

**94 DUNE ROAD  
EAST QUOGUE, TOWN OF SOUTHAMPTON  
SUFFOLK COUNTY, NEW YORK**

**BURBS  
NITROGEN LOADING MODEL**

**PREPARED FOR:**

**94 Dune Road Holding Corp.  
P.O. Box 681  
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**PREPARED BY:**



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**PWGC Project Number: DRH2101**



## Purpose

The purpose of this report is to document the findings of a nitrogen mass balance prediction performed by P.W. Grosser Consulting, Inc. (PWGC) for the evaluation of environmental impacts of the proposed multifamily residential development, with respect to nitrogen loading. The subject property is approximately 9.29 acres and is currently used as the Dockers Waterside Restaurant and Marina. The 9.29±-acre subject property consists of 3.38± acres of upland area, 3.75± acres of wetland area and 2.16± acres of surface water area. As such, the BURBS model includes only the developable 3.38± acres of upland area for the project area. The subject property is located at 94 Dune Road in the hamlet of East Quogue within the Town of Southampton, New York. The proposed action includes a change from one non-conforming use (restaurant/bar with office, marina with tennis court, decks and parking) to another non-conforming use (multifamily residential - proposed 25 condominium/townhouse units) on a portion of the overall subject property.

## Nitrogen Mass Balance Prediction

PWGC has evaluated the expected nitrogen loading to groundwater under several land use scenarios using the BURBS model. The BURBS model, developed at Cornell University by Hughes et al. (1985), is a computer simulation program that computes the potential impact of various land uses on groundwater within a community due to nitrogen. Cornell University has developed this model for specific applications on Long Island. For comparative purposes, PWGC has prepared a BURBS computation for five (5) land use scenarios: existing conditions, proposed development plan and three (3) alternative development plans. The three (3) alternative plans analyzed are as follows:

- Alternative #2: Develop Per Current Zoning and All Regulatory Controls
- Alternative #3: Reduced Density Alternative (20 Units)
- Alternative #5: Redevelopment of Property for Private Yacht Club

Alternative #4 (Town of Southampton Purchase of Subject Property) was not evaluated in this model due to the speculation associated with the future development of the subject property upon purchase by the Town of Southampton.

Based on PWGC experience, this program will predict a conservative estimate of nitrogen recharged to groundwater. It calculates loadings from wastewater, turf/landscaped land, natural land, runoff from impervious surfaces and atmospheric deposition. Each of these parameters is discussed and model parameters are defined.

There are 18 parameters used in the BURBS model:

1. Fraction of Land in Turf
2. Fraction of Land which is impervious
3. Average persons per dwelling
4. Housing density
5. Precipitation rate
6. Water recharged from turf
7. Water recharged from natural land
8. Evaporation from impervious surface

- 9. Runoff from impervious recharged
- 10. Home water use per person
- 11. Nitrogen concentration in precipitation
- 12. Nitrogen concentration in water used
- 13. Turf fertilization rate
- 14. Fraction of nitrogen leached from turf
- 15. Fraction of wastewater N lost as gas
- 16. Wastewater fraction removed by Sewer
- 17. Nitrogen per person in wastewater
- 18. Nitrogen removal rate of natural land.

### Determining Constant Parameter Values

The following parameters were constant across all scenarios: items 5, 7-12, 14, 17 and 18. Note that in some cases, certain parameters do not apply, but are still considered constant. For instance, the fraction of nitrogen leached from turf is considered a constant parameter even in scenarios where there is no turf area. These parameters are summarized in Table 1, below:

*Table 1 – BURBS Constant Parameters*

BURBS Parameters	BURBS Inputs	Units
5. Precipitation rate	41.4	inches/year
7. Water recharged from natural land	20.7	fraction
8. Evaporation from impervious surface	0.1	gallons/day
9. Runoff from impervious recharged	1	fraction
10. Home water use per person	100	gallons/day
11. Nitrogen concentration in precipitation	0.668	lbs./1000 sq ft
12. Nitrogen concentration in water used	0.54	fraction
14. Fraction of nitrogen leached from turf	0.3	fraction
17. Nitrogen per person in wastewater	10	lbs./year
18. Nitrogen removal rate of natural land	0.9	fraction

### Precipitation Rate (5)

The annual average precipitation in inches (BURBS). A value of 41.4 inches was used for this project. This is a typical rainfall amount for Long Island and was derived from the National Atmospheric Deposition Program NTN Site NY96 - Cedar Beach, Southold, New York.

### Water Recharged from Natural Land (7)

The amount of water per unit area of natural land which drains to groundwater (BURBS). Based upon PWGC experience and Long Island geology, approximately 50% of rainfall is recharged. Therefore, 20.70 inches per year was used for water recharged from natural land.

