Section 4.4 References

1. BLS (Bureau of Labor Statistics) 2005a, *Local Area Unemployment Statistics. Labor Force data by County, 2004 and 2005 Annual Averages.* Available at http://www.stats.bls.gov, accessed May 2006.

2. BLS 2005b. *May 2005 Occupational Employment and Wage Estimates for South Carolina.* Available at www.bls.gov/oes/current/oes sc.htm, accessed April 27, 2007.

3. Fairfield County 1997. *Fairfield County Comprehensive Plan Update.* Winnsboro, South Carolina. April 1997.

4. Golden, J., R. P. Ouellette, S. Saari, and P. N. Cheremisinoff 1980. Chapter 8: *Noise,* In Environmental Impact Data Book (Second Printing), Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1980.

5. U.S. NRC 1996, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, NUREG-1437, Volume 1, Office of Nuclear Regulatory Research, Washington, D.C. May 1996.

6. SCBCB (South Carolina Budget and Control Board) 2006. *Historical Analysis FY 1992-93 to FY 2005-06. October 31, 2006.* Available at www.budget.sc.gov/webfiles/00/historical, accessed April 28, 2007.

7. U.S. BEA (U.S. Bureau of Economic Analysis) 2006. *RIMS II Multipliers for Columbia, SC Region 2*, Regional Economic Analysis Division, Economic and Statistics Administration, 2006.

8. USCB (U.S. Census Bureau) 2000a. *DP-1 Profile of General Demographic Characteristics: 2000.* Available at http://factfinder.census/gov.

9. USCB 2000b. *GCT-HP1 Population, Housing Units, Area, and Density: 2000 Data Set: Census 2000 Summary File 1 (SF1) 100-Percent Data.* Available at http://factfinder.census.gov, accessed June 8, 2007.

10. U.S. EPA 2003, U.S. EPA, *Water on Tap: What you Need to Know,* EPA 815-K-03-007, Office of Water, Washington, D.C., 2003.

2.5.2.1 i-415 (BLS 2005)

See 4.4 Ref 1

Labor Force Data by County, 2005 Annual Averages

LAUS Code	State FIPS Code	County FIPS Code	County Name/State Abbreviation	Year	Labor Force	Employed	Unemployed	Unemployment Rate (%)
CN450010	45	001	Abbeville County, SC	2005	12,329	11,371	958	7.8
PA450500	45	003	Aiken County, SC	2005	75,081	70,590	4,491	6.0
CN450050	45	005	Allendale County, SC	2005	3,410	3,037	373	10.9
CN450070	45	007	Anderson County, SC	2005	83,645	77,369	6,276	7.5
CN450090	45	009	Bamberg County, SC	2005	6,781	6,194	587	8.7
CN450110	45	011	Barnwell County, SC	2005	9,686	8,789	897	9.3
PA450550	45	013	Beaufort County, SC	2005	63,483	60,650	2,833	4.5
PA450600	45	015	Berkeley County, SC	2005	72,165	68,266	3,899	5.4
CN450170	45	017	Calhoun County, SC	2005	7,318	6,773	545	7.4
CN450190	45	019	Charleston County, SC	2005	168,970	159,638	9,332	5.5
CN450210	45	021	Cherokee County, SC	2005	25,260	23,226	2,034	8.1
CN450230	45	023	Chester County, SC	2005	16,298	14,759	1,539	9.4
CN450250	45	025	Chesterfield County, SC	2005	18,482	16,703	1,779	9.6
CN450270	45	027	Clarendon County, SC	2005	13,070	11,809	1,261	9.6
CN450290	45	029	Colleton County, SC	2005	16,678	15,461	1,217	7.3
PA450650	45	031	Darlington County, SC	2005	31,107	28,333	2,774	8.9
CN450330	45	033	Dillon County, SC	2005	13,932	12,582	1,350	9.7
PA450670	45	035	Dorchester County, SC	2005	54,815	51,972	2,843	5.2
CN450370	45	037	Edgefield County, SC	2005	11,076	10,250	826	7.5
CN450390	45	039	Fairfield County, SC	2005	11,577	10,662	915	7.9
PA450700	45	041	Florence County, SC	2005	61,971	56,311	5,660	9.1
CN450430	45	043	Georgetown County, SC	2005	29,693	27,215	2,478	8.3
CN450450	45	045	Greenville County, SC	2005	207,117	195,510	11,607	5.6
PA451100	45	047	Greenwood County, SC	2005	33,231	30,222	3,009	9.1
CN450490	45	049	Hampton County, SC	2005	8,031	7,342	689	8.6
CN450510	45	051	Horry County, SC	2005	121,671	114,942	6,729	5.5
CN450530	45	053	Jasper County, SC	2005	10,511	9,985	526	5.0
CN450550	45	055	Kershaw County, SC	2005	29,016	27,098	1,918	6.6
PA450770	45	057	Lancaster County, SC	2005	30,346	27,774	2,572	8.5
PA451150	45	059	Laurens County, SC	2005	33,273	30,987	2,286	6.9
CN450610	45	061	Lee County, SC	2005	8,493	7,679	814	9.6
PA450800	45	063	Lexington County, SC	2005	127,570	121,336	6,234	4.9
CN450650	45	065	McCormick County, SC	2005	3,623	3,223	400	11.0
CN450670	45	067	Marion County, SC	2005	14,267	12,299	1,968	13.8

Stats.
www.bls.gov

Labor Force Data by County, 2005 Annual Averages

LAUS Code	State FIPS Code	County FIPS Code	County Name/State Abbreviation	Year	Labor Force	Employed	Unemployed	Unemployment Rate (%)
CN450690	45	069	Marlboro County, SC	2005	12,833	11,335	1,498	11.7
CN450710	45	071	Newberry County, SC	2005	17,934	16,681	1,253	7.0
CN450730	45	073	Oconee County, SC	2005	32,489	29,709	2,780	8.6
PA450850	45	075	Orangeburg County, SC	2005	41,667	37,684	3,983	9.6
PA450900	45	077	Pickens County, SC	2005	56,885	53,056	3,829	6.7
CN450790	45	079	Richland County, SC	2005	171,461	161,133	10,328	6.0
CN450810	45	081	Saluda County, SC	2005	9,459	8,799	660	7.0
PA450400	45	083	Spartanburg County, SC	2005	130,863	120,820	10,043	7.7
CN450850	45	085	Sumter County, SC	2005	47,122	42,964	4,158	8.8
CN450870	45	087	Union County, SC	2005	12,831	11,398	1,433	11.2
CN450890	45	089	Williamsburg County, SC	2005	16,082	14,241	1,841	11.4
PA451050	45	091	York County, SC	2005	96,917	90,564	6,353	6.6
					2,080,519	1,938,741	141,778	6.81%

Section 4.4 Ref 2

Referenced in Section 2.5

BLS 2005b. *May 2005 Occupational Employment and Wage Estimates forSouth Carolina*. Available at www.bls.gov/oes/current/oes sc.htm, accessed April 27, 2007.

