00	435.	227.4	24.01	651.4	0.0	0.0	0.0
002	1.02	.52	870.	704.3	0.00	0.0	7.2	945.6	47.4
003	.60	.52	1305.	761.2	0.00	0.0	1.3	650.9	34.0
004	.74	.52	1740.	733.1	0.00	0.0	.7	471.6	23.6
005	.40	.52	2175.	682.6	0.00	0.0	.4	117.4	5.9
006	0.00	.44	2610.	628.1	0.00	0.0	0.0	0.0	0.0
007	0.00	.36	3045.	576.1	0.00	0.0	0.0	0.0	0.0
008	0.00	.28	3480.	528.5	0.00	0.0	0.0	0.0	0.0
009	0.00	.20	3915.	485.2	0.00	0.0	0.0	0.0	0.0
010	0.00	.12	4350.	448.0	0.00	0.0	0.0	0.0	0.0
011	.25	.29	4785.	414.5	0.00	0.0	0.0	0.0	0.0
012	.20	.41	5220.	384.9	0.00	0.0	0.0	0.0	0.0
013	.86	.52	5655.	358.7	0.00	0.0	.0	12.0	.6
014	.54	.52	6090.	335.4	0.00	0.0	.0	4.2	.2
015	.65	.52	6525.	314.6	0.00	0.0	.0	3.0	.1
016	.27	.52	6960.	296.0	0.00	0.0	.0	.5	.0
017	0.00	.44	7395.	279.4	0.00	0.0	0.0	0.0	0.0
018	.47	.52	7830.	264.4	0.00	0.0	.0	.4	.0
019	1.40	.52	8265.	250.9	0.00	0.0	.0	.9	.0
020	2.70	.52	8700.	238.6	0.00	0.0	.0	.5	.0
021	1.18	.52	435.	227.4	24.01	340.7	1.6	1734.9	175.5
022	.48	.52	870.	704.3	0.00	0.0	.6	765.9	76.6
023	.15	.52	1305.	761.2	0.00	0.0	.3	27.3	2.7
024	0.00	.44	1740.	733.1	0.00	0.0	0.0	0.0	0.0
025	.65	.52	2175.	682.6	0.00	0.0	.2	90.1	9.0
026	.35	.52	2610.	628.1	0.00	0.0	.1	77.8	2.6
027	0.00	.44	3045.	576.1	0.00	0.0	0.0	0.0	0.0
028	0.00	.36	3480.	528.5	0.00	0.0	0.0	0.0	0.0
029	.33	.52	3915.	485.2	0.00	0.0	.0	2.8	.3
030	.10	.52	4350.	448.0	0.00	0.0	.0	.4	.0
031	0.00	.44	4785.	414.5	0.00	0.0	0.0	0.0	0.0
032	.12	.48	5220.	384.9	0.00	0.0	0.0	0.0	0.0
033	0.00	.40	5655.	358.7	0.00	0.0	0.0	0.0	0.0
034	.67	.52	6090.	335.4	0.00	0.0	.0	2.3	.2
035	.68	.52	6525.	314.6	0.00	0.0	.0	1.7	.2
036	1.05	.52	6960.	296.0	0.00	0.0	.0	1.4	.1
037	1.06	.52	7395.	279.4	0.00	0.0	.0	.6	.1
038	1.21	.52	7830.	264.4	0.00	0.0	.0	.3	.0
039	0.00	.44	8265.	250.9	0.00	0.0	0.0	0.0	0.0
040	0.00	.36	8700.	238.6	0.00	0.0	0.0	0.0	0.0
									330.0

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X1E6) (FC/CU.FT)	NITROGEN RATE (LB N/A)	APPLIED FC (X1E3/SQ.FT)	RUNOFF FC (X1E3/100ML)	RUNOFF FC (X1E6/ACRE)	RUNOFF FC (X1E9)
[NO. OF ANIMAL UNITS = 100 / MANAGEMENT PRACTICE CODE = 3]									
001	.20	.12	3600.	27.5	12.07	454.8	0.0	0.0	0.0
002	1.02	.52	7200.	85.2	0.00	0.0	1.3	725.6	72.6
003	.60	.52	10800.	92.1	0.00	0.0	.7	553.4	55.3
004	.76	.52	14400.	88.7	0.00	0.0	.4	278.5	27.4
005	.40	.52	18000.	82.6	0.00	0.0	.2	64.5	6.5
006	0.00	.44	21600.	76.0	0.00	0.0	0.0	0.0	0.0
007	0.00	.36	25200.	69.7	0.00	0.0	0.0	0.0	0.0
008	0.00	.28	28800.	63.9	0.00	0.0	0.0	0.0	0.0
009	0.00	.20	32400.	58.8	0.00	0.0	0.0	0.0	0.0
010	0.00	.12	36000.	54.2	0.00	0.0	0.0	0.0	0.0
011	.25	.29	39600.	50.1	0.00	0.0	0.0	0.0	0.0
012	.20	.41	43200.	46.6	0.00	0.0	0.0	0.0	0.0
013	.86	.52	46800.	43.4	0.00	0.0	.0	6.0	.6
014	.54	.52	50400.	40.6	0.00	0.0	.0	2.1	.2
015	.65	.52	54000.	38.1	0.00	0.0	.0	1.4	.1
016	.27	.52	57600.	35.8	0.00	0.0	.0	.3	.0
017	0.00	.44	61200.	33.8	0.00	0.0	0.0	0.0	0.0
018	.47	.52	64800.	32.0	0.00	0.0	.0	.2	.0
019	1.40	.52	68400.	30.3	0.00	0.0	.0	.4	.0
020	2.70	.52	72000.	28.7	0.00	0.0	.0	.2	.0
021	1.38	.52	3600.	27.5	12.02	454.8	1.9	2574.0	257.4
022	.43	.52	7200.	85.2	0.00	0.0	.8	321.7	32.2
023	.15	.52	10800.	97.1	0.00	0.0	.5	37.6	3.8
024	0.00	.44	14400.	88.7	0.00	0.0	0.0	0.0	0.0
025	.65	.52	18000.	82.6	0.00	0.0	.2	105.1	10.5
026	.35	.52	21600.	76.0	0.00	0.0	.1	32.1	3.2
027	0.00	.44	25200.	69.7	0.00	0.0	0.0	0.0	0.0
028	0.00	.36	28800.	63.9	0.00	0.0	0.0	0.0	0.0
029	.33	.52	32400.	58.8	0.00	0.0	.0	3.1	.3
030	.10	.52	36000.	54.2	0.00	0.0	.0	.5	.0
031	0.00	.44	39600.	50.1	0.00	0.0	0.0	0.0	0.0
032	.12	.48	43200.	46.6	0.00	0.0	0.0	0.0	0.0
033	0.00	.40	46800.	43.4	0.00	0.0	0.0	0.0	0.0
034	.67	.52	50400.	40.6	0.00	0.0	.0	2.4	.2
035	.68	.52	54000.	38.1	0.00	0.0	.0	1.7	.2
036	1.05	.52	57600.	35.8	0.00	0.0	.0	1.5	.1
037	1.06	.52	61200.	33.8	0.00	0.0	.0	.6	.1
038	1.71	.52	64800.	32.0	0.00	0.0	.0	.3	.0
039	0.00	.44	68400.	30.3	0.00	0.0	0.0	0.0	0.0
040	0.00	.36	72000.	28.7	0.00	0.0	0.0	0.0	0.0
									453.2

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X1E6) (FC/CU.FT)	NITROGEN RATE (LB-N/A)	APPLIED FC (X1E3/SQ.FT)	RUNOFF FC (X1E3/100ML)	RUNOFF FC (X1E6/ACRE)	RUNOFF FC (X1E9)

[NO. OF ANIMAL UNITS = 100 / MANAGEMENT PRACTICE CODE = 1]

001	0.00	0.00	285.	177.9	74.05	445.7	0.0	0.0	0.0
002	1.02	.52	570.	1010.9	0.00	0.0	1.5	447.7	44.3
003	.60	.52	855.	1159.4	0.00	0.0	.9	465.3	46.5
004	.76	.52	1140.	1100.2	0.00	0.0	.5	534.0	53.6
005	.40	.52	1425.	1030.2	0.00	0.0	.2	50.3	5.0
006	0.00	.44	1710.	951.1	0.00	0.0	0.0	0.0	0.0
007	0.00	.36	1995.	874.1	0.00	0.0	0.0	0.0	0.0
008	0.00	.28	2280.	803.0	0.00	0.0	0.0	0.0	0.0
009	0.00	.20	2565.	738.9	0.00	0.0	0.0	0.0	0.0
010	0.00	.12	2850.	681.8	0.00	0.0	0.0	0.0	0.0
011	.25	.29	3135.	631.1	0.00	0.0	0.0	0.0	0.0
012	.20	.41	3420.	586.2	0.00	0.0	0.0	0.0	0.0
013	.86	.52	3705.	546.3	0.00	0.0	.0	6.2	.6
014	.54	.52	3990.	510.9	0.00	0.0	.0	2.9	.3
015	.65	.52	4275.	479.3	0.00	0.0	.0	2.0	.2
016	.27	.52	4560.	451.1	0.00	0.0	.0	.4	.0
017	0.00	.44	4845.	425.8	0.00	0.0	0.0	0.0	0.0
018	.47	.52	5130.	403.0	0.00	0.0	.0	.3	.0
019	1.40	.52	5415.	382.4	0.00	0.0	.0	.6	.1
020	2.70	.52	5700.	363.7	0.00	0.0	.0	.3	.0
021	1.18	.52	5985.	346.6	0.00	0.0	.0	.0	.0
022	.48	.52	6270.	331.1	0.00	0.0	.0	.0	.0
023	.15	.52	6555.	316.9	0.00	0.0	.0	.0	.0
024	0.00	.44	6840.	303.8	0.00	0.0	0.0	0.0	0.0
025	.65	.52	7125.	291.7	0.00	0.0	.0	.0	.0
026	.35	.52	7410.	280.5	0.00	0.0	.0	.0	.0
027	0.00	.44	7695.	270.2	0.00	0.0	0.0	0.0	0.0
028	0.00	.36	7980.	260.5	0.00	0.0	0.0	0.0	0.0
029	.33	.52	8265.	251.6	0.00	0.0	.0	.0	.0
030	.10	.52	8550.	243.2	0.00	0.0	.0	.0	.0
031	0.00	.44	8835.	235.4	0.00	0.0	0.0	0.0	0.0
032	.12	.48	9120.	228.0	0.00	0.0	0.0	0.0	0.0
033	0.00	.40	9405.	221.1	0.00	0.0	0.0	0.0	0.0
034	.67	.52	9690.	214.6	0.00	0.0	.0	.0	.0
035	.68	.52	9975.	208.5	0.00	0.0	.0	.0	.0
036	1.05	.52	10260.	202.7	0.00	0.0	.0	.0	.0
037	1.06	.52	10545.	197.2	0.00	0.0	.0	.0	.0
038	1.21	.52	10830.	192.0	0.00	0.0	.0	.0	.0
039	0.00	.44	11115.	187.1	0.00	0.0	0.0	0.0	0.0
040	0.00	.36	11400.	182.4	0.00	0.0	0.0	0.0	0.0
									154.3