### Evaporation from Impervious Surfaces (8)

The fraction of precipitation falling on impervious surface assumed to evaporate (BURBS [1]). A value of 0.1 was used for each of the models' run. This amount is recommended by the BURBS parameter description.

### Runoff from Impervious Recharged (9)

The fraction of the runoff, which is recharged through recharge basins, ponds, etc. (BURBS). Evaporation is subtracted. All the runoff for this project area will be directed to the subsurface. Therefore, a value of 1 was used in each of the models' run.

### Home Water Use per Person (10)

Average in-home use of water (BURBS). The value used here was 100 gallons per person. This value was based on the Suffolk County Department of Health Services (SCDHS) estimate of 300 gallons of water use per day per single family home. Using an estimate of 3 persons per dwelling and dividing by the number of persons per dwelling, yields approximately 100 gallons used per person. This is a conservative estimate and includes all water uses such as bathing, sanitary, irrigation, etc.

### Nitrogen Concentration in Precipitation (11)

Average concentration of nitrogen in precipitation. The BURBS model recommends using data from the closest weather station where nitrogen tests were taken (BURBS). An average value of 0.675 mg/L was used in each of the BURBS models run. This was derived from the National Atmospheric Deposition Program NTN Site NY96 - Cedar Beach, Southold, New York. Concentrations of nitrate (NO<sub>3</sub>) were given as an annual average for the years 2003 through 2022, ranging from 0.43 mg/L to 0.92 mg/L.

### Nitrogen Concentration in Water Used (12)

Average concentration of nitrogen in water used (BURBS). An average value of 0.54 mg/L of Nitrate was used when running each of the models. The *Suffolk County Water Authority (SCWA) 2024 Drinking Water Quality Report* (for the calendar year 2023) indicated that the nitrogen concentrations for Distribution Area 1 varied from non-detectable to a high of 4.56 mg/L, with an average value of 0.54 mg/L.

### Fraction of Nitrogen Leached from Turf (14)

The fraction of nitrogen applied from fertilizer, precipitation, etc., which leaches to groundwater. The BURBS model recommends 0.35 for sandy soil if clippings are removed, or 0.5 if clippings are left on turf. A value of 0.30 was used which is a comparable value from the Long Island Nitrogen Action Plan (LINAP) Nitrogen Loading Model (NLM).

### Nitrogen per Person in Wastewater (17)

The average nitrogen per person in the United States is 10 pounds per person per day (BURBS [2]). This value was used when running the BURBS model in all scenarios.

### Nitrogen Removal Rate of Natural Land (18)

The fraction of nitrogen in precipitation, which is removed by natural land before the water is recharged which should be at least 90 percent (BURBS). Based upon the recommendations made by the BURBS parameter description, a value of 0.9 was used for all scenarios.

## Determining Variable Parameter Values

The following parameters vary by scenario: items 1-4, 6, 13, 15 and 16. These parameters are summarized in Table 2, below:

Table 2 – BURBS Variable Parameters

94 Dune Road, East Quogue, NY	Area	BURBS Inputs								
		1. Fraction Turf	2. Fraction Impervious	3. Average Persons Per Dwelling	Number of Dwellings	4. Housing Density	6. Water Recharged from Turf	13. Turf/ Agriculture Fertilization Rate	15. Fraction of wastewater N lost as gas	16. Wastewater Fraction Removed by Sewer
Scenario	Acres	Fraction	Fraction	Persons	Dwellings	Dwellings /acre	Fraction	lbs./1000 sq ft	Fraction	Fraction
Existing Conditions	3.38	0.021	0.657	3	11.20	3.314	20.7	2.04	0.50	0
Proposed	3.38	0	0.402	3	25	7.396	20.7	2.04	0.85	0
Alternative #2	3.38	0.299	0.149	3	1	0.296	31.05	2.04	0.65	0
Alternative #3	3.38	0	0.363	3	20	5.917	20.7	2.04	0.85	0
Alternative #5	3.38	0	0.456	3	23.07	6.824	20.7	2.04	0.85	0

### Fraction of Land in Turf, Impervious, and Natural (1, 2)

The fraction of land in turf refers to areas maintained as lawn. The fraction of land which is impervious is the sum of roof areas, driveways, and roads. Both the fraction of land in turf and impervious must be between 0 and 1. The fraction of land in natural vegetation is computed as 1 minus the sum of the fraction in turf and impervious, thus the sum of these must be less than 1 (BURBS). The existing land area was derived from the existing conditions survey. For the proposed development and alternative plans, the land areas were derived from the proposed site plans.