(Fairfield 1997)

Section 4.4 Ref 3

COMPREHENSIVE PLAN UPDATE, 1997

FAIRFIELD COUNTY

Prepared By: Vismor & Associates, Inc.

compatibility

RESOLUTION
RECOMMENDING ADOPTION OF
A COMPREHENSIVE PLAN
FOR
FAIRFIELD COUNTY, SOUTH CAROLINA

WHEREAS, the General Assembly of South Carolina enacted in 1994 an amendment to the Code of Laws of South Carolina by adding Chapter 29 to Title 6, "South Carolina Local Government Comprehensive Planning Enabling Act of 1994", and repealing all previously enacted planning Acts and Codes; and

WHEREAS, the 1994 Enabling Act requires that the local planning commission develop and maintain a planning process which will result in the systematic preparation and continued reevaluation and updating of those elements considered critical, necessary, and desirable to guide the development and redevelopment of its area of jurisdiction; and

WHEREAS, the planning process shall include the development of a Comprehensive Plan which shall consist of a population element, an economic element, natural and cultural resources element, a community facilities element, a housing element, and a land use element; and

WHEREAS, the Fairfield County Planning Commission developed and adopted 11-19-92 such a Plan; and

WHEREAS, the 1994 Planning Enabling Act stipulates that the "Planning Commission shall review the Comprehensive Plan or elements of it as often as necessary, but not less than once every five years; and

WHEREAS, the Fairfield County Planning Commission on this five-year anniversary (1997) has reviewed the Plan to determine the need for change, and has recommended amending the Plan to incorporate such change(s) as included in such document and shown on the Plan Map:

NOW THEREFORE, THE FAIRFIELD COUNTY PLANNING COMMISSION, BY RESOLUTION, HEREBY RECOMMENDS FOR ADOPTION BY FAIRFIELD COUNTY COUNCIL A REVISED AND AMENDED "COMPREHENSIVE PLAN" FOR FAIRFIELD COUNTY, INCLUDING ALL REFERENCED PLAN MAPS, THIS 15 DAY OF APRIL, 1997.

Mike Mills

Mike Mills, Chairman
Fairfield County Planning Commission

TABLE OF CONTENTS

	Page
INTRODUCTION	1
SECTION I. DEMOGRAPHIC AND ECONOMIC OVERVIEW	3
Demographic Trends	3
Demographic Composition	6
Demographic Forecast	10
Housing	13
Income	17
Business Activity	18
Employment	19
SECTION II. ENVIRONMENTAL FEATURES	26
Position in the State	26
Climate	26
Geologic Formations	27
Soils	28
Topography	33
Wetlands	39
Flood Hazard Areas	41
SECTION III. LAND USE AND INFRASTRUCTURE	43
Existing Land Use	43
Infrastructure	50
SECTION IV. LAND USE FORECAST	62
SECTION V. PLANNING ISSUES AND OBJECTIVES	65
Citizen Participation in the Identification of Issues and Needs	65
Summary Listing	69
Amplification of Issues, Objectives and Recommended Responses	69

SECTION VI. COMPREHENSIVE DEVELOPMENT PLAN, 2010 84

Land Use Plan Element 86
Projects and Facilities Plan Element 91
Development Policies 96

SECTION VII. PLAN IMPLEMENTATION 102

Air the Plan 102
Adopt the Plan 103
Maintain the Plan 103
Coordinate the Plan 103
Enact Development and Land Use Regulations To Assure Plan Compliance and Implementation 104
Conclusion 106

INTRODUCTION

Fairfield County was created in 1785, with the division of the Camden District into five counties. Prior to the establishment of the county, it was a hunting ground for the Catawba Indians, and was subsequently settled by the English and Scotch-Irish, beginning in 1740.

Early English settlements were made around rivers and creeks. Eventually these settlements led to a cotton plantation culture which gave way to "share cropping" following the War Between the States.

Share cropping, in turn, led to soil depletion and massive erosion of most of the county. And finally, the arrival of the boll weevil in about 1920 finished the cotton industry in Fairfield County. From this adversity, the county has rebounded with a more vigorous and diversified economic base, as discussed herein.

Fairfield County is organized under the Council-Administrator form of government, authorized by the Home Rule Act of 1974. The centerpiece of the governmental complex is the historical Fairfield County Courthouse, constructed in 1823.

For all the changes that have taken place over time, Fairfield, with an area of about 686 square miles and a population density of only 26.5 persons per square mile, remains a predominantly rural area. However, it is being impacted as never before by the expansion of the Greater Columbia Area, and improved accessibility via I-77 through the county.

These changes have and will continue to support the suburbanization of employment facilities in the county. They may also lead to the exurbanization of Winnsboro and Ridgeway, and the suburbanization of areas in closer proximity to Richland County.

These development scenarios surely will alter the landscape and the rural character of Fairfield County. And if left unplanned and uncontrolled, these changes could result in a patchwork of subdivisions, commercial strips, and incompatible industrial uses completely lacking in character or traditional values, compromising rather than enhancing "quality of life" in the county. In addition to creating negative fall-out sometimes associated with development, and lending order to the process,

---

1 Central Midlands Regional Planning Council, Central Midlands Historic Preservation Survey, 1974.

planning, as advanced in this document, is predicated on the following.

Planning makes sense. You would not build a home without a plan. In fact, very few actions are taken without some sort of plan. Without a plan, the county is in the precarious position of having to respond to issues as they arise without regard to possible long-range implications. The problem with this is that it can and often does place pressure on local officials to address issues that were neither anticipated nor budgeted. It also places with such officials the responsibility of resolving land use problems created by unplanned development---problems of land use incompatibility and infringement of property rights, among others.

Planning can save money. The county and other service providers can tie fiscal planning into the land use planning process so that major capital items such as water, sewer, schools, recreation facilities, fire protection, etc. will be provided in a timely efficient manner, to accommodate future development. And this can save money in right-of-way and public site acquisitions, along with other money-saving ventures.

Planning can ensure project coordination. Advance planning can ensure that roads intersect at proper angles, and that traffic movement is not incumbered by poor street design, unlimited curb cuts, and access points.

Finally, Planning is required by the State if land use regulations (zoning) and development controls are to be adopted by the county. According to 6-7-710 of the S.C. Code of Laws, 1976, "Land use regulations shall be made in accordance with a Comprehensive Plan".

More to the point, this Plan is intended to promote an arrangement of land use, circulation and services which will encourage and contribute to the economic, social and physical health, safety, welfare and convenience of the county. It is further intended to guide development and change to meet existing and anticipated needs and conditions; to contribute to a healthy and pleasant environment; to balance growth and stability; to reflect economic potentialities and limitations; to protect investment to the extent reasonable and feasible; and to serve as a basis for regulating land use and the development process.

The following sections dimension the various elements of the Plan and include a strategy for implementation.

SECTION I

DEMOGRAPHIC AND ECONOMIC OVERVIEW

This initial section of the Plan will dimension the influence of demographics and economics on development and land use in Fairfield County.

Characteristics of the population are studied over time to determine trends, composition, distribution and related information essential to the planning process. The economic base also is assessed in terms of its influence on existing and future development.

DEMOGRAPHIC TRENDS

An awareness of the population base and what it is doing is critical to the development of a Plan. How many people are we planning for? What is the trend? What are the characteristics of the population? Where is growth taking place?

The answer to these questions will tell us much about what to expect in the way of future land use and intensity of development.

The official 1990 Census places the number of county residents at 22,295, up 7.7 percent over the 1980 population, which was up 3.5 percent over 1970. This 20-year growth record reverses an earlier out-migration trend recorded in the 1960s, when the county population declined by 3.4 percent.

Overall, growth of the county has not kept pace with that of the State, which recorded gains of 20 percent and 11.7 percent, respectively during the 70s and 80s. However, growth in two areas of the county, Ridgeway and Winnsboro south, closely mirrors the average rate of increase for the State.

The Ridgeway Census County Division (see Map I) increased by 13.4 percent between 1970 and 1980, and by 12.1 percent between 1980 and 1990, above the state average of 11.1 percent. Increased growth in Winnsboro south was even stronger during the 80s, although the rate was slightly less at 9.6 percent.