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X1E6) (FC/CU.FT)	NITROGEN RATE (LB N/A)	APPLIED FC (X1E9/SQ.FT)	RUNOFF FC (X1E3/100ML)	RUNOFF FC (X1E6/ACRE)	RUNOFF FC (X1E9)
[NO. OF ANIMAL UNITS = 400 / MANAGEMENT PRACTICE CODE = 1]									
001	0.00	0.00	0.	1890.0	96.22	19735.1	0.0	0.0	0.0
002	1.02	.52	0.	1890.0	96.22	9092.4	77.4	38436.0	167.1
003	.60	.52	0.	1890.0	96.22	6575.0	41.1	27468.2	245.9
004	.76	.52	0.	1890.0	96.22	4946.3	48.7	54035.7	343.4
005	.40	.52	0.	1890.0	96.22	3957.0	36.5	12656.6	153.2
006	0.00	.44	0.	1890.0	96.22	3297.5	0.0	0.0	0.0
007	0.00	.36	0.	1890.0	96.22	2826.4	0.0	0.0	0.0
008	0.00	.28	0.	1890.0	96.22	2473.1	0.0	0.0	0.0
009	0.00	.20	0.	1890.0	96.22	2198.3	0.0	0.0	0.0
010	0.00	.12	0.	1890.0	96.22	1978.5	0.0	0.0	0.0
011	.25	.29	0.	1890.0	96.22	1798.6	0.0	0.0	0.0
012	.20	.41	0.	1890.0	96.22	1648.8	0.0	0.0	0.0
013	.86	.52	0.	1890.0	96.22	1521.9	22.9	15781.6	312.9
014	.54	.52	0.	1890.0	96.22	1413.2	17.5	8293.4	290.3
015	.65	.52	0.	1890.0	96.22	1319.0	15.5	9110.1	341.6
016	.27	.52	0.	1890.0	96.22	1236.6	13.7	2674.0	107.0
017	0.00	.44	0.	1890.0	96.22	1163.3	0.0	0.0	0.0
018	.47	.52	0.	1890.0	96.22	1099.2	14.3	4545.2	204.5
019	1.40	.52	0.	1890.0	96.22	1041.3	11.9	16110.2	744.3
020	2.79	.52	0.	1890.0	96.22	989.3	6.4	17521.0	866.0
021	1.18	.52	0.	1890.0	96.22	942.1	5.9	6663.0	349.8
022	.48	.52	0.	1890.0	96.22	899.3	6.6	2711.8	149.7
023	.15	.52	0.	1890.0	96.22	860.2	7.3	558.4	32.1
024	0.00	.44	0.	1890.0	96.22	824.4	0.0	0.0	0.0
025	.65	.52	0.	1890.0	96.22	791.1	9.7	1882.7	305.6
026	.55	.52	0.	1890.0	96.22	761.0	8.8	2450.6	157.7
027	0.00	.44	0.	1890.0	96.22	732.3	0.0	0.0	0.0
028	0.00	.36	0.	1890.0	96.22	706.6	0.0	0.0	0.0
029	.33	.52	0.	1890.0	96.22	682.2	7.4	882.6	53.0
030	.10	.52	0.	1890.0	96.22	659.5	9.2	109.6	11.7
031	0.00	.44	0.	1890.0	96.22	638.2	0.0	0.0	0.0
032	.12	.48	0.	1890.0	96.22	618.3	0.0	0.0	0.0
033	0.00	.40	0.	1890.0	96.22	599.5	0.0	0.0	0.0
034	.67	.52	0.	1890.0	96.22	581.9	8.8	4281.1	302.7
035	.68	.52	0.	1890.0	96.22	565.3	7.5	4637.7	306.0
036	1.05	.52	0.	1890.0	96.22	549.6	6.5	6154.5	550.9
037	1.06	.52	0.	1890.0	96.22	534.7	9.2	5758.7	606.0
038	1.21	.52	0.	1890.0	96.22	520.7	4.4	5112.6	485.7
039	0.00	.44	0.	1890.0	96.22	507.5	0.0	0.0	0.0
040	0.00	.36	0.	1890.0	96.22	474.6	0.0	0.0	0.0
									7393.8

EOI ENCOUNTERED.

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X1E5) (FC/CU.FT)	NITROGEN RATE (LB N/A)	APPL FD FC (X1E5/SQ.FT)	RUNOFF FC (X1E5/100ML)	RUNOFF FC (X1E5/ACRE)	RUNOFF FC (X1E9)
[NO. OF ANIMAL UNITS = 100 / MANAGEMENT PRACTICE CODE = 1]									
001	0.00	0.00	0.	1890.0	24.05	4966.3	0.0	0.0	0.0
002	1.02	.18	0.	1890.0	24.05	2473.1	17.0	16051.5	83.5
003	.60	.18	0.	1890.0	24.05	1663.8	14.0	8050.6	67.6
004	.76	.18	0.	1890.0	24.05	1234.6	11.5	8751.4	87.5
005	.40	.18	0.	1890.0	24.05	992.3	9.2	3602.1	45.0
006	0.00	.16	0.	1890.0	24.05	824.4	0.0	0.0	0.0
007	0.00	.14	0.	1890.0	24.05	706.6	0.0	0.0	0.0
008	0.00	.12	0.	1890.0	24.05	618.3	0.0	0.0	0.0
009	0.00	.10	0.	1890.0	24.05	549.6	0.0	0.0	0.0
010	0.00	.08	0.	1890.0	24.05	494.6	0.0	0.0	0.0
011	.25	.18	0.	1890.0	24.05	449.7	6.7	802.3	24.5
012	.20	.18	0.	1890.0	24.05	412.2	6.0	1109.7	33.3
013	.86	.18	0.	1890.0	24.05	380.5	5.4	4660.4	151.5
014	.54	.18	0.	1890.0	24.05	353.3	4.0	2157.3	74.9
015	.65	.18	0.	1890.0	24.05	329.8	3.6	2352.3	88.2
016	.27	.18	0.	1890.0	24.05	309.1	3.2	864.4	33.4
017	0.00	.16	0.	1890.0	24.05	291.0	0.0	0.0	0.0
018	.47	.18	0.	1890.0	24.05	274.8	3.5	1557.5	65.3
019	1.40	.18	0.	1890.0	24.05	260.3	2.7	3262.8	158.6
020	2.70	.18	0.	1890.0	24.05	247.3	1.5	4039.5	717.0
021	1.18	.18	0.	1890.0	24.05	235.5	1.4	1697.3	89.1
022	.48	.18	0.	1890.0	24.05	224.8	1.6	771.2	42.4
023	.15	.18	0.	1890.0	24.05	215.1	1.7	255.2	14.7
024	0.00	.16	0.	1890.0	24.05	206.1	0.0	0.0	0.0
025	.65	.18	0.	1890.0	24.05	197.9	2.1	1509.7	94.4
026	.35	.18	0.	1890.0	24.05	190.2	2.1	721.2	46.7
027	0.00	.16	0.	1890.0	24.05	183.2	0.0	0.0	0.0
028	0.00	.14	0.	1890.0	24.05	176.7	0.0	0.0	0.0
029	.38	.18	0.	1890.0	24.05	170.6	2.3	647.6	46.9
030	.10	.18	0.	1890.0	24.05	164.9	2.7	150.0	13.5
031	0.00	.16	0.	1890.0	24.05	159.6	0.0	0.0	0.0
032	.12	.18	0.	1890.0	24.05	154.6	2.7	187.2	14.6
033	0.00	.16	0.	1890.0	24.05	149.9	0.0	0.0	0.0
034	.67	.18	0.	1890.0	24.05	145.5	2.2	1098.0	115.8
035	.68	.18	0.	1890.0	24.05	141.3	1.3	1138.3	164.9
036	1.05	.18	0.	1890.0	24.05	137.4	1.5	1466.7	148.6
037	1.06	.18	0.	1890.0	24.05	133.7	1.2	1319.2	132.0
038	1.21	.18	0.	1890.0	24.05	130.2	1.0	1233.6	171.9
039	0.00	.16	0.	1890.0	24.05	126.8	0.0	0.0	0.0
040	0.00	.14	0.	1890.0	24.05	123.7	0.0	0.0	0.0
									2128.8

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X1E6) (FC/CU.FT)	NITROGEN RATE (LB-N/A)	APPLIED FC (X1E5/SQ.FT)	RUNOFF FC (X1E3/100ML)	RUNOFF FC (X1E6/ACRE)	RUNOFF FC (X1E9)

[NO. OF ANIMAL UNITS = 100 / MANAGEMENT PRACTICE CODE = 2]