### Average Persons per Dwelling and House Density (3, 4)

The average number of people living in each house or dwelling unit (BURBS) and the housing density. The number of dwelling units per acre (BURBS) are part of the wastewater calculations in the BURBS model. These values (items 3 and 4) were calculated based on the expected gallons of wastewater generated per day. The number of dwellings was then back calculated based on the assumption that there are 300 gallons/day/dwelling – (see items 10 [Home Water Use per Person]). For the existing scenario, the subject property is currently served by an individual sanitary system. Based on the current use and the SCDHS design flow standards of 10 gallons per day (gpd)/seat (density load), 20 gpd/seat (kitchen load), 10 gpd/slip, and 100 gpd/tennis court, the current sanitary flow is approximately 3,360 gpd. Given that there are 300 gallons/day/dwelling, this would equate to 11.20 dwellings (3.314 dwellings/acre).

For the proposed scenario, the proposed STP has been designed with a flow of 7,500 gpd, which would have 25 dwellings (7.396 dwellings/acre). For alternative #2, it is expected that 300 gpd would be used for the single-family dwelling, which means that there would be 1 dwelling at 300 gallons/day/dwelling (0.296 dwellings/acre). For alternative #3, the proposed STP would be designed with a flow of 6,000 gpd, which would equate to 20 dwellings at 300 gallons/day/dwelling (5.917 dwellings/acre). For alternative #5, the proposed STP would be designed with a flow of 6,919.91 gpd. Given that there are 300 gallons/day/dwelling, this would equate to 23.07 dwellings (6.824 dwellings/acre).

### Water Recharged from Turf (6)

The amount of water per unit area of turf which drains to groundwater (BURBS). Based on PWGC experience and Long Island geology, approximately 50% of rainfall is recharged. It is noted that the subject property is not currently irrigated, and irrigation is not included in the design for the proposed action, alternative #3, or alternative #5. Therefore, the recharge percentage of 50% (20.70 inches per year) was used for water recharged from turf for the three aforementioned scenarios. However, alternative #2 would include approximately 2.87± acres of irrigated areas. To account for the turf areas being irrigated and the possibility of soil saturation, the recharge percentage was increased to 75% for alternative #2. Therefore, 31.05 inches per year was used for water recharged from turf for alternative #2.

### Turf Fertilization Rate (13)

Average yearly nitrogen application rate expected from residential turf (BURBS). PWGC used 2.04 lbs./1000 square feet for the turf fertilization rate, which is the calculated rate according to the LINAP NLM for residential application.

### Fraction of Wastewater Nitrogen Lost as Gas (15)

Fraction of nitrogen in wastewater which volatilizes or is converted to gaseous nitrogen through denitrification. Roughly 0.50 under Long Island, New York conditions (BURBS [5]). For the existing scenario a value of 0.50 was used as the current sanitary flow utilizes a conventional system. The proposed development, alternative #3 and alternative #5 would utilize a formal sewage treatment plant, which equates to a nitrogen removal efficiency of 85%. A value of 0.85 was used for these scenarios. Alternative #2 would be within its maximum permitted sanitary discharge for the subject property and thus able to utilize an Innovative/Alternative (I/A) on-site system. This equates to a nitrogen removal of 65%; a value of 0.65 was used for alternative #2.

### Fraction of Wastewater Removed by Sewer (16)

The efficiency of sewer systems. If no sewers are present, use 0 (BURBS [4]). If sewers are proposed as the sanitary disposal method, use 1 (BURBS). For those scenarios that do not propose a sewer connection at this site, the fraction of wastewater removed by sewers is 0. For those scenarios that propose a sewer connection at this site, the fraction of wastewater removed by sewers is 1. As none of the scenarios include a sewer connection, the fraction of wastewater removed by sewer is 0 for all scenarios.

### Summary of BURBS Model Results

As described above, PWGC utilized the BURBS model to estimate the nitrogen output from five (5) scenarios: existing conditions, proposed development, and the three (3) alternative plans. The BURBS model predicts nitrogen leached to groundwater independent of land area (i.e., lbs. N/acre/year). In order to calculate the estimated mass of nitrogen leached to groundwater, the acreage of each of the project components is multiplied by the model output, yielding pounds of nitrogen per year. The total N leached and the N concentration in each scenario is summarized in Table 3, below:

Table 3 – BURBS Results Summary

94 Dune Road East Quogue, NY	Sources of N Leached				Total N Leached		N Concentration
	Turf	Natural Land	Waste Water	Impervious Runoff			
Scenario	lbs./acre/yr.	lbs./acre/yr.	lbs./acre/yr.	lbs./acre/yr.	lbs./acre/yr.	lbs./yr.	mg/L
Existing Conditions	0.06	0.20	50.52	4.12	54.90	185.57	5.39
Proposed	0	0.37	33.83	2.52	36.73	124.15	2.83
Alternative #2	0.85	0.35	3.16	0.94	5.29	17.88	0.85
Alternative #3	0	0.40	27.07	2.27	29.74	100.52	2.59
Alternative #5	0	0.34	31.21	2.86	34.41	116.32	2.72

The detailed model calculations are shown in Attachment A.