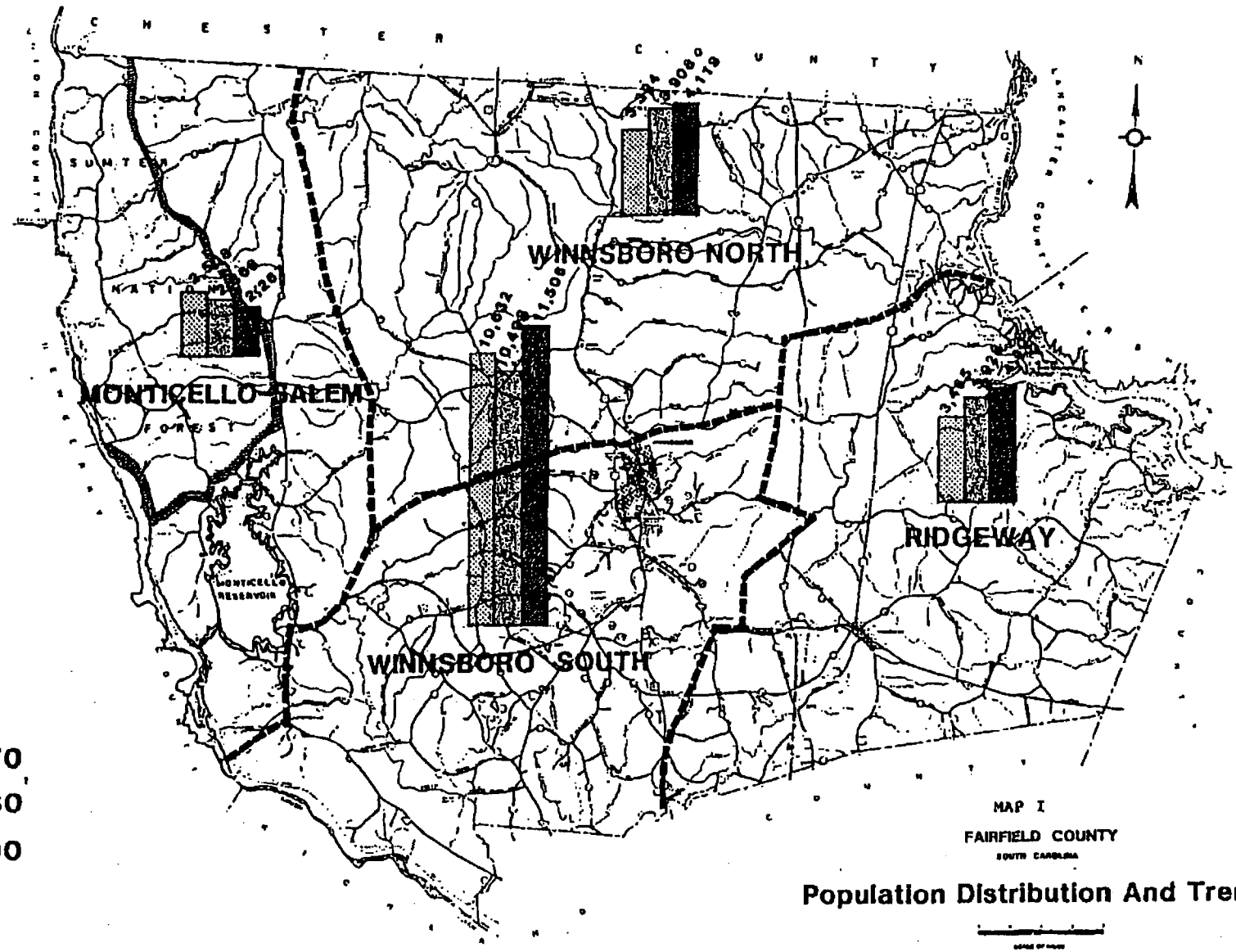
The growth of these areas may be attributed to improved linkage by I-77 to the Columbia MSA (Metropolitan Statistical Area), better accessibility to "outside" market areas, and to opening these areas and their inherent amenities to development.

TABLE I

DEMOGRAPHIC TRENDS
FAIRFIELD COUNTY AND CENSUS COUNTY DIVISIONS

CENSUS COUNTY DIVISIONS	1970	1980	1990	Change 1970-1980 No.	Change 1970-1980 %	Change 1980-1990 No.	Change 1980-1990 %
FAIRFIELD COUNTY	19,999	20,700	22,295	701	3.5	1,595	7.7
Monticello-Salem	2,508	2,366	2,267	-142	-5.7	- 99	-4.2
Ridgeway	3,465	3,928	4,403	463	13.4	475	12.1
Winnsboro North	3,394	3,908	4,119	514	15.1	211	5.4
Winnsboro South	10,632	10,498	11,506	-137	-1.3	1,008	9.6
South Carolina (000)	2,591	3,122	3,487	531	20.0	365	11.7
PERCENT COUNTY							
Monticello-Salem	12.5	11.4	10.2				
Ridgeway	17.3	19.0	19.7				
Winnsboro North	17.0	18.9	18.5				
Winnsboro South	53.2	50.7	51.6				

Source: U.S. Department of Commerce, Bureau of Census, Census of Population, Number of Inhabitants, Selected Years.



1970
1980
1990

MAP I

FAIRFIELD COUNTY

SOUTH CAROLINA

Population Distribution And Trends

Census County Divisions

The balance of the county has not faired as well over the last 20 years. Winnsboro North CCD had a modest increase, but population has declined in the more rural and remote Monticello-Salem Area. On the positive side, however, the county's growth rate during the 80s more than doubled the rate of growth in the 70s.

DEMOGRAPHIC COMPOSITION

To more fully understand the population, we need to take stock of its component parts or characteristics, including gender, age and race.

Gender Composition

As a general rule, the female population is larger than its male counterpart. In 1990, the female population in South Carolina accounted for 51.4 percent of the total. Fairfield County by comparison, had an even higher ratio of females, 52.1 percent. On average the county's female population has fluctuated between 51 and 52 percent of the total over the last 20 years. However, the trend is definitely up, as shown by Table II.

Nationally, the sexes are about evenly distributed in the pre-teen and teenage years, but with age the ratio generally becomes imbalanced on the female side. While the process is gradual, females at age 65 and over are in the majority position. And this pattern is also prevalent in Fairfield County where in 1990, females comprised over eight percent of the total population, while males accounted for only 5 percent.

From a planning standpoint, this trend has little affect on land use planning, except for the obvious housing implications. More people of any one sex, generally produces more one-person households, favoring smaller units and aggregate housing facilities.