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X1E6) (FC/CU.FT)	NITROGEN RATE (LB-N/A)	APPLIED FC (X1E5/SQ.FT)	RUNOFF FC (X1E3/100ML)	RUNOFF FC (X1E6/ACRE)	RUNOFF FC (X1E9)
001	0.00	0.00	0.	1240.0	24.01	5714.9	0.0	0.0	0.0
002	1.07	.18	0.	1240.0	24.01	1657.4	14.8	12506.0	62.5
003	.60	.18	0.	1240.0	24.01	1280.8	10.5	6271.7	47.0
004	.76	.18	0.	1240.0	24.01	920.7	8.6	6572.7	65.7
005	.40	.18	0.	1240.0	24.01	740.0	6.9	2705.3	33.8
006	0.00	.16	0.	1240.0	24.01	612.1	0.0	0.0	0.0
007	0.00	.14	0.	1240.0	24.01	530.7	0.0	0.0	0.0
008	0.00	.12	0.	1240.0	24.01	464.4	0.0	0.0	0.0
009	0.00	.10	0.	1240.0	24.01	412.8	0.0	0.0	0.0
010	0.00	.08	0.	1240.0	24.01	371.5	0.0	0.0	0.0
011	.25	.18	0.	1240.0	24.01	337.7	5.0	667.7	18.4
012	.20	.18	0.	1240.0	24.01	309.6	4.5	835.6	25.0
013	.86	.18	0.	1240.0	24.01	285.8	4.1	3560.2	118.8
014	.54	.18	0.	1240.0	24.01	265.3	3.0	1606.7	56.2
015	.65	.18	0.	1240.0	24.01	247.7	2.7	1766.7	64.3
016	.27	.18	0.	1240.0	24.01	232.2	2.4	626.7	25.1
017	0.00	.16	0.	1240.0	24.01	218.5	0.0	0.0	0.0
018	.47	.18	0.	1240.0	24.01	206.4	2.6	1158.3	52.0
019	1.40	.18	0.	1240.0	24.01	175.5	2.1	2981.5	141.6
020	2.70	.18	0.	1240.0	24.01	185.7	1.7	3184.1	159.2
021	1.18	.18	0.	1240.0	24.01	176.9	1.1	1775.1	66.9
022	.48	.18	0.	1240.0	24.01	168.9	1.2	579.2	31.9
023	.15	.18	0.	1240.0	24.01	161.5	1.4	171.7	11.0
024	0.00	.16	0.	1240.0	24.01	154.8	0.0	0.0	0.0
025	.65	.18	0.	1240.0	24.01	148.6	1.8	1153.9	79.9
026	.35	.18	0.	1240.0	24.01	142.7	1.6	541.6	35.2
027	0.00	.16	0.	1240.0	24.01	137.6	0.0	0.0	0.0
028	0.00	.14	0.	1240.0	24.01	132.7	0.0	0.0	0.0
029	.33	.18	0.	1240.0	24.01	128.1	1.8	436.4	35.8
030	.10	.18	0.	1240.0	24.01	123.3	1.6	135.2	10.1
031	0.00	.16	0.	1240.0	24.01	119.8	0.0	0.0	0.0
032	.12	.18	0.	1240.0	24.01	116.1	1.7	154.9	10.7
033	0.00	.16	0.	1240.0	24.01	112.6	0.0	0.0	0.0
034	.67	.18	0.	1240.0	24.01	109.3	1.6	1089.7	59.2
035	.68	.18	0.	1240.0	24.01	106.1	1.5	1060.3	75.8
036	1.05	.18	0.	1240.0	24.01	103.2	1.1	1206.7	105.6
037	1.06	.18	0.	1240.0	24.01	100.4	.9	990.7	51.6
038	1.21	.18	0.	1240.0	24.01	97.8	.8	966.1	91.6
039	0.00	.16	0.	1240.0	24.01	95.3	0.0	0.0	0.0
040	0.00	.14	0.	1240.0	24.01	92.9	0.0	0.0	0.0
									1598.6

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X10^6) (FC/CU.FT)	NITROGEN RATE (LB N/A)	APPLIED FC (X10?/CU.FT)	RUNOFF FC (X10?/100ML)	RUNOFF FC (X10?/ACRE)	RUNOFF FC (X10?)

[NO. OF ANIMAL UNITS = 100 / MANAGEMENT PRACTICE CODE = 3]

001	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
002	1.05	.18	0.	150.0	.60	124.0	1.0	517.0	51.7
003	.61	.18	0.	150.0	.60	124.0	1.0	628.4	62.8
004	.77	.18	0.	150.0	.60	124.0	1.1	579.9	58.0
005	.41	.18	0.	150.0	.60	124.0	1.1	459.5	46.0
006	.01	.17	0.	150.0	.60	124.0	0.0	0.0	0.0
007	.01	.16	0.	150.0	.60	124.0	0.0	0.0	0.0
008	.01	.15	0.	150.0	.60	124.0	0.0	0.0	0.0
009	.01	.14	0.	150.0	.60	124.0	0.0	0.0	0.0
010	.01	.13	0.	150.0	.60	124.0	0.0	0.0	0.0
011	.26	.18	0.	150.0	.60	124.0	1.3	353.9	35.4
012	.21	.18	0.	150.0	.60	124.0	1.8	342.7	34.3
013	.87	.18	0.	150.0	.60	124.0	1.7	1500.7	150.1
014	.55	.18	0.	150.0	.60	124.0	1.4	752.0	75.2
015	.66	.18	0.	150.0	.60	124.0	1.3	887.1	88.7
016	.28	.18	0.	150.0	.60	124.0	1.2	344.5	34.5
017	.01	.17	0.	150.0	.60	124.0	0.0	0.0	0.0
018	.48	.18	0.	150.0	.60	124.0	1.6	719.7	72.0
019	1.41	.18	0.	150.0	.60	124.0	1.3	1372.1	137.2
020	2.71	.18	0.	150.0	.60	124.0	.8	2103.5	210.4
021	1.19	.18	0.	150.0	.60	124.0	.7	874.4	87.4
022	.49	.18	0.	150.0	.60	124.0	.9	435.1	43.5
023	.16	.18	0.	150.0	.60	124.0	1.1	157.3	15.7
024	.01	.17	0.	150.0	.60	124.0	0.0	0.0	0.0
025	.66	.18	0.	150.0	.60	124.0	1.5	968.9	96.9
026	.36	.18	0.	150.0	.60	124.0	1.4	478.9	47.9
027	.01	.17	0.	150.0	.60	124.0	0.0	0.0	0.0
028	.01	.16	0.	150.0	.60	124.0	0.0	0.0	0.0
029	.34	.18	0.	150.0	.60	124.0	1.7	517.7	51.8
030	.11	.18	0.	150.0	.60	124.0	1.6	149.5	15.0
031	.01	.17	0.	150.0	.60	124.0	0.0	0.0	0.0
032	.13	.18	0.	150.0	.60	124.0	1.0	179.9	18.0
033	.01	.17	0.	150.0	.60	124.0	0.0	0.0	0.0
034	.78	.18	0.	150.0	.60	124.0	1.0	1211.7	121.1
035	.69	.18	0.	150.0	.60	124.0	1.3	1051.0	105.1
036	1.06	.18	0.	150.0	.60	124.0	1.2	1456.7	145.7
037	1.07	.18	0.	150.0	.60	124.0	1.1	1215.0	121.5
038	1.22	.18	0.	150.0	.60	124.0	1.0	1770.1	177.0
039	.01	.17	0.	150.0	.60	124.0	0.0	0.0	0.0
040	.01	.16	0.	150.0	.60	124.0	0.0	0.0	0.0
									2157.8

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X1E6) (FC/CU.FT)	NITROGEN RATE (LB-N/A)	APPLIED FC (X1E5/SQ.FT)	RUNOFF FC (X1E3/100ML)	RUNOFF FC (X1E6/ACRE)	RUNOFF FC (X1E9)
[NO. OF ANIMAL UNITS = 100 / MANAGEMENT PRACTICE CODE = 1]									
001	0.00	0.00	0.	1890.0	24.05	4940.3	0.0	0.0	0.0
002	1.07	.52	0.	1890.0	24.05	2473.1	48.4	20621.3	104.5
003	.60	.52	0.	1890.0	24.05	1640.8	36.2	20417.7	153.1
004	.76	.52	0.	1890.0	24.05	1230.6	30.4	21273.8	212.7
005	.40	.52	0.	1890.0	24.05	959.5	24.0	7210.4	58.9
006	0.00	.44	0.	1890.0	24.05	824.4	0.0	0.0	0.0
007	0.00	.36	0.	1890.0	24.05	706.6	0.0	0.0	0.0
008	0.00	.28	0.	1890.0	24.05	618.3	0.0	0.0	0.0
009	0.00	.20	0.	1890.0	24.05	549.6	0.0	0.0	0.0
010	0.00	.12	0.	1890.0	24.05	494.6	0.0	0.0	0.0
011	.25	.29	0.	1890.0	24.05	449.7	0.0	0.0	0.0
012	.20	.41	0.	1890.0	24.05	412.2	0.0	0.0	0.0
013	.86	.52	0.	1890.0	24.05	380.5	14.0	9363.1	520.6
014	.54	.52	0.	1890.0	24.05	353.3	11.0	5138.4	181.4
015	.65	.52	0.	1890.0	24.05	329.8	9.7	5695.8	215.5
016	.27	.52	0.	1890.0	24.05	309.1	8.6	1671.2	64.8
017	0.00	.44	0.	1890.0	24.05	291.0	0.0	0.0	0.0
018	.47	.52	0.	1890.0	24.05	274.8	8.7	2840.3	127.8
019	1.40	.52	0.	1890.0	24.05	260.3	7.4	10663.9	479.5
020	2.70	.52	0.	1890.0	24.05	247.3	4.0	10825.6	541.3
021	1.18	.52	0.	1890.0	24.05	235.5	3.7	4164.4	218.6
022	.48	.52	0.	1890.0	24.05	224.8	4.1	1694.9	73.2
023	.15	.52	0.	1890.0	24.05	215.1	4.9	349.0	20.1
024	0.00	.44	0.	1890.0	24.05	206.1	0.0	0.0	0.0
025	.65	.52	0.	1890.0	24.05	197.9	6.1	3056.1	121.0
026	.35	.52	0.	1890.0	24.05	190.2	5.5	1531.6	99.6
027	0.00	.44	0.	1890.0	24.05	183.2	0.0	0.0	0.0
028	0.00	.36	0.	1890.0	24.05	176.7	0.0	0.0	0.0
029	.33	.52	0.	1890.0	24.05	170.6	5.9	549.5	39.4
030	.10	.52	0.	1890.0	24.05	164.9	5.0	110.5	8.7
031	0.00	.44	0.	1890.0	24.05	159.6	0.0	0.0	0.0
032	.12	.48	0.	1890.0	24.05	154.6	0.0	0.0	0.0
033	0.00	.40	0.	1890.0	24.05	149.9	0.0	0.0	0.0
034	.67	.52	0.	1890.0	24.05	145.5	5.5	2660.2	226.4
035	.68	.52	0.	1890.0	24.05	141.3	4.7	2993.8	253.7
036	1.05	.52	0.	1890.0	24.05	137.4	4.0	4034.1	368.1
037	1.06	.52	0.	1890.0	24.05	133.7	3.3	3933.5	303.7
038	1.21	.52	0.	1890.0	24.05	130.2	2.3	3195.4	303.6
039	0.00	.44	0.	1890.0	24.05	126.8	0.0	0.0	0.0
040	0.00	.36	0.	1890.0	24.05	123.7	0.0	0.0	0.0
									4261.2

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X1E6) (FC/CU.FT)	NITROGEN RATE (LB N/A)	APPLIED FC (X1E3/SQ.FT)	RUNOFF FC (X1E5/100ML)	RUNOFF FC (X1E6/ACRE)	RUNOFF FC (X1E9)

[NO. OF ANIMAL UNITS = 100 / MANAGEMENT PRACTICE CODE = 1]