Based upon the above results, the existing conditions scenario has the highest total nitrogen leached (i.e., 185.57 lbs./year) due to its increased impervious surface and subsequently increased amount of runoff as compared to the proposed scenario. The proposed scenario includes 124.15 lbs./year of nitrogen leached, which is 33% less than existing conditions. Alternatives #3 and #5 include slightly lower amounts of total nitrogen leached as compared to the proposed scenario due to greater acreages of natural land and lesser acreages of impervious areas. Specifically, the nitrogen leached for alternatives #3 and #5 would be 100.52 lbs./year and 116.32 lbs./yr., respectively. Alternative #2 would have the lowest total nitrogen leached (i.e., 17.88 lbs./yr.) due to the decreased amounts of impervious areas and subsequently the runoff produced. The concentration of nitrogen leached is highest for the existing conditions scenario at 5.39 mg/L, with the proposed scenario being 2.83 mg/L.

The existing conditions scenario is not consistent with the Long Island Comprehensive Waste Treatment Management Plan (commonly referred to as the “208 Study”), which recommends a limit on groundwater nitrogen concentration of 4 mg/L for properties within Groundwater Management Zone V. However, the proposed scenario, as well as the three (3) alternative scenarios, would be consistent with the recommendation set forth in the 208 Study. Based upon the results of the model, the proposed action has a nitrogen concentration of 2.83 mg/L which is 29% lower than the limit set forth by the 208 Study (i.e., 4 mg/L).

Therefore, the proposed action and all three (3) alternative scenarios would have less impact on the groundwater from a nitrogen perspective than existing conditions. Additionally, this type of development is consistent with the future growth projections utilized by Suffolk County as part of the Subwatersheds Wastewater Plan (SWP) which was prepared by SCDHS as part of the LINAP and to fulfill the recommendations of the Suffolk County Comprehensive Water Resources Management Plan.

## Resources

- (1) National Atmospheric Deposition Program (2020). Annual Precipitation-Weighted Mean Concentrations. <https://nadp.slh.wisc.edu/sites/ntn-ny96/>
- (2) Suffolk County Water Authority (SCWA). (2024). 2023 Drinking Water Quality Report. <http://s1091480.instanturl.net/dwqr2024/AWQR%202024%20FINAL.pdf>
- (3) Suffolk County. (2015, March). Suffolk County Comprehensive Water Resources Management Plan (Section 8). <https://www.suffolkcountyny.gov/Portals/0/FormsDocs/Health/EnvironmentalQuality/ComprehensiveWaterResourceManagementPlan/Section%208%20Wastewater%20Management.pdf>

Attachment A – Detailed BURBS Model Calculations

BURBS Summary  
 "94 Dune Road Holding Corporation"

BURBS Input #	BURBS Inputs																		BURBS Results										
																			N Leached (lbs/acre/yr)						N Leached				
	Total Acreage	Turf Acreage	Fraction Turf	Impervious Acreage	Fraction Impervious	Average Persons Per Dwelling	Number of Dwellings	Housing Density	Precipitation Rate (in/yr)	Water Recharge From Turf (in/yr)	Water Recharge from Natural Land (in/yr)	Evaporation from impervious surface (fraction)	Runoff from impervious recharge (fraction)	Home water use per person (gal/day)	Nitrogen in precip (mg/L)	Nitrogen in water used (mg/L)	Turf/Agriculture Fertilization Rate (lbs./1k sqft)	Fraction N Leached from Turf	Fraction of wastewater N lost as gas	Wastewater fraction removed by Sewer	Nitrogen per person in wastewater	Nitrogen removal rate of natural land	Turf	Natural Land	Waste Water	Impervious Runoff	Total (lbs./acre/yr.)	Total (lbs/yr)	N Conc. (mg/L)
Existing	3.38	0.07	0.021	2.22	0.657	3	11.2	3.314	41.4	20.7	20.7	0.1	1	100	0.668	0.54	2.04	0.03	0.50	0	10	0.9	0.06	0.20	50.52	4.12	54.90	185.57	5.39
Proposed	3.38	0.00	0.000	1.36	0.402	3	25	7.396	41.4	20.7	20.7	0.1	1	100	0.668	0.54	2.04	0.03	0.85	0	10	0.9	0.00	0.37	33.83	2.52	36.73	124.15	2.83
Alternative #2	3.38	1.01	0.299	0.50	0.149	3	1	0.296	41.4	31.05	20.7	0.1	1	100	0.668	0.54	2.04	0.03	0.65	0	10	0.9	0.85	0.35	3.16	0.94	5.29	17.88	0.85
Alternative #3	3.38	0.00	0.000	1.23	0.363	3	20	5.917	41.4	20.7	20.7	0.1	1	100	0.668	0.54	2.04	0.03	0.85	0	10	0.9	0.00	0.40	27.07	2.27	29.74	100.52	2.59