Age Composition

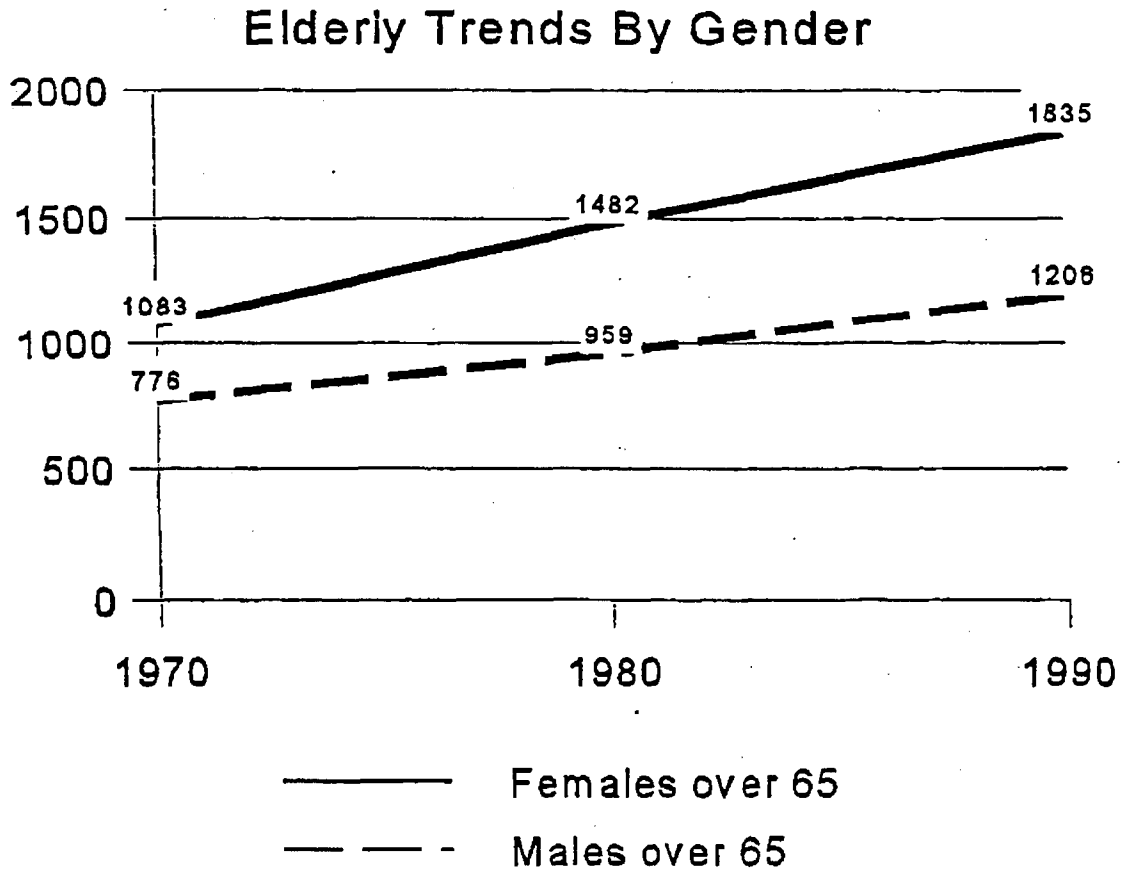
Two noteworthy trends are taking place in the age composition of county residents. One, the number of children and adolescents (under the age of 18) is declining sharpely. And this decline surely will show up in future population counts, if not off-set by in-migration. Two, the number of elderly persons (65 and older) is increasing significantly.

From 41 percent of the total population in 1970, the under 18 population group dropped to 28 percent by 1990, for a 22 percent decline. Conversely, the elderly population grew from nine percent to 14 percent of the total, for a 64 percent

TABLE II

GENDER COMPOSITION AND TRENDS
FAIRFIELD COUNTY, 1970-1990

	1970		1980		1990	
	No.	%	No.	%	No.	%
Males	9,756	48.8	9,993	48.3	10,689	47.9
Over 65	776	03.9	959	04.6	1,206	05.4
Females	10,243	51.2	10,707	51.7	11,606	52.1
Over 65	1,083	05.4	1,482	07.2	1,835	08.2



increase. The more productive age group, between 18 and 64, also increased from 50 to 58 percent during this period, but at a slower rate.

Table III

Comparative Trends In Selected Age Groups, Fairfield County and South Carolina, 1970-1990

	Percent Population 1970	1990
Under 18		
Fairfield County	.41	.28
South Carolina	.37	.24
Over 64		
Fairfield County	.09	.14
South Carolina	.07	.11

Source: U.S. Bureau of Census, General Population Characteristics, South Carolina, Selected Years.

The concern for what is happening in Fairfield County, if there is cause for concern, is the decline in the young. But the situation in Fairfield County is not out of line with the trend in the State, where the under 18 age group declined over the last 20 years from 37 to 24 percent of the population. Actually, the ratio of young people in Fairfield County is higher than the state average.

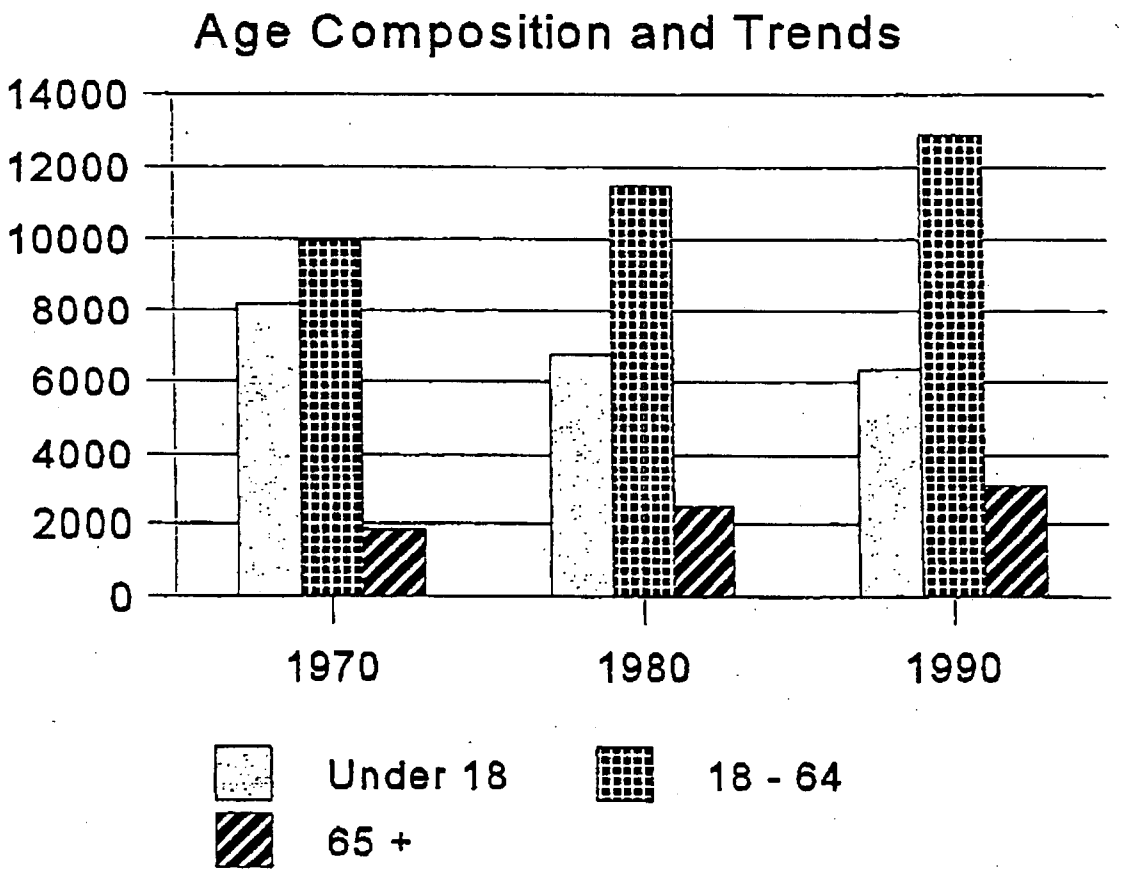
The ratio of elderly persons also is higher in Fairfield County than in the state. The reason lies logically in increased longevity and stability. Fairfield County's aging population is staying home, as opposed to migrating to retirement areas.

The implications of this from a planning and land use standpoint suggest that more attention be placed on addressing the needs of an aging population, i.e. congregate housing, nursing homes, health care facilities, passive parks, public transportation, small lot subdivisions, patio and multi-family dwellings, etc.

TABLE IV

AGE COMPOSITION AND TRENDS
FAIRFIELD COUNTY, 1970-1990

	1970		1980		1990	
	NO.	%	NO.	%	NO.	%
Under 18	8,172	.41	6,764	.33	6,343	.28
18 - 64	9,968	.50	11,495	.55	12,911	.58
65 and over	1,859	.09	2,441	.12	3,041	.14
TOTAL	19,999	100	20,700	100	22,295	100



Racial Composition

Looking now at the racial composition, we find that the county is composed predominantly of African-Americans. The White population comprises only 42 percent of the total, but has shown a slight percentage increase over the last 20 years. Both groups grew by about eight percent over the last 10 years, up from the previous 10-year period, between 1970 and 1980.