001	0.00	0.00	0.	1890.0	24.05	4946.3	0.0	0.0	0.0
002	1.02	0.00	0.	1890.0	24.05	2473.1	17.4	8836.5	41.8
003	.60	0.00	0.	1890.0	24.05	1648.8	0.0	0.0	0.0
004	.76	0.00	0.	1890.0	24.05	1236.6	13.3	2132.6	21.8
005	.40	0.00	0.	1890.0	24.05	989.3	0.0	0.0	0.0
006	0.00	0.00	0.	1890.0	24.05	824.4	0.0	0.0	0.0
007	0.00	0.00	0.	1890.0	24.05	706.6	0.0	0.0	0.0
008	0.00	0.00	0.	1890.0	24.05	618.3	0.0	0.0	0.0
009	0.00	0.00	0.	1890.0	24.05	549.6	0.0	0.0	0.0
010	0.00	0.00	0.	1890.0	24.05	494.6	0.0	0.0	0.0
011	.25	0.00	0.	1890.0	24.05	449.7	0.0	0.0	0.0
012	.20	0.00	0.	1890.0	24.05	412.2	0.0	0.0	0.0
013	.86	0.00	0.	1890.0	24.05	380.5	5.7	1516.3	49.5
014	.54	0.00	0.	1890.0	24.05	353.3	0.0	0.0	0.0
015	.65	0.00	0.	1890.0	24.05	329.8	4.6	735.9	8.8
016	.27	0.00	0.	1890.0	24.05	309.1	0.0	0.0	0.0
017	0.00	0.00	0.	1890.0	24.05	291.0	0.0	0.0	0.0
018	.47	0.00	0.	1890.0	24.05	274.8	0.0	0.0	0.0
019	1.40	0.00	0.	1890.0	24.05	260.3	3.8	3111.6	147.8
020	2.70	0.00	0.	1890.0	24.05	247.3	2.2	4765.9	235.3
021	1.18	0.00	0.	1890.0	24.05	235.5	1.7	1017.4	55.5
022	.48	0.00	0.	1890.0	24.05	224.8	0.0	0.0	0.0
023	.15	0.00	0.	1890.0	24.05	215.1	0.0	0.0	0.0
024	0.00	0.00	0.	1890.0	24.05	206.1	0.0	0.0	0.0
025	.65	0.00	0.	1890.0	24.05	197.9	2.5	130.7	6.7
026	.35	0.00	0.	1890.0	24.05	190.2	0.0	0.0	0.0
027	0.00	0.00	0.	1890.0	24.05	183.2	0.0	0.0	0.0
028	0.00	0.00	0.	1890.0	24.05	176.7	0.0	0.0	0.0
029	.38	0.00	0.	1890.0	24.05	170.6	0.0	0.0	0.0
030	.10	0.00	0.	1890.0	24.05	164.9	0.0	0.0	0.0
031	0.00	0.00	0.	1890.0	24.05	159.6	0.0	0.0	0.0
032	.12	0.00	0.	1890.0	24.05	154.6	0.0	0.0	0.0
033	0.00	0.00	0.	1890.0	24.05	149.9	0.0	0.0	0.0
034	.67	0.00	0.	1890.0	24.05	145.5	2.2	155.1	13.6
035	.68	0.00	0.	1890.0	24.05	141.3	2.1	167.4	14.8
036	1.05	0.00	0.	1890.0	24.05	137.4	1.9	901.3	81.1
037	1.06	0.00	0.	1890.0	24.05	133.7	1.7	770.1	73.1
038	1.21	0.00	0.	1890.0	24.05	130.2	1.5	941.0	87.4
039	0.00	0.00	0.	1890.0	24.05	126.8	0.0	0.0	0.0
040	0.00	0.00	0.	1890.0	24.05	123.7	0.0	0.0	0.0
									838.3

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X1E6) (FC/CU.FT)	NITROGEN RATE (LB-N/A)	APPLIED FC (X1E7/SQ.FT)	RUNOFF FC (X1E7/100ML)	RUNOFF FC (X1E6/ACRE)	RUNOFF FC (X1E9)
[NO. OF ANIMAL UNITS = 100 / MANAGEMENT PRACTICE CODE = 2]									
001	0.00	0.00	0.	1240.0	24.01	3714.7	0.0	0.0	0.0
002	1.02	0.00	0.	1240.0	24.01	1857.4	14.5	6274.1	31.4
003	.60	0.00	0.	1240.0	24.01	1238.3	0.0	0.0	0.0
004	.76	0.00	0.	1240.0	24.01	928.7	10.0	1609.2	16.4
005	.40	0.00	0.	1240.0	24.01	743.0	0.0	0.0	0.0
006	0.00	0.00	0.	1240.0	24.01	619.1	0.0	0.0	0.0
007	0.00	0.00	0.	1240.0	24.01	530.7	0.0	0.0	0.0
008	0.00	0.00	0.	1240.0	24.01	464.4	0.0	0.0	0.0
009	0.00	0.00	0.	1240.0	24.01	412.8	0.0	0.0	0.0
010	0.00	0.00	0.	1240.0	24.01	371.5	0.0	0.0	0.0
011	.25	0.00	0.	1240.0	24.01	337.7	0.0	0.0	0.0
012	.20	0.00	0.	1240.0	24.01	309.6	0.0	0.0	0.0
013	.86	0.00	0.	1240.0	24.01	285.8	4.3	1158.3	37.0
014	.54	0.00	0.	1240.0	24.01	265.3	0.0	0.0	0.0
015	.65	0.00	0.	1240.0	24.01	247.7	3.4	177.2	6.5
016	.27	0.00	0.	1240.0	24.01	232.2	0.0	0.0	0.0
017	0.00	0.00	0.	1240.0	24.01	218.5	0.0	0.0	0.0
018	.47	0.00	0.	1240.0	24.01	206.4	0.0	0.0	0.0
019	1.40	0.00	0.	1240.0	24.01	195.5	2.3	2337.0	111.0
020	2.70	0.00	0.	1240.0	24.01	185.7	1.6	5534.3	176.7
021	1.18	0.00	0.	1240.0	24.01	176.9	1.3	765.6	40.7
022	.48	0.00	0.	1240.0	24.01	168.9	0.0	0.0	0.0
023	.15	0.00	0.	1240.0	24.01	161.5	0.0	0.0	0.0
024	0.00	0.00	0.	1240.0	24.01	154.8	0.0	0.0	0.0
025	.65	0.00	0.	1240.0	24.01	148.6	1.2	98.2	6.1
026	.35	0.00	0.	1240.0	24.01	142.9	0.0	0.0	0.0
027	0.00	0.00	0.	1240.0	24.01	137.6	0.0	0.0	0.0
028	0.00	0.00	0.	1240.0	24.01	132.7	0.0	0.0	0.0
029	.33	0.00	0.	1240.0	24.01	128.1	0.0	0.0	0.0
030	.10	0.00	0.	1240.0	24.01	123.8	0.0	0.0	0.0
031	0.00	0.00	0.	1240.0	24.01	119.8	0.0	0.0	0.0
032	.12	0.00	0.	1240.0	24.01	116.1	0.0	0.0	0.0
033	0.00	0.00	0.	1240.0	24.01	112.6	0.0	0.0	0.0
034	.67	0.00	0.	1240.0	24.01	109.3	1.7	118.8	10.1
035	.68	0.00	0.	1240.0	24.01	106.1	1.5	127.2	11.1
036	1.05	0.00	0.	1240.0	24.01	103.2	1.5	676.9	60.9
037	1.06	0.00	0.	1240.0	24.01	100.4	1.3	593.4	54.2
038	1.21	0.00	0.	1240.0	24.01	97.8	1.1	706.0	67.1
039	0.00	0.00	0.	1240.0	24.01	95.3	0.0	0.0	0.0
040	0.00	0.00	0.	1240.0	24.01	92.9	0.0	0.0	0.0
									616.8

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X1E6) (FC/CU.FT)	NITROGEN RATE (LB-N/A)	APPLIED FC (X1E3/CU.FT)	RUNOFF FC (X1E3/100ML)	RUNOFF FC (X1E6/ACRE)	RUNOFF FC (X1E9)
[NO. OF ANIMAL UNITS = 100 / MANAGEMENT PRACTICE CODE = 3]									
001	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
002	1.03	0.00	0.	150.0	.60	124.0	.7	308.2	30.8
003	.61	0.00	0.	150.0	.60	124.0	1.0	9.6	1.0
004	.77	0.00	0.	150.0	.60	124.0	1.1	174.0	17.4
005	.41	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
006	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
007	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
008	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
009	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
010	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
011	.26	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
012	.21	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
013	.87	0.00	0.	150.0	.60	124.0	1.6	443.0	44.3
014	.55	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
015	.66	0.00	0.	150.0	.60	124.0	1.4	65.4	6.5
016	.78	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
017	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
018	.48	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
019	1.41	0.00	0.	150.0	.60	124.0	1.5	1224.0	122.4
020	2.71	0.00	0.	150.0	.60	124.0	.7	1204.4	120.4
021	1.19	0.00	0.	150.0	.60	124.0	.8	459.7	45.9
022	.49	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
023	.16	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
024	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
025	.66	0.00	0.	150.0	.60	124.0	1.4	65.4	6.5
026	.36	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
027	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
028	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
029	.34	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
030	.11	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
031	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
032	.13	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
033	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
034	.68	0.00	0.	150.0	.60	124.0	1.7	135.6	13.6
035	.69	0.00	0.	150.0	.60	124.0	1.5	158.9	15.9
036	1.06	0.00	0.	150.0	.60	124.0	1.4	666.6	66.7
037	1.07	0.00	0.	150.0	.60	124.0	1.2	592.5	59.2
038	1.22	0.00	0.	150.0	.60	124.0	1.1	720.9	72.1
039	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
040	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
									696.3