**BURBS**  
**"94 Dune Road Holding Corporation"**

Parameter Definitions  
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1. Fraction of land in turf - refers to area maintained as lawn, must be between 0 and 1.
2. Fraction of land which is impervious - sum of roof area, driveways and roads; must be between 0 and 1. The fraction of land in natural vegetation is computed as 1 minus the sum of fraction in turf and the fraction impervious, thus the sum of these 2 must be less than 1.
3. Average persons per dwelling - the average number of people living in each house or dwelling unit.
4. Housing density - the number of dwelling units per acre.
5. Precipitation rate - the annual average precipitation in inches.
6. Water recharged from turf - the amount of water per unit area of turf which drains to groundwater. This can be computed from a water budget for the root zone. A 1-2-3 spreadsheet is available for this. [1]
7. Water recharged from natural land - the amount of water per unit area of natural of natural vegetation which drains to groundwater. This can be computed from a water budget.
8. Evaporation from impervious surface - the fraction of precipitation falling on impervious surface assumed to evaporate. Try 0.10. [1]
9. Runoff from impervious recharged - The fraction of the runoff which is recharged through recharge basins, ponds etc. Evaporation is subtracted. Use 0 here if storm sewers drain all runoff to surface waters.
10. Water use per person - average in-home use of water. Try 44 gallons per person per day. [2]
11. Nitrogen concentration in precipitation - average concentration, Use data from closest weather station where nitrogen tests were done.
12. Nitrogen concentration in water used - average concentration in water used in homes.
13. Turf fertilization rate - average yearly nitrogen application rate expected for residential turf.
14. Fraction of nitrogen leached from turf - the fraction of nitrogen applied from fertilizer, precipitation etc. which leaches to groundwater. For sandy soil try 0.35 if clippings are removed, or try 0.5 if clippings are left on turf. These values are based on Long Island studies [3],[4]. For tighter soils the fraction leached will probably be less.
15. Fraction of Wastewater N lost as gas - fraction of nitrogen in wastewater which volatilizes or is converted to gaseous N through denitrification. Roughly 0.50 under Long Island, N.Y. conditions.[5] This value is dependent on temperature and soil. Warmer areas will probably have higher fractions volatilized as will areas with tighter soils. Colder areas will probably have lower fractions. Vary this widely in your sensitivity analysis. (Perhaps 0.2 to 0.8)
16. Fraction of wastewater removed by sewer - efficiency of sewer. Try 0.90 which is to assume that 10% exfiltrates from sewers. If no sewers are present use 0. [4]
17. Nitrogen per person in wastewater - the average in the U.S. is 10 lbs/person/day. [2]
18. Nitrogen removal rate of natural land - the fraction of nitrogen in precipitation which is removed by natural land before the water is recharged. Should be at least 90 percent. Try 95 percent for forested areas.

BURBS  
"94 Dune Road Holding Corporation"

BIBLIOGRAPHY

- 
- [1] Mather, John R. 1979. The Influence of Land-Use Change on Water Resources. Water Resources Center, University of Delaware. Newark, Delaware.
  - [2] Long Island Regional Planning Board. 1978. Long Island Comprehensive Waste Treatment Management Plan (208 study). Hauppauge, N.Y.
  - [3] Hughes, Henry B.F. and K.S. Porter. 1983. Land Use and Ground Water Quality in the Pine Barrens of Southampton. Center for Environmental Research, Cornell University, Ithaca, N.Y.
  - [4] Hughes, Henry B.F., J. Pike and K.S. Porter. 1985. Assessment of Ground-Water Contamination by Nitrogen and Synthetic Organics in Two Water Districts in Nassau County, N.Y. Center for Environmental Research, Cornell University, Ithaca, N.Y.
  - [5] Andreoli, A., R. Reynolds, N. Bartilucci and R. Forgione. 1977. Pilot Plant Study: Nitrogen Removal in a Modified Residential Subsurface Disposal System. Suffolk County Department of Health Services, Hauppauge, N.Y.

**BURBS Existing Conditions**  
**"94 Dune Road Holding Corporation"**

Welcome to BURBS  
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A Lotus 1-2-3 spreadsheet for calculating the impact of residential development on the nitrate concentration in groundwater.