Interestingly, the most dramatic rate increase has come in "other" minorities, i.e. Indian, Eskimo, Asian, etc. From only two persons in this category in 1970, the number was up to 57 by 1990. In terms of overall make-up, these groups still comprise only a very small component of the county's population, less than one percent.

In sum, racial composition appears to be fairly stable in Fairfield County, as shown by Table V. And based on the rate of change over the last 20 years, the ratio is not expected to change appreciably in the future, although a few areas may become more concentrated with one or the other major races.

DEMOGRAPHIC FORECAST

That Fairfield County is in a 20-year growth mode, following a population decline in the 1960s, is an encouraging sign. Will it carry into the future and if so, what are the expectations? The answer to these questions is fundamental to the planning process. Planning is, after all, a people-oriented exercise. To dimension the size and distribution of future populations is elementary.

Future population forecasts for the county do indeed indicate a continuation of the growth trend. From a 1990 population of 22,295, the county's population is forecast to increase moderately to nearly 25,000 by 2010. Growth increments at 5-year intervals are shown by Table VI.

For planning purposes, it is not enough simply to dimension the future size of the population. It is of equal importance to determine where within the county population shifts and changes are expected to occur---to establish a distribution pattern.

Toward this end, we have extrapolated from the total for the four Census Divisions in the county, based on established trends and conditions within each. The results of this exercise are shown on Table VI.

Three of the four divisions are projected to increase in population, with the larger increase projected for Winnsboro South. Also population gains are forecast for Ridgeway and

TABLE V

RACIAL COMPOSITION AND TRENDS
FAIRFIELD COUNTY, 1970-1990

				CHANGE			
				1970-1980		1980-1990	
NUMBER	1970	1980	1990	NO.	%	NO.	%
White	8,115	8,580	9,244	465	.06	664	.08
African-Amer.	11,882	12,083	12,994	201	.02	911	.08
Other	2	37	57	35	17.5	20	.54

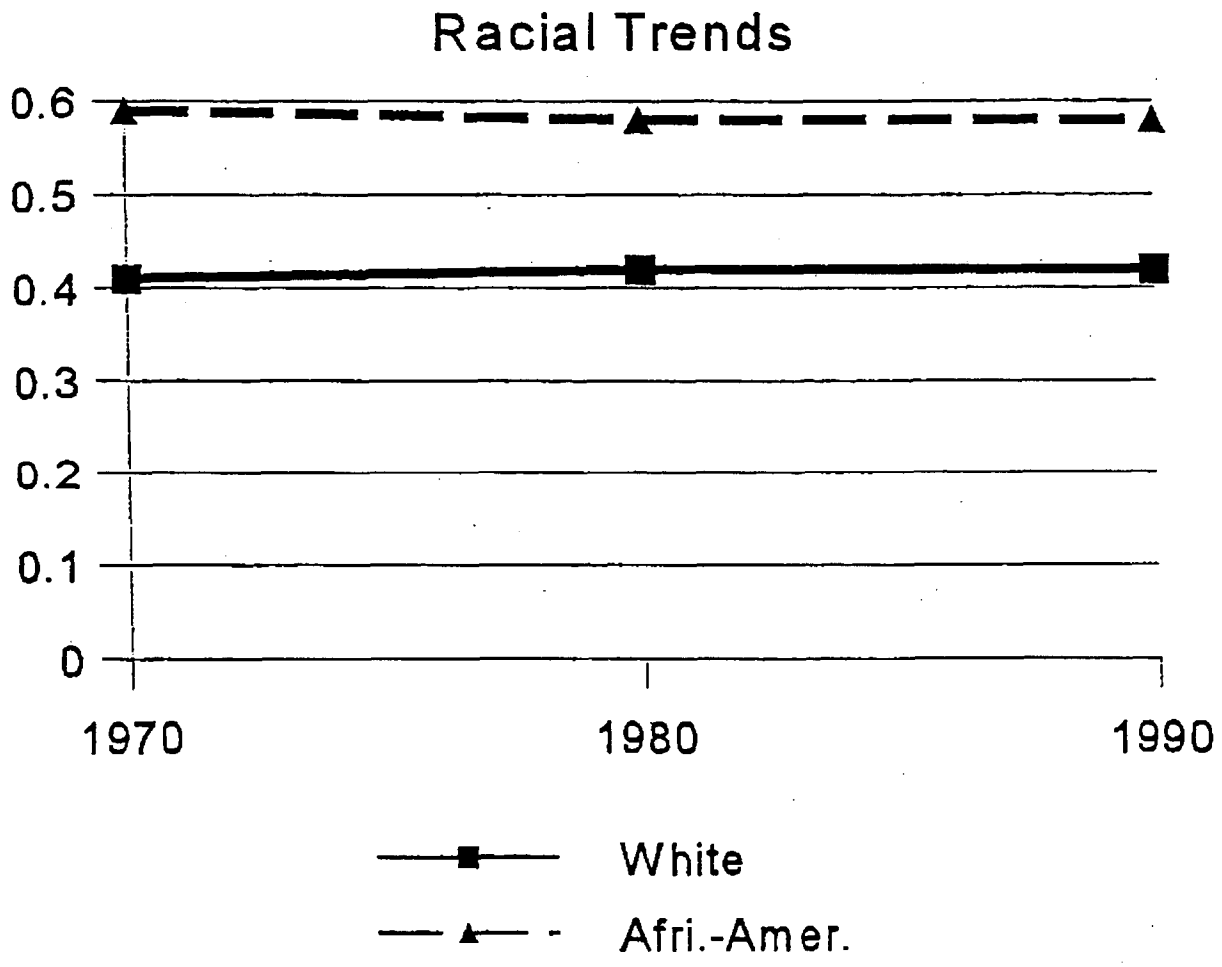
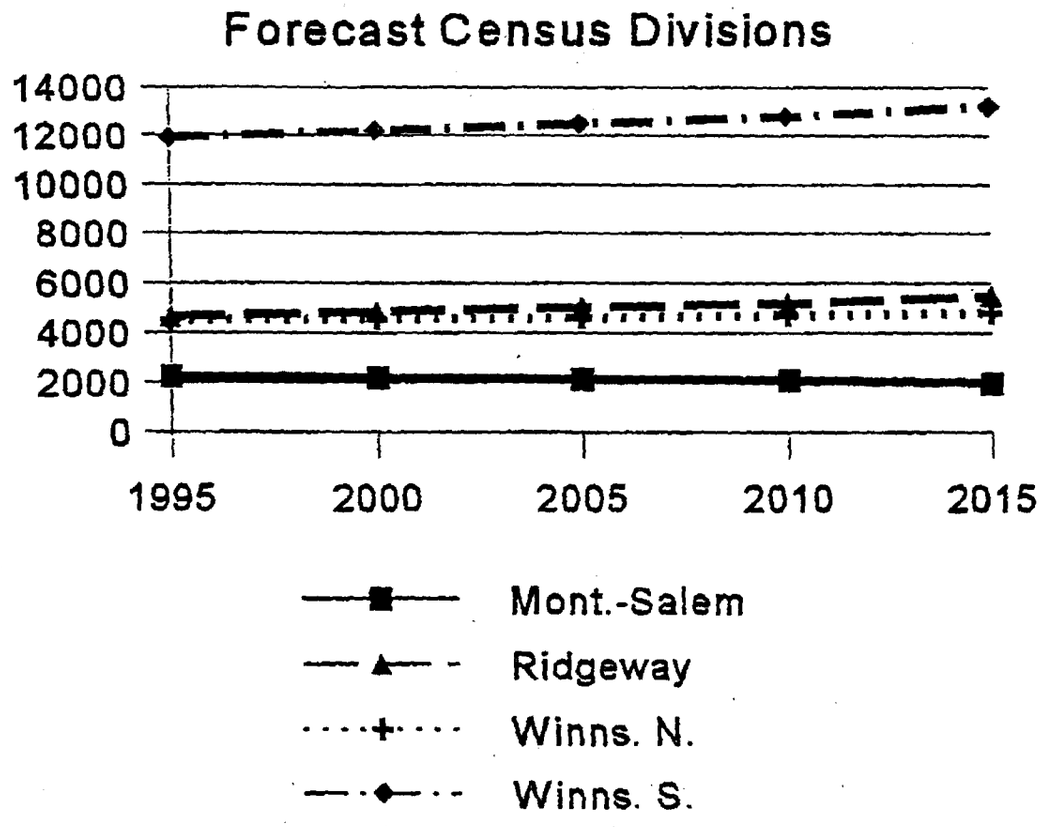