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X1E6) (FC/CU.FT)	NITROGEN RATE (LB N/A)	APPLIED FC (X1E3/SQ.FT)	RUNOFF FC (X1E3/100ML)	RUNOFF FC (X1E6/ACRE)	RUNOFF FC (X1E9)
[NO. OF ANIMAL UNITS = 100 / MANAGEMENT PRACTICE CODE = 1]									
001	0.00	0.00	0.	1890.0	24.05	4946.8	0.0	0.0	0.0
002	1.02	0.00	0.	1890.0	24.05	2175.1	19.5	16651.5	55.5
003	.60	0.00	0.	1890.0	24.05	1660.8	13.9	5787.2	42.8
004	.76	0.00	0.	1890.0	24.05	1254.6	11.5	6555.0	46.3
005	.40	0.00	0.	1890.0	24.05	988.3	9.5	2005.5	75.1
006	0.00	0.00	0.	1890.0	24.05	874.4	0.0	0.0	0.0
007	0.00	0.00	0.	1890.0	24.05	706.6	0.0	0.0	0.0
008	0.00	0.00	0.	1890.0	24.05	618.5	0.0	0.0	0.0
009	0.00	0.00	0.	1890.0	24.05	549.6	0.0	0.0	0.0
010	0.00	0.00	0.	1890.0	24.05	494.6	0.0	0.0	0.0
011	.25	0.00	0.	1890.0	24.05	447.7	6.7	543.8	2.5
012	.20	0.00	0.	1890.0	24.05	412.2	0.0	0.0	0.0
013	.86	0.00	0.	1890.0	24.05	380.5	5.7	3866.7	135.5
014	.54	0.00	0.	1890.0	24.05	353.5	4.4	1522.1	55.3
015	.65	0.00	0.	1890.0	24.05	329.8	4.0	1842.5	69.1
016	.27	0.00	0.	1890.0	24.05	309.1	3.4	257.2	16.3
017	0.00	0.00	0.	1890.0	24.05	291.0	0.0	0.0	0.0
018	.47	0.00	0.	1890.0	24.05	274.5	3.7	1075.0	46.1
019	1.40	0.00	0.	1890.0	24.05	260.3	3.2	3898.3	165.2
020	2.70	0.00	0.	1890.0	24.05	247.5	1.7	4377.7	216.5
021	1.18	0.00	0.	1890.0	24.05	235.5	1.6	1575.0	82.6
022	.48	0.00	0.	1890.0	24.05	224.8	1.7	404.8	26.7
023	.15	0.00	0.	1890.0	24.05	215.1	0.0	0.0	0.0
024	0.00	0.00	0.	1890.0	24.05	206.1	0.0	0.0	0.0
025	.65	0.00	0.	1890.0	24.05	197.9	2.5	1145.4	71.6
026	.35	0.00	0.	1890.0	24.05	190.2	2.2	546.4	21.5
027	0.00	0.00	0.	1890.0	24.05	183.2	0.0	0.0	0.0
028	0.00	0.00	0.	1890.0	24.05	176.7	0.0	0.0	0.0
029	.33	0.00	0.	1890.0	24.05	170.6	2.4	320.5	13.2
030	.10	0.00	0.	1890.0	24.05	164.9	0.0	0.0	0.0
031	0.00	0.00	0.	1890.0	24.05	159.6	0.0	0.0	0.0
032	.12	0.00	0.	1890.0	24.05	154.6	0.0	0.0	0.0
033	0.00	0.00	0.	1890.0	24.05	149.9	0.0	0.0	0.0
034	.67	0.00	0.	1890.0	24.05	145.5	2.2	1067.5	90.7
035	.68	0.00	0.	1890.0	24.05	141.3	1.9	925.6	80.6
036	1.65	0.00	0.	1890.0	24.05	137.4	1.7	1454.4	130.5
037	1.06	0.00	0.	1890.0	24.05	133.7	1.4	1210.1	111.9
038	1.21	0.00	0.	1890.0	24.05	130.2	1.7	1557.1	119.6
039	0.00	0.00	0.	1890.0	24.05	126.8	0.0	0.0	0.0
040	0.00	0.00	0.	1890.0	24.05	123.7	0.0	0.0	0.0
									1697.9

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X1E6) (FC/CU.FT)	NITROGEN RATE (LB-N/A)	APPLIED FC (X1E3/CU.FT)	RUNOFF FC (X1E3/100ML)	RUNOFF FC (X1E6/ACRE)	RUNOFF FC (X1E9)
	[NO. OF ANIMAL UNITS = 100 / MANAGEMENT PRACTICE CODE = 3]								
001	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
002	1.03	0.00	0.	150.0	.60	124.0	1.0	319.0	31.9
003	.61	0.00	0.	150.0	.60	124.0	1.0	419.6	42.0
004	.77	0.00	0.	150.0	.60	124.0	1.1	655.6	65.6
005	.41	0.00	0.	150.0	.60	124.0	1.1	247.7	24.8
006	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
007	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
008	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
009	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
010	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
011	.26	0.00	0.	150.0	.60	124.0	1.8	109.5	11.0
012	.21	0.00	0.	150.0	.60	124.0	1.7	17.6	1.8
013	.87	0.00	0.	150.0	.60	124.0	1.7	1187.0	118.7
014	.55	0.00	0.	150.0	.60	124.0	1.4	508.2	50.8
015	.66	0.00	0.	150.0	.60	124.0	1.4	653.0	65.3
016	.28	0.00	0.	150.0	.60	124.0	1.3	103.6	10.4
017	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
018	.48	0.00	0.	150.0	.60	124.0	1.6	447.4	44.7
019	1.41	0.00	0.	150.0	.60	124.0	1.4	1732.5	173.2
020	2.71	0.00	0.	150.0	.60	124.0	.8	2049.2	204.9
021	1.19	0.00	0.	150.0	.60	124.0	.8	793.6	79.4
022	.49	0.00	0.	150.0	.60	124.0	.9	262.7	26.3
023	.16	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
024	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
025	.66	0.00	0.	150.0	.60	124.0	1.5	697.8	69.8
026	.36	0.00	0.	150.0	.60	124.0	1.4	225.7	22.6
027	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
028	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
029	.34	0.00	0.	150.0	.60	124.0	1.7	230.7	23.1
030	.11	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
031	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
032	.13	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
033	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
034	.68	0.00	0.	150.0	.60	124.0	1.3	881.9	88.2
035	.69	0.00	0.	150.0	.60	124.0	1.5	773.3	77.3
036	1.06	0.00	0.	150.0	.60	124.0	1.4	1232.6	123.3
037	1.07	0.00	0.	150.0	.60	124.0	1.2	1054.8	105.5
038	1.22	0.00	0.	150.0	.60	124.0	1.1	1125.2	112.5
039	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
040	.01	0.00	0.	150.0	.60	124.0	0.0	0.0	0.0
									1624.9

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X1E6) (FC/CU.FT)	NITROGEN RATE (LB-N/A)	APPLIED FC (X1E3/SQ.FT)	RUNOFF FC (X1E3/100ML)	RUNOFF FC (X1E6/ACRE)	RUNOFF FC (X1E9)
[NO. OF ANIMAL UNITS = 100 / MANAGEMENT PRACTICE CODE = 1]									
001	0.00	0.00	285.	346.7	24.05	507.1	0.0	0.0	0.0
002	1.02	0.00	570.	1073.4	0.00	0.0	5.6	2515.2	125.8
003	.60	0.00	855.	1160.3	0.00	0.0	1.4	571.4	28.6
004	.76	0.00	1140.	1117.3	0.00	0.0	.8	465.7	23.3
005	.40	0.00	1425.	1040.4	0.00	0.0	.4	92.4	4.5
006	0.00	0.00	1710.	957.4	0.00	0.0	0.0	0.0	0.0
007	0.00	0.00	1995.	873.1	0.00	0.0	0.0	0.0	0.0
008	0.00	0.00	2280.	805.6	0.00	0.0	0.0	0.0	0.0
009	0.00	0.00	2565.	740.6	0.00	0.0	0.0	0.0	0.0
010	0.00	0.00	2850.	682.9	0.00	0.0	0.0	0.0	0.0
011	.25	0.00	3135.	631.2	0.00	0.0	.0	2.4	.1
012	.20	0.00	3420.	586.7	0.00	0.0	0.0	0.0	0.0
013	.86	0.00	3705.	546.7	0.00	0.0	.0	14.7	.7
014	.54	0.00	3990.	511.2	0.00	0.0	.0	3.9	.2
015	.65	0.00	4275.	479.5	0.00	0.0	.0	3.1	.2
016	.27	0.00	4560.	451.2	0.00	0.0	.0	.3	.0
017	0.00	0.00	4845.	425.2	0.00	0.0	0.0	0.0	0.0
018	.47	0.00	5130.	403.0	0.00	0.0	.0	.5	.0
019	1.40	0.00	5415.	382.4	0.00	0.0	.0	1.3	.1
020	2.70	0.00	5700.	363.7	0.00	0.0	.0	.8	.0
021	1.13	0.00	285.	346.7	24.05	453.6	2.1	2147.2	214.7
022	.48	0.00	570.	1073.4	0.00	0.0	.9	258.5	25.8
023	.15	0.00	855.	1160.3	0.00	0.0	0.0	0.0	0.0
024	0.00	0.00	1140.	1117.3	0.00	0.0	0.0	0.0	0.0
025	.65	0.00	1425.	1040.4	0.00	0.0	.3	124.3	12.4
026	.35	0.00	1710.	957.4	0.00	0.0	.2	23.6	2.4
027	0.00	0.00	1995.	873.1	0.00	0.0	0.0	0.0	0.0
028	0.00	0.00	2280.	805.6	0.00	0.0	0.0	0.0	0.0
029	.33	0.00	2565.	740.6	0.00	0.0	.0	6.5	.7
030	.10	0.00	2850.	682.9	0.00	0.0	0.0	0.0	0.0
031	0.00	0.00	3135.	631.2	0.00	0.0	0.0	0.0	0.0
032	.12	0.00	3420.	586.7	0.00	0.0	0.0	0.0	0.0
033	0.00	0.00	3705.	546.7	0.00	0.0	0.0	0.0	0.0
034	.67	0.00	3990.	511.2	0.00	0.0	.0	3.7	.4
035	.68	0.00	4275.	479.5	0.00	0.0	.0	2.1	.2
036	1.05	0.00	4560.	451.2	0.00	0.0	.0	7.1	.7
037	1.06	0.00	4845.	425.2	0.00	0.0	.0	1.0	.1
038	1.21	0.00	5130.	403.0	0.00	0.0	.0	.5	.1
039	0.00	0.00	5415.	382.4	0.00	0.0	0.0	0.0	0.0
040	0.00	0.00	5700.	363.7	0.00	0.0	0.0	0.0	0.0
									440.5