<<<< Center for Environmental Research, Cornell University >>>>  
 Ithaca, N.Y. 1985

There are 9 pages:

	A	B	C	D	E	F	G	H	I	J	
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DATA - Enter a values for each parameter:

1. Fraction of land in turf	0.02	fraction
2. Fraction of land which is impervious	0.66	fraction
3. Average persons per dwelling	3.00	people
4. Housing density	3.31	dwellings/acre
5. Precipitation rate	41.40	inches/year
6. Water recharged from turf	20.70	inches/year
7. Water recharged from natural land	20.70	inches/year
8. Evaporation from impervious surface	0.10	fraction
9. Runoff from impervious recharged	1.00	fraction
10. Home water use per person	100.00	gallons/day
11. Nitrogen concentration in precip.	0.67	mg/l
12. Nitrogen concentration in water used	0.54	mg/l
13. Turf fertilization rate	2.04	lbs/1000 sq ft
14. Fraction of nitrogen leached from turf	0.03	fraction
15. Fraction of wastewater N lost as gas	0.50	fraction
16. Wastewater fraction removed by Sewer	0.00	fraction
17. Nitrogen per person in wastewater	10.00	lbs/year
18. Nitrogen removal rate of natural land	0.90	fraction

INTERMEDIATE CALCULATIONS

Fraction Natural Land	0.32	
Population Density	9.94	people/acre
Nitrogen addition from precipitation	6.27	lbs/acre/year
N content of wastewater incl. water used	10.16	lbs/person/year

LABELS FOR GRAPH

Turf	Overall
Natural	Nitrate
Sewage	Conc. =
Runoff	5.4
TOTAL	mg / liter

MACRO COMMANDS

**BURBS Existing Conditions**  
**"94 Dune Road Holding Corporation"**

INSTRUCTIONS

-----  
It is assumed that you already know how to use Lotus 1-2-3. This 1-2-3 spreadsheet is set up to calculate the amount of water and nitrogen which will be recharged from a residential development. It calculates loadings from wastewater, turf, natural land and runoff from impervious surfaces.

You must enter values for all the parameters on the data page which starts in cell A21. These parameters are defined and discussed on the page to right of this one. ----->

If you are uncertain of the appropriate value to use for a parameter, we suggest that you try several values in the range of possible values. The numerical output from this model is only as accurate as the parameters and assumptions and hence should be interpreted carefully.

There are several predefined graphs which you can use.

This software is free to all owners of Lotus 1-2-3 and carries no guarantee.

RESULTS:

	WATER RECHARGED		NITROGEN LEACHED	
	inches/yr	percent	lbs/acre/yr	percent
Turf	0.4	1%	0.1	0%
Natural Land	6.7	15%	0.2	0%
Wastewater	13.4	30%	50.5	92%
Impervious Runoff	24.5	54%	4.1	8%
TOTAL	44.9		54.9	

Nitrogen concentration in recharge                      5.4 mg/l

Graphs of the data can be accessed by typing <Alt> G.  
Select a graph, then type "Q" to exit graph menu.

**BURBS Proposed**  
**"94 Dune Road Holding Corporation"**

Welcome to BURBS  
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A Lotus 1-2-3 spreadsheet for calculating the impact of residential development on the nitrate concentration in groundwater.

<<<< Center for Environmental Research, Cornell University >>>>  
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There are 9 pages:

	A	B	C	D	E	F	G	H	I	J	
1	+-----+										
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<Alt> W = results + parameters on split screen	60	+-----+									
<Alt> U = undo split screen								š Bibliography		š	
<Alt> G = graphs								+-----<Alt> B-----			

DATA - Enter a values for each parameter:

1. Fraction of land in turf	0.00	fraction
2. Fraction of land which is impervious	0.40	fraction
3. Average persons per dwelling	3.00	people
4. Housing density	7.40	dwellings/acre
5. Precipitation rate	41.40	inches/year
6. Water recharged from turf	20.70	inches/year
7. Water recharged from natural land	20.70	inches/year
8. Evaporation from impervious surface	0.10	fraction
9. Runoff from impervious recharged	1.00	fraction
10. Home water use per person	100.00	gallons/day
11. Nitrogen concentration in precip.	0.67	mg/l
12. Nitrogen concentration in water used	0.54	mg/l
13. Turf fertilization rate	2.04	lbs/1000 sq ft
14. Fraction of nitrogen leached from turf	0.03	fraction
15. Fraction of wastewater N lost as gas	0.85	fraction
16. Wastewater fraction removed by Sewer	0.00	fraction
17. Nitrogen per person in wastewater	10.00	lbs/year
18. Nitrogen removal rate of natural land	0.90	fraction