TABLE VI

DEMOGRAPHIC FORECAST
FAIRFIELD COUNTY AND CENSUS COUNTY DIVISIONS

	2000	2005	2010	2015
FAIRFIELD COUNTY	23,800	24,300	24,800	25,500
Monticello-Salem	2,200	2,150	2,100	2,000
Ridgeway	4,850	5,050	5,200	5,500
Winnsboro North	4,550	4,600	4,700	4,800
Winnsboro South	12,200	12,500	12,800	13,200

Source: The Strom Thurmond Institute of Government, Forecast of Population for South Carolina's Census County Divisions, 1991; adjusted by Vismor & Associates, Inc. to reflect 1990 Census counts, and county projections by the S.C. State Data Center.



Winnsboro North Census Divisions. Only the Monticello-Salem Division is projected to decline, but not significantly.

Projected increases in the three "growth" divisions are predicated in part on their proximity to I-77, improved accessibility and enhanced development potential.

Continued polarization of population in the Winnsboro area is projected, together with relatively strong growth in the Ridgeway and Lake Wateree Areas.

At this time, no major deviations from existing patterns of development are projected, only expansions.

HOUSING

Occupancy Characteristics

To be expected, the increase in housing units over the last 20 years (between 1970 and 1990) far exceeded the increase in population. The reason, of course, is that the number of persons per household declined during this period from 3.80 to 2.93. At the same time, the number of one-person households increased from 14 to 22 percent of all households.

Table VII

Household Characteristics
Fairfield County

	1970	1980	1990
Number of Households	5,284	6,355	7,467
Persons Per Household	3.80	3.21	2.93
Number of One-Person Households	741	1,231	1,634
Percent Total	.14	.19	.22

Source: U.S. Bureau of Census, Detailed Housing Characteristics, Selected Years.

This trend toward smaller households bodes well for the housing industry, as smaller households translate into more housing just to accommodate the same number of people. And in a growth situation, the results are compounded as evidenced by a 17 percent increase in housing between 1970 and 1980, and an 18

percent increase during the following decade.

Another positive sign for the housing industry is the increase in home ownership. Owner occupancy increased by 40 percent between 1970 and 1980, and again by 20 percent between 1980 and 1990. The ratio of owner-occupied dwellings also increased from 60 percent of all housing units in 1970 to 72 percent by 1990.

The number of rental and vacant units also increased over the last 10 years, from 1980 to 1990.

The high rate of owner occupancy is a sign of stability and vesting in the county, and speaks to the commitment of more permanent residency.

Structural Characteristics

Single-family, detached homes dominate the housing market in Fairfield County, but not to the extent they once did. From 92 percent of all housing in 1970, the number of single-family units dropped to 69 percent of the total by 1990. This decline was recorded while the actual number of single-family housing units was increasing by 48 percent.

The big shift in structural characteristics has been in the introduction of the manufactured house or mobile home. From only three percent of all housing in 1970, mobile homes provided in 1990, 23 percent of the county's housing. This is a direct response to the need for alternative low-cost housing. Additionally, apartments, condominiums, duplexes and other multi-family dwellings now provide about eight percent of all housing, up from five percent in 1970.

Significantly, the housing shifts we are seeing in Fairfield County are not out-of-line with what is happening in the State and the Nation. The rising cost of single-family housing has created a market for alternative forms of multi-family dwellings and mobile homes. And the county may expect an even larger share of the market to be absorbed by such housing in the future.

The major fall-out of this will be in reconciling differences between housing types---to enhance compatibility. Additionally, mobile home development practices to date have failed to consistently produce safe, quality environs.

In light of what is happening, careful land use planning is needed to ameliorate inherent differences between such housing, lessen the impact of multi-family and mobile homes on established community life-style, and ensure the safety of such housing.

TABLE VIII

HOUSING OCCUPANCY CHARACTERISTICS,
FAIRFIELD COUNTY, 1970-1990

	1970	1990	CHANGE 1970-1990 NO.	%
Year-Round Housing Units	5,887	8,115	2,228	38
Owner-occupied	3,497	5,831	2,334	67
Percent	.60	.72		
Renter-occupied	1,729	1,636	- 93	-05
Percent	.29	.20	- 13	-02
Vacant	661	648		
Percent	.11	.08		
Seasonal Recreational Housing Units	120	615	495	413

Source: U.S. Bureau of Census, Detailed Housing Characteristics, 1970, 1980, 1990.

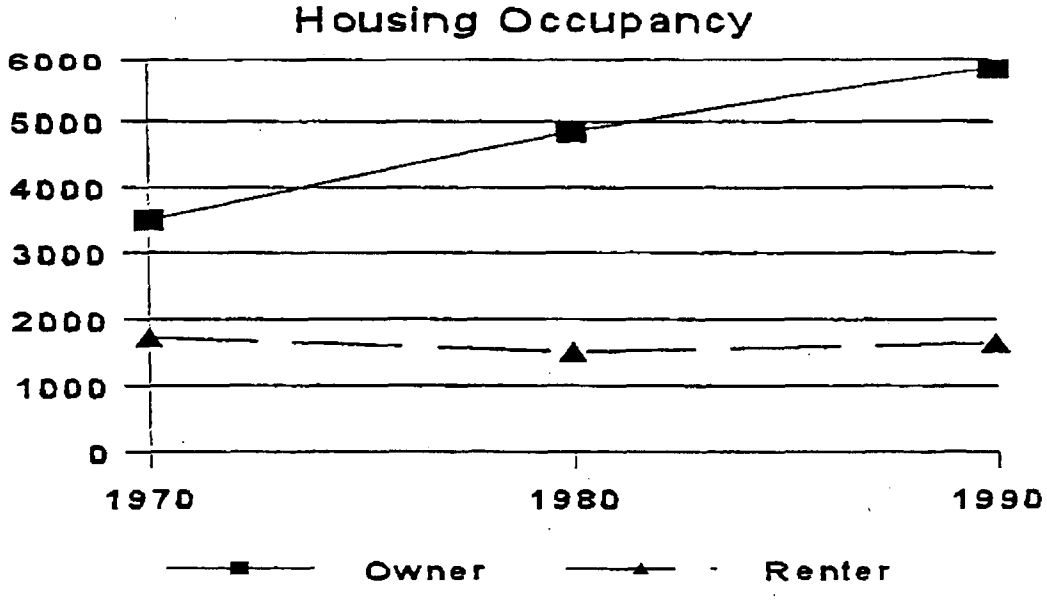
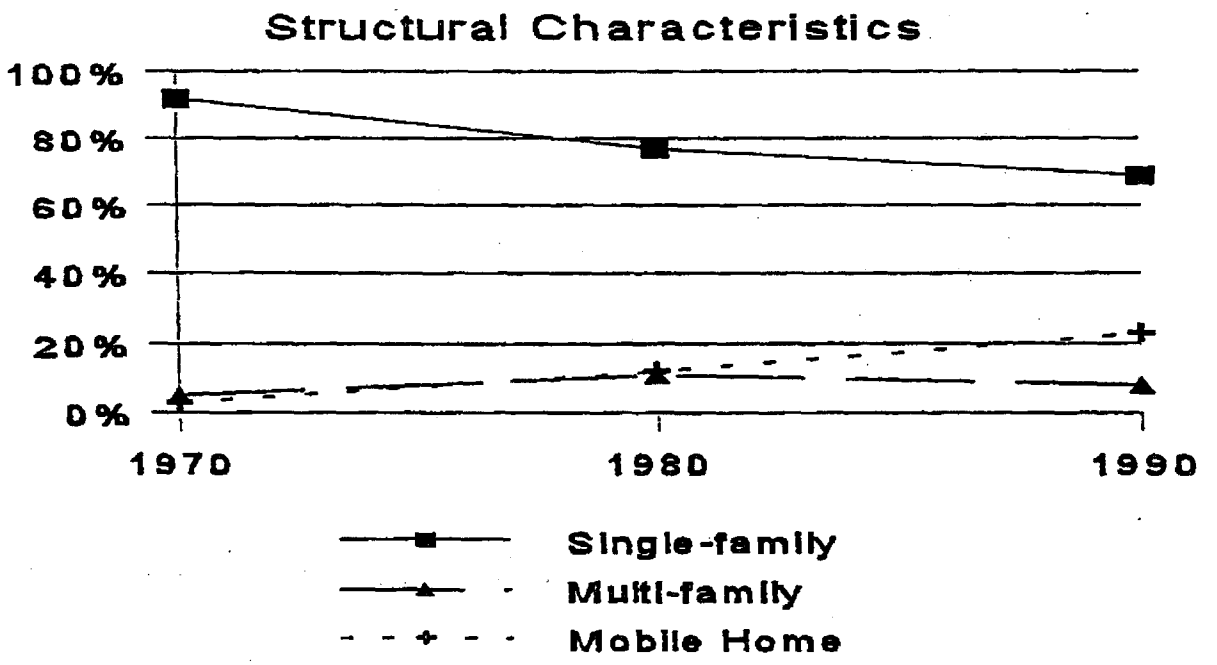