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X1E6) (FC/CU.FT)	NITROGEN RATE (LB N/A)	APPLIED FC (X1E9/CU.FT)	RUNOFF FC (X1E3/100ML)	RUNOFF FC (X1E6/ACRE)	RUNOFF FC (X1E2)
[NO. OF ANIMAL UNITS = 100 / MANAGEMENT PRACTICE CODE = 3]									
001	.20	0.00	3600.	27.5	12.07	454.6	0.0	0.0	0.0
002	1.02	0.00	7200.	55.2	0.00	0.0	1.4	1174.1	117.4
003	.60	0.00	10800.	92.1	0.00	0.0	.6	258.6	25.9
004	.76	0.00	14400.	88.7	0.00	0.0	.4	204.4	20.4
005	.40	0.00	18000.	82.6	0.00	0.0	.2	55.1	5.5
006	0.00	0.00	21600.	76.0	0.00	0.0	0.0	0.0	0.0
007	0.00	0.00	25200.	69.7	0.00	0.0	0.0	0.0	0.0
008	0.00	0.00	28800.	63.9	0.00	0.0	0.0	0.0	0.0
009	0.00	0.00	32400.	58.8	0.00	0.0	0.0	0.0	0.0
010	0.00	0.00	36000.	54.2	0.00	0.0	0.0	0.0	0.0
011	.25	0.00	39600.	50.1	0.00	0.0	.0	1.0	.1
012	.20	0.00	43200.	46.6	0.00	0.0	0.0	0.0	0.0
013	.86	0.00	46800.	43.4	0.00	0.0	.0	5.8	.6
014	.54	0.00	50400.	40.6	0.00	0.0	.0	1.5	.1
015	.65	0.00	54000.	38.1	0.00	0.0	.0	1.1	.1
016	.27	0.00	57600.	35.8	0.00	0.0	.0	.1	.0
017	0.00	0.00	61200.	33.8	0.00	0.0	0.0	0.0	0.0
018	.47	0.00	64800.	32.0	0.00	0.0	.0	.2	.0
019	1.40	0.00	68400.	30.3	0.00	0.0	.0	.4	.0
020	2.70	0.00	72000.	28.7	0.00	0.0	.0	.3	.0
021	1.38	0.00	3600.	27.5	12.07	454.6	1.9	2357.9	235.8
022	.48	0.00	7200.	55.2	0.00	0.0	.8	223.3	22.3
023	.15	0.00	10800.	92.1	0.00	0.0	0.0	0.0	0.0
024	0.00	0.00	14400.	88.7	0.00	0.0	0.0	0.0	0.0
025	.65	0.00	18000.	82.6	0.00	0.0	.7	101.6	10.2
026	.05	0.00	21600.	76.0	0.00	0.0	.1	18.7	1.9
027	0.00	0.00	25200.	69.7	0.00	0.0	0.0	0.0	0.0
028	0.00	0.00	28800.	63.9	0.00	0.0	0.0	0.0	0.0
029	.33	0.00	32400.	58.8	0.00	0.0	.0	5.0	.5
030	.10	0.00	36000.	54.2	0.00	0.0	0.0	0.0	0.0
031	0.00	0.00	39600.	50.1	0.00	0.0	0.0	0.0	0.0
032	.12	0.00	43200.	46.6	0.00	0.0	0.0	0.0	0.0
033	0.00	0.00	46800.	43.4	0.00	0.0	0.0	0.0	0.0
034	.67	0.00	50400.	40.6	0.00	0.0	.0	2.7	.3
035	.68	0.00	54000.	38.1	0.00	0.0	.0	1.5	.1
036	1.05	0.00	57600.	35.8	0.00	0.0	.0	1.4	.1
037	1.06	0.00	61200.	33.8	0.00	0.0	.0	.6	.1
038	1.21	0.00	64800.	32.0	0.00	0.0	.0	.3	.0
039	0.00	0.00	68400.	30.3	0.00	0.0	0.0	0.0	0.0
040	0.00	0.00	72000.	28.7	0.00	0.0	0.0	0.0	0.0
									439.7

1

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X1E[illegible]) (FC/CU.FT)	NITROGEN RATE (LB-N/A)	APPLIED FC (X1E[illegible]/SQ.FT)	RUNOFF FC (X1E[illegible]/100ML)	RUNOFF FC (X1E6/ACRE)	RUNOFF FC (X1E9)

[NO. OF ANIMAL UNITS = 4000 / MANAGEMENT PRACTICE CODE - 1]

001	0.00	0.00	0.	1890.0	962.16	197051.2	0.0	0.0	0.0
002	1.02	.18	0.	1890.0	962.16	90925.6	1275.3	1445147.5	3375.7
003	.60	.18	0.	1890.0	962.16	65050.4	1400.5	[illegible]	[illegible]
004	.76	.18	0.	1890.0	962.16	40462.8	1150.4	875135.4	8751.4
005	.40	.18	0.	1890.0	962.16	35570.2	[illegible]	360200.0	4502.6
006	0.00	.16	0.	1890.0	962.16	32775.2	0.0	0.0	0.0
007	0.00	.14	0.	1890.0	962.16	28204.5	0.0	0.0	0.0
008	0.00	.12	0.	1890.0	962.16	24751.4	0.0	0.0	0.0
009	0.00	.10	0.	1890.0	962.16	21707.3	0.0	0.0	0.0
010	0.00	.08	0.	1890.0	962.16	19785.1	0.0	0.0	0.0
011	.25	.18	0.	1890.0	962.16	17906.5	685.4	88950.9	2445.5
012	.20	.18	0.	1890.0	962.16	16457.6	579.8	110905.2	5507.7
013	.86	.18	0.	1890.0	962.16	15217.9	539.7	466605.8	15146.3
014	.54	.18	0.	1890.0	962.16	14157.7	400.2	218853.9	7487.7
015	.65	.18	0.	1890.0	962.16	13196.1	363.2	255731.3	8021.2
016	.27	.18	0.	1890.0	962.16	12365.7	324.7	83443.2	5357.7
017	0.00	.16	0.	1890.0	962.16	11630.3	0.0	0.0	0.0
018	.47	.18	0.	1890.0	962.16	10921.7	348.5	153253.6	6977.5
019	1.40	.18	0.	1890.0	962.16	10413.2	779.3	376681.0	13356.7
020	2.70	.18	0.	1890.0	962.16	9887.6	155.9	423251.5	21197.6
021	1.10	.18	0.	1890.0	962.16	9421.5	142.4	162780.4	9213.5
022	.43	.18	0.	1890.0	962.16	8995.2	165.1	77112.3	4241.6
023	.15	.18	0.	1890.0	962.16	8602.2	171.0	75521.3	1167.5
024	0.00	.16	0.	1890.0	962.16	8240.5	0.0	0.0	0.0
025	.65	.18	0.	1890.0	962.16	7914.0	240.5	150973.3	9455.9
026	.35	.18	0.	1890.0	962.16	7602.7	212.6	77116.6	4007.5
027	0.00	.16	0.	1890.0	962.16	7327.3	0.0	0.0	0.0
028	0.00	.14	0.	1890.0	962.16	7066.1	0.0	0.0	0.0
029	.33	.18	0.	1890.0	962.16	6822.5	205.3	64758.1	4075.0
030	.10	.18	0.	1890.0	962.16	6575.0	216.8	17290.4	[illegible]
031	0.00	.16	0.	1890.0	962.16	6352.3	0.0	0.0	0.0
032	.12	.18	0.	1890.0	962.16	6182.7	231.6	16277.8	1457.6
033	0.00	.16	0.	1890.0	962.16	5925.5	0.0	0.0	0.0
034	.47	.18	0.	1890.0	962.16	5813.2	215.9	137727.4	[illegible]
035	.63	.18	0.	1890.0	962.16	[illegible]	176.7	115577.7	[illegible]
036	1.65	.18	0.	1890.0	962.16	5475.9	151.3	[illegible]	13462.4
037	1.06	.18	0.	1890.0	962.16	5337.3	173.1	131715.0	12202.1
038	1.21	.18	0.	1890.0	962.16	5200.6	[illegible]	123363.6	13194.5
039	0.00	.16	0.	1890.0	962.16	5070.1	0.0	0.0	0.0
040	0.00	.14	0.	1890.0	962.16	[illegible]	0.0	0.0	0.0

EOI ENCOUNTERED.

212,872.9

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X1E?) (FC/CU.FT)	NITROGEN RATE (LB-N/A)	APPLIED FC (X1[illegible]/SQ.FT)	RUNOFF FC (X1[illegible]/100ML)	RUNOFF FC (X1[illegible]/ACRE)	RUNOFF FC (X1E9)

[NO. OF ANIMAL UNITS = 100 / MANAGEMENT PRACTICE CODE = 1]

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC	NITROGEN RATE	APPLIED FC	RUNOFF FC (/100ML)	RUNOFF FC (/ACRE)	RUNOFF FC (X1E9)
001	.46	.53	0.	1890.0	24.05	2946.3	0.0	0.0	0.0
002	1.41	.52	0.	1890.0	24.05	2475.1	17.4	24734.0	124.0
003	.63	.52	0.	1890.0	24.05	1645.5	12.1	7667.7	52.6
004	.52	.52	0.	1890.0	24.05	1294.6	10.[illegible]	9417.6	94.1
005	.16	.52	0.	1890.0	24.05	782.3	8.7	716.6	9.0
006	.41	.52	0.	1890.0	24.05	804.4	8.8	2904.3	44.3
007	.16	.52	0.	1890.0	24.05	706.6	7.9	650.5	11.4
008	.62	.52	0.	1890.0	24.05	618.5	7.6	4215.1	64.3
009	.16	.52	0.	1890.0	24.05	549.6	6.3	516.9	11.6
010	0.00	.44	0.	1890.0	24.05	494.6	0.0	0.0	0.0
011	.71	.52	0.	1890.0	24.05	442.7	4.0	3402.9	93.6
012	.17	.52	0.	1890.0	24.05	412.2	4.9	457.5	15.7
013	.74	.52	0.	1890.0	24.05	380.5	4.7	3303.2	107.4
014	.34	.52	0.	1890.0	24.05	353.3	4.0	1066.4	37.3
015	0.00	.44	0.	1890.0	24.05	329.3	0.0	0.0	0.0
016	0.00	.36	0.	1890.0	24.05	309.1	0.0	0.0	0.0
017	0.00	.28	0.	1890.0	24.05	291.0	0.0	0.0	0.0
018	0.00	.20	0.	1890.0	24.05	274.6	0.0	0.0	0.0
019	0.00	.12	0.	1890.0	24.05	260.3	0.0	0.0	0.0
020	0.00	.04	0.	1890.0	24.05	247.3	0.0	0.0	0.0
021	.45	.41	0.	1890.0	24.05	235.5	0.0	0.0	0.0
022	0.00	.33	0.	1890.0	24.05	224.5	0.0	0.0	0.0
023	.53	.52	0.	1890.0	24.05	215.1	3.3	874.4	50.3
024	.57	.57	0.	1890.0	24.05	206.1	2.9	1336.5	79.6
025	.07	.46	0.	1890.0	24.05	197.9	0.0	0.0	0.0
026	.06	.44	0.	1890.0	24.05	190.2	0.0	0.0	0.0
027	0.00	.36	0.	1890.0	24.05	183.2	0.0	0.0	0.0
028	0.00	.28	0.	1890.0	24.05	176.7	0.0	0.0	0.0
029	1.02	.52	0.	1890.0	24.05	170.6	2.5	1835.4	132.3
030	.46	.52	0.	1890.0	24.05	164.9	2.0	708.[illegible]	55.9
031	.27	.52	0.	1890.0	24.05	159.6	1.7	411.1	31.9
032	.29	.52	0.	1890.0	24.05	154.6	1.9	412.1	33.0
033	.72	.52	0.	1890.0	24.05	149.9	1.9	1348.9	101.6
034	.05	.49	0.	1890.0	24.05	145.5	0.0	0.0	0.0
035	.20	.52	0.	1890.0	24.05	141.3	1.3	164.4	14.4
036	0.00	.44	0.	1890.0	24.05	137.4	0.0	0.0	0.0
037	.07	.45	0.	1890.0	24.05	133.7	0.0	0.0	0.0
038	0.00	.37	0.	1890.0	24.05	130.2	0.0	0.0	0.0
039	0.00	.29	0.	1890.0	24.05	126.8	0.0	0.0	0.0
040	0.00	.21	0.	1890.0	24.05	123.7	0.0	0.0	0.0
									1186.8