INTERMEDIATE CALCULATIONS

Fraction Natural Land	0.60	
Population Density	22.19	people/acre
Nitrogen addition from precipitation	6.27	lbs/acre/year
N content of wastewater incl. water used	10.16	lbs/person/year

LABELS FOR GRAPH

Turf	Overall
Natural	Nitrate
Sewage	Conc. =
Runoff	2.8
TOTAL	mg / liter

MACRO COMMANDS

BURBS Proposed  
"94 Dune Road Holding Corporation"

INSTRUCTIONS

-----  
It is assumed that you already know how to use Lotus 1-2-3. This 1-2-3 spreadsheet is set up to calculate the amount of water and nitrogen which will be recharged from a residential development. It calculates loadings from wastewater, turf, natural land and runoff from impervious surfaces.

You must enter values for all the parameters on the data page which starts in cell A21. These parameters are defined and discussed on the page to right of this one. ----->

If you are uncertain of the appropriate value to use for a parameter, we suggest that you try several values in the range of possible values. The numerical output from this model is only as accurate as the parameters and assumptions and hence should be interpreted carefully.

There are several predefined graphs which you can use.

This software is free to all owners of Lotus 1-2-3 and carries no guarantee.

RESULTS:

	WATER RECHARGED		NITROGEN LEACHED	
	inches/yr	percent	lbs/acre/yr	percent
Turf	0.0	0%	0.0	0%
Natural Land	12.4	22%	0.4	1%
Wastewater	29.8	52%	33.8	92%
Impervious Runoff	15.0	26%	2.5	7%
TOTAL	57.2		36.7	

Nitrogen concentration in recharge                      2.8 mg/l

Graphs of the data can be accessed by typing <Alt> G.  
Select a graph, then type "Q" to exit graph menu.

**BURBS Alternative # 2**  
**"94 Dune Road Holding Corporation"**

Welcome to BURBS  
 -----

A Lotus 1-2-3 spreadsheet for calculating the impact of residential development on the nitrate concentration in groundwater.

<<<< Center for Environmental Research, Cornell University >>>>  
 Ithaca, N.Y. 1985

There are 9 pages:

	A	B	C	D	E	F	G	H	I	J	
1	+-----+										
Press the "Alt"	š	Welcome	š	Instructions	š	Definitions	š				
key with one	š	(you are here)	š	<Alt> I	š	(3 pages)	š				
letter	20	+-----+									
to switch	š	Parameters	š	Results	š				š		
sections.	š	<Alt> P	š	<Alt> R	š				š		
	40	+-----+									
Special	š	Calculations	š				š				
Commands:	š	<Alt> C	š				š				
	60	+-----+									
<Alt> W = results + parameters on split screen							š	Bibliography	š		
<Alt> U = undo split screen				<Alt> G = graphs				+-----	<Alt> B	+-----	

DATA - Enter a values for each parameter:

1. Fraction of land in turf	0.30	fraction
2. Fraction of land which is impervious	0.15	fraction
3. Average persons per dwelling	3.00	people
4. Housing density	0.30	dwellings/acre
5. Precipitation rate	41.40	inches/year
6. Water recharged from turf	31.05	inches/year
7. Water recharged from natural land	20.70	inches/year
8. Evaporation from impervious surface	0.10	fraction
9. Runoff from impervious recharged	1.00	fraction
10. Home water use per person	100.00	gallons/day
11. Nitrogen concentration in precip.	0.67	mg/l
12. Nitrogen concentration in water used	0.54	mg/l
13. Turf fertilization rate	2.04	lbs/1000 sq ft
14. Fraction of nitrogen leached from turf	0.03	fraction
15. Fraction of wastewater N lost as gas	0.65	fraction
16. Wastewater fraction removed by Sewer	0.00	fraction
17. Nitrogen per person in wastewater	10.00	lbs/year
18. Nitrogen removal rate of natural land	0.90	fraction

INTERMEDIATE CALCULATIONS

Fraction Natural Land	0.55	
Population Density	0.89	people/acre
Nitrogen addition from precipitation	6.27	lbs/acre/year
N content of wastewater incl. water used	10.16	lbs/person/year

LABELS FOR GRAPH

Turf		Overall
Natural		Nitrate
Sewage		Conc. =
Runoff		0.8
TOTAL		mg / liter

MACRO COMMANDS



**BURBS Alternative # 3**  
**"94 Dune Road Holding Corporation"**

Welcome to BURBS  
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A Lotus 1-2-3 spreadsheet for calculating the impact of residential development on the nitrate concentration in groundwater.