TABLE IX

HOUSING STRUCTURAL CHARACTERISTICS
FAIRFIELD COUNTY, 1970-1990

Structural Characteristics	1970	1980	1990	CHANGE 1970-1990 No.	%
Single-family	5,427	5,321	6,037	610	0.11
Multi-family	284	752	712	428	1.51
Mobile Homes	176	807	1,981	1,805	10.26
TOTAL	5,887	6,880	8,730	2,843	

Source: Ibid., Detailed Housing Characteristics, 1970, 1980, 1990.



Financial Characteristics

The financial characteristics of owner-occupied housing indicate that a majority of the homes in Fairfield County are relatively low value, and perhaps structurally deficient in some way. Over 53 percent of all owner-occupied housing is valued at less than $50,000, compared with only 37 percent statewide. Conversely, less than 10 percent of all housing is valued at or above $100,000. The median housing value in the county is only $47,500.

These characteristics tell us a lot about living conditions in the county, which appear to reflect a more basic existence for the majority of home owners, irrespective of relative housing and land costs.

Table X

Housing Costs and Values
Fairfield County, 1990

	Owner-Occupied Dwellings	
	No. Units	Ratio
Less than $50,000	1,919	.53
$50,000 - 99,999	1,380	.38
100,000 -149,999	232	.06
150,000 -199,999	60	.02
200,000 plus	26	.01

MEDIAN VALUE $47,500

Source: Ibid.

INCOME

Income is a definitive measure of life style. As such, it must be considered "below average" in Fairfield County, based on comparables to the State.

Fairfield County residents have per capita incomes approximately 24 percent below the state average. And over the last eight years, from 1981 to 1989, there has been relatively little change in relation to the state.

Table XI
Per Capita Income Trends,
Fairfield County and the State
1983-1993

	Fairfield County	State	Ratio To State
1993	13,770	16,861	.82
1991	13,479	15,391	.88
1989	10,355	13,624	.76
1987	7,538	9,967	.76
1985	6,565	8,890	.74
1983	5,926	7,830	.76

Source: State Budget and Control Board, Division of Research and Statistical Services, Newsletter Vol. 10, No. 2, Spring 1990.

These data account for the relatively low housing values discussed previously and establish a need for additional economic development and for readying a work force to accommodate such development.

Income may affect the use of land from several directions. Certainly, many private commercial enterprises consider area income characteristics before locating a new establishment or expanding an existing one. Income levels indicate industrial wage scales a new manufacturer may face. Also, certain public facilities and programs are geared toward lower income areas.

The affect of income on land use is most vividly expressed in the quality of development. Any improvement usually is contingent on economic growth, resulting in higher paying jobs and/or federal subsidies, i.e. housing and community development block grant funds.

BUSINESS ACTIVITY

Business activity in the county generally has been on the rise. The number of service and wholesale establishments increased between 1977 and 1987. And the number of retail establishments held firm at 90. Employment and sales also increased, as shown by Table XII.

From 38 service establishments in 1977, the number increased to 48 by 1987, creating approximately 173 new jobs in the service

sector. Job development was not as significant in the other two major business categories (retail and wholesale trade), but increases were recorded in both.

Still the major business activity in Fairfield County is in retail trade, accounting in 1987 for 58 percent of the business establishments, 62 percent of the jobs in business, and 70 percent of sales. While the largest gains have been in the service sector, it is still relatively small compared with the retail sector.

On closer examination of the service sector, we see that health services lead the way in the number of establishments, in spite of a decline between 1982 and 1987. Following in order of numbers of establishments are automotive, business, amusement, legal, hotel, personal, engineering and research.

With respect to retail establishments, the leading business activity is in food stores, followed by eating and drinking establishments, gas stations, general merchandise, building materials and hardware, drug, auto dealers, apparel shops and furniture stores.

Most of these establishments are not in the unincorporated areas of the county however. They are located in the Towns of Winnsboro and Ridgeway, where the population is sufficiently concentrated to support business activities and enterprises. As a result, their impact on land use and development of the unincorporated areas is relatively limited at this time. That is not to say that suburbanization and movement of such activities will not impact the countryside in the future. Indeed, it is quite likely as the ties inevitably strengthen between Fairfield and the Columbia MSA (Metropolitan Statistical Area). And planning to accommodate these potential occurrences is part of what this Plan is all about.

EMPLOYMENT

Employment and job opportunities do more to influence growth and development than perhaps any other factor. In fact, studies show that the creation of 100 new industrial jobs will generate 68 new non-manufacturing jobs, one new retail establishment, and 67 additional families, among other things.

Thirty-one percent of all non-agricultural jobs in Fairfield County were in manufacturing in 1994, down five percent over the last eight years. The largest employer is in transportation equipment, resulting from the location of Mack Trucks in 1987, followed by apparel and other textiles.

In the area of non-manufacturing, which provides about 65

percent of all non-agricultural jobs, government is the largest employer, accounting for approximately 29 percent or over one out of every four non-manufacturing jobs. The service sector is the second leading employer, followed in order by wholesale and retail trade, transportation and public utilities. Construction, mining, finance, insurance and real estate account for appreciable smaller numbers of jobs as shown by Table XIV.

Significantly, both manufacturing and non-manufacturing employment are up over the last eight years, although declines in some segments of the economy have been recorded since 1986. Non-manufacturing and service jobs increasingly are out-distancing manufacturing employment statewide, as is the case in Fairfield County. The ratio for South Carolina declined from 27 percent in 1986 to 29 percent by 1994. In Fairfield County the decline was from 36 percent to 31 percent.