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X1E6) (CC/CU.FT)	NITROGEN RATE (LB N/A)	APPLIED FC (X1E9/SQ.FT)	RUNOFF FC (X1E5/100ML)	RUNOFF FC (X1E6/ACRE)	RUNOFF FC (X1E9)
[NO. OF ANIMAL UNITS = 100 / MANAGEMENT PRACTICE CODE = 2]									
001	.46	.38	0.	1240.0	24.01	5714.9	0.0	0.0	0.0
002	1.61	.52	0.	1240.0	24.01	1057.4	13.0	13032.7	73.1
003	.63	.52	0.	1240.0	24.01	1230.5	9.0	5763.1	59.5
004	.92	.52	0.	1240.0	24.01	883.7	8.2	7062.3	70.7
005	.16	.52	0.	1240.0	24.01	745.0	6.5	530.9	6.7
006	.41	.52	0.	1240.0	24.01	619.1	6.6	2241.7	33.6
007	.16	.52	0.	1240.0	24.01	530.7	5.9	488.1	6.5
008	.62	.52	0.	1240.0	24.01	464.4	5.7	3164.8	63.5
009	.16	.52	0.	1240.0	24.01	412.8	4.7	358.2	6.7
010	0.00	.44	0.	1240.0	24.01	371.5	0.0	0.0	0.0
011	.71	.52	0.	1240.0	24.01	337.7	4.5	2555.7	70.3
012	.17	.52	0.	1240.0	24.01	302.6	3.7	343.9	10.3
013	.74	.52	0.	1240.0	24.01	285.8	3.7	2480.9	60.6
014	.34	.52	0.	1240.0	24.01	265.3	3.0	800.9	28.0
015	0.00	.44	0.	1240.0	24.01	247.7	0.0	0.0	0.0
016	0.00	.36	0.	1240.0	24.01	232.2	0.0	0.0	0.0
017	0.00	.28	0.	1240.0	24.01	218.5	0.0	0.0	0.0
018	0.00	.20	0.	1240.0	24.01	206.4	0.0	0.0	0.0
019	0.00	.12	0.	1240.0	24.01	195.5	0.0	0.0	0.0
020	0.00	.04	0.	1240.0	24.01	185.7	0.0	0.0	0.0
021	.45	.41	0.	1240.0	24.01	176.9	0.0	0.0	0.0
022	0.00	.33	0.	1240.0	24.01	168.9	0.0	0.0	0.0
023	.53	.52	0.	1240.0	24.01	161.5	2.5	656.7	37.6
024	.52	.52	0.	1240.0	24.01	154.8	2.2	996.3	59.8
025	.07	.46	0.	1240.0	24.01	148.6	0.0	0.0	0.0
026	.06	.44	0.	1240.0	24.01	142.9	0.0	0.0	0.0
027	0.00	.36	0.	1240.0	24.01	137.6	0.0	0.0	0.0
028	0.00	.28	0.	1240.0	24.01	132.7	0.0	0.0	0.0
029	1.07	.52	0.	1240.0	24.01	128.1	1.9	1370.9	97.4
030	.46	.52	0.	1240.0	24.01	123.8	1.5	565.8	44.7
031	.29	.52	0.	1240.0	24.01	119.8	1.4	300.8	23.9
032	.29	.52	0.	1240.0	24.01	116.1	1.4	307.5	24.0
033	.72	.52	0.	1240.0	24.01	112.6	1.4	954.7	77.1
034	.05	.49	0.	1240.0	24.01	109.3	0.0	0.0	0.0
035	.20	.52	0.	1240.0	24.01	106.1	1.0	125.5	10.6
036	0.00	.44	0.	1240.0	24.01	103.2	0.0	0.0	0.0
037	.09	.45	0.	1240.0	24.01	100.4	0.0	0.0	0.0
038	0.00	.37	0.	1240.0	24.01	97.8	0.0	0.0	0.0
039	0.00	.29	0.	1240.0	24.01	95.3	0.0	0.0	0.0
040	0.00	.21	0.	1240.0	24.01	92.9	0.0	0.0	0.0
									891.1

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X1E6) (FC/CU.FT)	NITROGEN RATE (LB-N/A)	APPLIED FC (X1E3/SQ.FT)	RUNOFF FC (X1E3/100ML)	RUNOFF FC (X1E6/ACRE)	RUNOFF FC (X1E9)
	[NO. OF ANIMAL UNITS = 100 / MANAGEMENT PRACTICE CODE = 5]								
001	.47	.59	0.	150.0	.60	124.0	0.0	0.0	0.0
002	1.62	.52	0.	150.0	.60	124.0	.5	1177.7	117.0
003	.64	.52	0.	150.0	.60	124.0	.7	516.4	51.6
004	.93	.52	0.	150.0	.60	124.0	1.1	924.8	92.5
005	.17	.52	0.	150.0	.60	124.0	1.1	93.0	9.3
006	.42	.52	0.	150.0	.60	124.0	1.5	446.5	44.6
007	.17	.52	0.	150.0	.60	124.0	1.3	124.1	12.4
008	.63	.52	0.	150.0	.60	124.0	1.5	631.2	63.1
009	.17	.52	0.	150.0	.60	124.0	1.4	126.5	12.7
010	.01	.45	0.	150.0	.60	124.0	0.0	0.0	0.0
011	.72	.52	0.	150.0	.60	124.0	1.6	935.4	93.5
012	.18	.52	0.	150.0	.60	124.0	1.4	146.7	14.7
013	.75	.52	0.	150.0	.60	124.0	1.5	1049.0	104.9
014	.35	.52	0.	150.0	.60	124.0	1.3	373.8	37.4
015	.01	.45	0.	150.0	.60	124.0	0.0	0.0	0.0
016	.01	.38	0.	150.0	.60	124.0	0.0	0.0	0.0
017	.01	.31	0.	150.0	.60	124.0	0.0	0.0	0.0
018	.01	.24	0.	150.0	.60	124.0	0.0	0.0	0.0
019	.01	.17	0.	150.0	.60	124.0	0.0	0.0	0.0
020	.01	.10	0.	150.0	.60	124.0	0.0	0.0	0.0
021	.46	.48	0.	150.0	.60	124.0	0.0	0.0	0.0
022	.01	.41	0.	150.0	.60	124.0	0.0	0.0	0.0
023	.54	.52	0.	150.0	.60	124.0	1.6	636.6	63.7
024	.53	.52	0.	150.0	.60	124.0	1.6	753.7	75.4
025	.03	.47	0.	150.0	.60	124.0	0.0	0.0	0.0
026	.07	.46	0.	150.0	.60	124.0	0.0	0.0	0.0
027	.01	.39	0.	150.0	.60	124.0	0.0	0.0	0.0
028	.01	.32	0.	150.0	.60	124.0	0.0	0.0	0.0
029	1.03	.52	0.	150.0	.60	124.0	1.7	1347.5	134.7
030	.47	.52	0.	150.0	.60	124.0	1.4	570.1	57.0
031	.30	.52	0.	150.0	.60	124.0	1.4	317.8	31.8
032	.50	.52	0.	150.0	.60	124.0	1.3	330.5	33.1
033	.73	.52	0.	150.0	.60	124.0	1.5	1000.4	100.0
034	.06	.50	0.	150.0	.60	124.0	0.0	0.0	0.0
035	.21	.52	0.	150.0	.60	124.0	1.5	170.4	17.0
036	.01	.45	0.	150.0	.60	124.0	0.0	0.0	0.0
037	.10	.47	0.	150.0	.60	124.0	0.0	0.0	0.0
038	.01	.40	0.	150.0	.60	124.0	0.0	0.0	0.0
039	.01	.33	0.	150.0	.60	124.0	0.0	0.0	0.0
040	.01	.26	0.	150.0	.60	124.0	0.0	0.0	0.0
									1188.1

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X1E6) (FC/CU.FT)	NITROGEN RATE (LB N/A)	APPLIED FC (X1E3/SQ.FT)	RUNOFF FC (X1E3/100ML)	RUNOFF FC (X1E6/ACRE)	RUNOFF FC (X1E9)

[NO. OF ANIMAL UNITS = 100 / MANAGEMENT PRACTICE CODE - 1]