<<<< Center for Environmental Research, Cornell University >>>>  
 Ithaca, N.Y. 1985

There are 9 pages:

	A	B	C	D	E	F	G	H	I	J	
1	+-----+										
Press the "Alt"	š	Welcome	š	Instructions	š	Definitions	š				
key with one	š	(you are here)	š	<Alt> I	š	(3 pages)	š				
letter	20	+-----+									
to switch	š	Parameters	š	Results	š		š				
sections.	š	<Alt> P	š	<Alt> R	š		š				
	40	+-----+									
Special	š	Calculations	š		š		š				
Commands:	š	<Alt> C	š		š		š				
<Alt> W = results + parameters on split screen	60	+-----+									
<Alt> U = undo split screen									š	Bibliography š	
				<Alt> G = graphs					+-----	<Alt> B-----+	

DATA - Enter a values for each parameter:

1. Fraction of land in turf	0.00	fraction
2. Fraction of land which is impervious	0.36	fraction
3. Average persons per dwelling	3.00	people
4. Housing density	5.92	dwellings/acre
5. Precipitation rate	41.40	inches/year
6. Water recharged from turf	20.70	inches/year
7. Water recharged from natural land	20.70	inches/year
8. Evaporation from impervious surface	0.10	fraction
9. Runoff from impervious recharged	1.00	fraction
10. Home water use per person	100.00	gallons/day
11. Nitrogen concentration in precip.	0.67	mg/l
12. Nitrogen concentration in water used	0.54	mg/l
13. Turf fertilization rate	2.04	lbs/1000 sq ft
14. Fraction of nitrogen leached from turf	0.03	fraction
15. Fraction of wastewater N lost as gas	0.85	fraction
16. Wastewater fraction removed by Sewer	0.00	fraction
17. Nitrogen per person in wastewater	10.00	lbs/year
18. Nitrogen removal rate of natural land	0.90	fraction

INTERMEDIATE CALCULATIONS

Fraction Natural Land	0.64	
Population Density	17.75	people/acre
Nitrogen addition from precipitation	6.27	lbs/acre/year
N content of wastewater incl. water used	10.16	lbs/person/year

LABELS FOR GRAPH

Turf	Overall
Natural	Nitrate
Sewage	Conc. =
Runoff	2.6
TOTAL	mg / liter

MACRO COMMANDS



**BURBS Alternative # 5**  
**"94 Dune Road Holding Corporation"**

Welcome to BURBS  
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A Lotus 1-2-3 spreadsheet for calculating the impact of residential development on the nitrate concentration in groundwater.

<<<< Center for Environmental Research, Cornell University >>>>  
 Ithaca, N.Y. 1985

There are 9 pages:

	A	B	C	D	E	F	G	H	I	J	
1	+-----+										
Press the "Alt"	š	Welcome	š	Instructions	š	Definitions	š			š	
key with one	š	(you are here)	š	<Alt> I	š	(3 pages)	š			š	
letter	20	+-----+									
to switch	š	Parameters	š	Results	š		š			š	
sections.	š	<Alt> P	š	<Alt> R	š		š			š	
	40	+-----+									
	š	Calculations	š		š		š			š	
Special	š	<Alt> C	š		š		š			š	
Commands:	60	+-----+									
<Alt> W = results + parameters on split screen									š	Bibliography š	
<Alt> U = undo split screen			<Alt> G = graphs						+-----	<Alt> B-----+	

DATA - Enter a values for each parameter:

1. Fraction of land in turf	0.00	fraction
2. Fraction of land which is impervious	0.46	fraction
3. Average persons per dwelling	3.00	people
4. Housing density	6.82	dwellings/acre
5. Precipitation rate	41.40	inches/year
6. Water recharged from turf	20.70	inches/year
7. Water recharged from natural land	20.70	inches/year
8. Evaporation from impervious surface	0.10	fraction
9. Runoff from impervious recharged	1.00	fraction
10. Home water use per person	100.00	gallons/day
11. Nitrogen concentration in precip.	0.67	mg/l
12. Nitrogen concentration in water used	0.54	mg/l
13. Turf fertilization rate	2.04	lbs/1000 sq ft
14. Fraction of nitrogen leached from turf	0.03	fraction
15. Fraction of wastewater N lost as gas	0.85	fraction
16. Wastewater fraction removed by Sewer	0.00	fraction
17. Nitrogen per person in wastewater	10.00	lbs/year
18. Nitrogen removal rate of natural land	0.90	fraction

INTERMEDIATE CALCULATIONS

Fraction Natural Land	0.54	
Population Density	20.47	people/acre
Nitrogen addition from precipitation	6.27	lbs/acre/year
N content of wastewater incl. water used	10.16	lbs/person/year

LABELS FOR GRAPH

Turf	Overall
Natural	Nitrate
Sewage	Conc. =
Runoff	2.7
TOTAL	mg / liter

MACRO COMMANDS