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X1E6) (FC/CU.FT)	NITROGEN RATE (LB N/A)	APPLIED FC (X1E3/SQ.FT)	RUNOFF FC (X1E3/100ML)	RUNOFF FC (X1E6/ACRE)	RUNOFF FC (X1E9)
001	1.50	.52	0.	1890.0	24.05	4246.9	22.3	16685.3	41.0
002	.71	.52	0.	1890.0	24.05	2473.1	17.4	11772.3	56.4
003	0.00	.44	0.	1890.0	24.05	1646.6	0.0	0.0	0.0
004	0.00	.36	0.	1890.0	24.05	1236.6	0.0	0.0	0.0
005	.33	.52	0.	1890.0	24.05	989.3	11.9	1163.1	13.3
006	.37	.52	0.	1890.0	24.05	824.4	10.6	3152.5	47.3
007	0.00	.44	0.	1890.0	24.05	706.6	0.0	0.0	0.0
008	.37	.52	0.	1890.0	24.05	613.3	8.4	6033.1	127.0
009	.51	.52	0.	1890.0	24.05	549.6	6.3	2787.4	62.7
010	1.70	.52	0.	1890.0	24.05	494.6	4.8	7718.4	193.0
011	4.40	.52	0.	1890.0	24.05	449.7	1.9	8505.1	233.9
012	1.00	.52	0.	1890.0	24.05	412.2	2.2	2097.5	62.9
013	.33	.52	0.	1890.0	24.05	380.5	2.7	694.0	27.6
014	.27	.52	0.	1890.0	24.05	353.3	3.2	633.5	22.2
015	.85	.52	0.	1890.0	24.05	329.8	3.5	2705.4	101.5
016	1.05	.52	0.	1890.0	24.05	309.1	3.1	3058.0	172.3
017	.70	.52	0.	1890.0	24.05	291.6	2.6	1661.5	70.6
018	0.00	.44	0.	1890.0	24.05	274.8	0.0	0.0	0.0
019	0.00	.36	0.	1890.0	24.05	260.3	0.0	0.0	0.0
020	0.00	.28	0.	1890.0	24.05	247.3	0.0	0.0	0.0
021	0.00	.20	0.	1890.0	24.05	235.5	0.0	0.0	0.0
022	.53	.52	0.	1890.0	24.05	224.3	3.1	470.9	23.1
023	1.81	.52	0.	1890.0	24.05	215.1	2.5	4445.9	255.6
024	2.60	.52	0.	1890.0	24.05	206.1	1.3	7058.1	201.5
025	2.33	.52	0.	1890.0	24.05	197.9	1.0	2250.8	139.4
026	.41	.52	0.	1890.0	24.05	190.2	1.2	329.7	26.0
027	2.50	.52	0.	1890.0	24.05	183.2	1.1	2794.3	186.7
028	.35	.52	0.	1890.0	24.05	176.7	1.1	318.5	22.3
029	.35	.52	0.	1890.0	24.05	170.6	1.5	415.0	30.1
030	.25	.52	0.	1890.0	24.05	164.9	1.7	293.3	22.0
031	0.00	.44	0.	1890.0	24.05	159.6	0.0	0.0	0.0
032	0.00	.36	0.	1890.0	24.05	154.6	0.0	0.0	0.0
033	.06	.34	0.	1890.0	24.05	149.9	0.0	0.0	0.0
034	.65	.52	0.	1890.0	24.05	145.5	2.0	821.5	67.0
035	1.24	.52	0.	1890.0	24.05	141.3	1.7	2077.3	161.3
036	.35	.52	0.	1890.0	24.05	137.4	1.3	374.6	33.7
037	.92	.52	0.	1890.0	24.05	133.7	1.4	1250.9	115.7
038	0.00	.44	0.	1890.0	24.05	130.2	0.0	0.0	0.0
039	.54	.52	0.	1890.0	24.05	126.8	1.5	569.6	55.6
040	1.06	.52	0.	1890.0	24.05	123.7	1.4	1465.7	145.5
									2685.6

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X1E3) (FC/CU.FT)	NITROGEN RATE (LB N/A)	APPLIED FC (X1E3/SQ.FT)	RUNOFF FC (X1E3/100ML)	RUNOFF FC (X1E6/ACRE)	RUNOFF FC (X1E9)

[NO. OF ANIMAL UNITS = 100 / MANAGEMENT PRACTICE CODE = 2]

001	1.00	.52	0.	1240.0	24.01	3714.9	17.1	17006.1	30.8
002	.71	.52	0.	1240.0	24.01	1057.4	13.1	8466.0	47.3
003	0.00	.44	0.	1240.0	24.01	1230.3	0.0	0.0	0.0
004	0.00	.36	0.	1240.0	24.01	928.7	0.0	0.0	0.0
005	.33	.52	0.	1240.0	24.01	743.6	9.0	878.5	10.4
006	.37	.52	0.	1240.0	24.01	619.1	7.5	2367.7	35.5
007	0.00	.44	0.	1240.0	24.01	530.7	0.0	0.0	0.0
008	.87	.52	0.	1240.0	24.01	464.4	6.3	4500.7	91.6
009	.51	.52	0.	1240.0	24.01	412.8	4.7	2073.5	47.1
010	1.70	.52	0.	1240.0	24.01	371.5	3.6	5947.0	145.7
011	4.40	.52	0.	1240.0	24.01	337.7	1.4	6337.7	175.7
012	1.00	.52	0.	1240.0	24.01	303.6	1.7	1575.9	47.3
013	.33	.52	0.	1240.0	24.01	285.3	2.0	521.7	16.9
014	.27	.52	0.	1240.0	24.01	265.3	2.4	475.8	16.7
015	.33	.52	0.	1240.0	24.01	247.7	2.6	2031.9	76.2
016	1.05	.52	0.	1240.0	24.01	232.2	2.5	2286.7	91.9
017	.70	.52	0.	1240.0	24.01	218.3	2.0	1247.9	53.0
018	0.00	.44	0.	1240.0	24.01	206.4	0.0	0.0	0.0
019	0.00	.36	0.	1240.0	24.01	195.5	0.0	0.0	0.0
020	0.00	.28	0.	1240.0	24.01	185.7	0.0	0.0	0.0
021	0.00	.20	0.	1240.0	24.01	176.9	0.0	0.0	0.0
022	.53	.52	0.	1240.0	24.01	166.9	2.4	316.1	17.4
023	1.31	.52	0.	1240.0	24.01	161.5	1.9	5339.1	192.0
024	2.60	.52	0.	1240.0	24.01	154.8	1.0	2522.1	151.5
025	2.33	.52	0.	1240.0	24.01	148.6	.7	1675.4	104.7
026	.41	.52	0.	1240.0	24.01	142.9	.9	300.2	19.5
027	2.50	.52	0.	1240.0	24.01	137.6	.8	2022.1	141.7
028	.35	.52	0.	1240.0	24.01	132.7	.5	251.2	16.9
029	.35	.52	0.	1240.0	24.01	128.1	1.1	311.7	22.6
030	.25	.52	0.	1240.0	24.01	123.8	1.2	220.3	16.5
031	0.00	.44	0.	1240.0	24.01	119.8	0.0	0.0	0.0
032	0.00	.36	0.	1240.0	24.01	116.1	0.0	0.0	0.0
033	.06	.34	0.	1240.0	24.01	112.6	0.0	0.0	0.0
034	.65	.52	0.	1240.0	24.01	109.3	1.5	617.0	52.4
035	1.24	.52	0.	1240.0	24.01	106.1	1.3	1536.4	136.2
036	.35	.52	0.	1240.0	24.01	103.2	1.0	381.3	25.3
037	.72	.52	0.	1240.0	24.01	100.4	1.1	332.4	30.9
038	0.00	.44	0.	1240.0	24.01	97.6	0.0	0.0	0.0
039	.54	.52	0.	1240.0	24.01	95.3	1.1	427.9	41.7
040	1.06	.52	0.	1240.0	24.01	92.9	1.1	1078.4	107.5
									2016.8

DAY	PRECIP +IRRIG (IN)	SOIL MOISTURE (IN)	STORAGE VOLUME (CU.FT)	STORAGE CONC(X1E6) (FC/CU.FT)	NITROGEN RATE (LB N/A)	APPLIED FC (X1E3/SQ.FT)	RUNOFF FC (X1E3/100ML)	RUNOFF FC (X1E6/ACRE)	RUNOFF FC (X1E9)
[NO. OF ANIMAL UNITS = 100 / MANAGEMENT PRACTICE CODE = 3]									
001	1.31	.52	0.	150.0	.60	124.0	.5	377.0	37.7
002	.72	.52	0.	150.0	.60	124.0	.6	543.8	54.4
003	.01	.45	0.	150.0	.60	124.0	0.0	0.0	0.0
004	.01	.38	0.	150.0	.60	124.0	0.0	0.0	0.0
005	.34	.52	0.	150.0	.60	124.0	1.4	176.6	17.7
006	.38	.52	0.	150.0	.60	124.0	1.5	468.5	46.9
007	.01	.45	0.	150.0	.60	124.0	0.0	0.0	0.0
008	.88	.52	0.	150.0	.60	124.0	1.6	1204.4	120.4
009	.52	.52	0.	150.0	.60	124.0	1.4	615.9	61.6
010	1.71	.52	0.	150.0	.60	124.0	1.1	1915.0	191.5
011	4.41	.52	0.	150.0	.60	124.0	.5	2273.7	227.4
012	1.01	.52	0.	150.0	.60	124.0	.7	634.9	63.5
013	.34	.52	0.	150.0	.60	124.0	.9	234.3	23.4
014	.28	.52	0.	150.0	.60	124.0	1.1	230.2	23.0
015	.84	.52	0.	150.0	.60	124.0	1.3	1006.7	100.7
016	1.06	.52	0.	150.0	.60	124.0	1.2	1205.6	120.6
017	.71	.52	0.	150.0	.60	124.0	1.1	708.0	70.8
018	.01	.45	0.	150.0	.60	124.0	0.0	0.0	0.0
019	.01	.38	0.	150.0	.60	124.0	0.0	0.0	0.0
020	.01	.31	0.	150.0	.60	124.0	0.0	0.0	0.0
021	.01	.24	0.	150.0	.60	124.0	0.0	0.0	0.0
022	.54	.52	0.	150.0	.60	124.0	1.6	302.8	30.3
023	1.82	.52	0.	150.0	.60	124.0	1.4	2415.9	241.6
024	2.61	.52	0.	150.0	.60	124.0	.7	1337.5	133.7
025	2.34	.52	0.	150.0	.60	124.0	.6	1382.6	138.3
026	.42	.52	0.	150.0	.60	124.0	.3	267.2	26.7
027	2.51	.52	0.	150.0	.60	124.0	.7	1865.1	186.5
028	.36	.52	0.	150.0	.60	124.0	.8	250.3	25.0
029	.36	.52	0.	150.0	.60	124.0	1.1	307.5	30.8
030	.26	.52	0.	150.0	.60	124.0	1.2	228.0	22.8
031	.01	.45	0.	150.0	.60	124.0	0.0	0.0	0.0
032	.01	.38	0.	150.0	.60	124.0	0.0	0.0	0.0
033	.07	.37	0.	150.0	.60	124.0	0.0	0.0	0.0
034	.66	.52	0.	150.0	.60	124.0	1.7	741.7	74.2
035	1.25	.52	0.	150.0	.60	124.0	1.4	1740.3	174.1
036	.36	.52	0.	150.0	.60	124.0	1.2	341.0	34.1
037	.93	.52	0.	150.0	.60	124.0	1.3	1159.2	115.9
038	.01	.45	0.	150.0	.60	124.0	0.0	0.0	0.0
039	.55	.52	0.	150.0	.60	124.0	1.4	566.7	56.7
040	1.07	.52	0.	150.0	.60	124.0	1.4	1401.0	140.1
									2664.7

Appendix E. Model Daily Bacterial Flowchart