From this, it may be concluded that Fairfield's economy, albeit small, is well-balanced, with a stronger than average showing in manufacturing employment.

Most industrial plants are located in the Winnsboro area. But with the opening of the Walter Brown Industrial Park, off I-77, there has been a shift to the park since its opening in 1993.

The success of the Walter Brown Park has stirred the county to focus on the development of additional parks in the SC-34 corridor between Ridgeway and Winnsboro, supported by the facilitation of this area with water and sewer infrastructure.

The county's civilian labor force in support of industrial and economic development, increased by 23 percent between 1986 and 1994. Still, the unemployment rate is relatively high, at 9.7 percent compared with only 6.3 percent for the state.

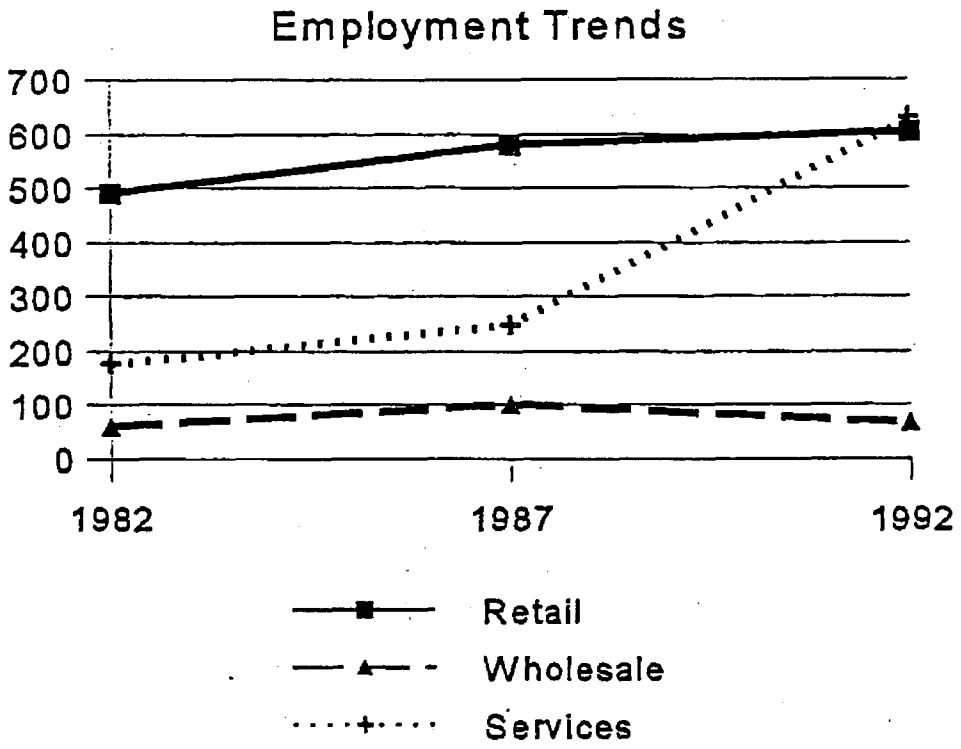


TABLE XII
FAIRFIELD COUNTY
TRENDS IN BUSINESS, EMPLOYMENT
AND SALES, 1982-1992

	1982	1987	1992
Business Establishments*			
Wholesale Trade	14	17	9
Retail Trade	90	90	86
Service Industry	45	48	55
Total	149	155	150
Employment			
Wholesale Trade	60	101	68
Retail Trade	491	491	605
Service Industry	177	248	629
Total	728	930	1302
Annual Sales (000)			
Wholesale Trade	$19,389	$18,202	$17,788
Retail Trade	37,920	60,784	57,369
Service Industry	5,231	7,528	18,898
Total	$62,540	$86,514	$94,055

*Establishments with payrolls.

TABLE XIII

FAIRFIELD COUNTY
PROFILE OF SERVICE AND RETAIL SECTORS
1982 - 1992

	1982	1987	1992	1982-1992 Change
No. Service Establishments*				
Total	45	48	50	5
Hotels, lodging	3	4	3	0
Personal services	NA	4	8	NA
Business services	NA	5	7	NA
Automotive services	2	6	3	1
Misc. Repair services	NA	3	1	NA
Amusement, recreation	2	5	5	3
Health services	13	10	12	-1
Legal services	6	5	5	-1
Social services	NA	1	1	NA
Engineering, account. research services	NA	4	5	NA
No. Retail Trade Establishments*				
Total	90	90	86	-4
Building Mat., Hardware	4	6	5	1
Genl. Mdse.	7	8	7	0
Food	20	18	19	-1
Auto dealers	6	5	7	-1
Gas stations	9	12	10	1
Apparel & access.	6	5	4	-2
Furniture, home furn.	5	4	4	-1
Eating & drinking	16	16	17	1
Drug	7	6	4	-3
Misc. Retail	10	10	9	-1

*Establishments with payrolls
NA = Not available

Source: U.S. Department of Commerce, Bureau of Census, Census of Service Industries, Geographic Area Services, South Carolina, Selected Years.

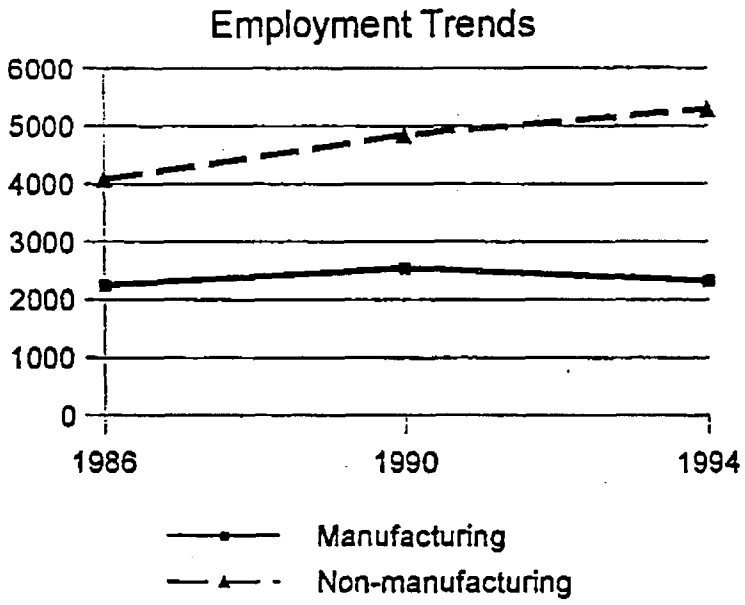


TABLE XIV
FAIRFIELD COUNTY
NON-AGRICULTURAL WAGE AND SALARY
EMPLOYMENT TRENDS, 1986-1994

	1986	1990	1994
TOTAL	6,330	7,400	7,620
Manufacturing	2,250	2,550	2,330
Non-manufacturing	4,080	4,850	5,290
Construction & Mining	270	350	370
Transportation & Public Utility	1,060	920	1,060
Wholesale & Retail Trade	670	1,040	1,180
Finance, Insurance & Real Estate	150	110	100
Services (1)	810	1,130	1,070
Government	1,110	1,300	1,520

(1) Included in services are those services related to agriculture, as well as the wide range of services to individual and business establishments.

TABLE XV

MANUFACTURING AND INDUSTRIAL INVENTORY
FAIRFIELD COUNTY, 1996

PLANT LOCATIONS SINCE 1990	NO. EMPLOYEES
Fairfield Fabricators	6
Lang-Makra	40
Isola USA	110
Gividi Inc. (under construction)	80
Warner-Makat (under construction)	35
TOTAL	271
PLANT LOCATIONS BETWEEN 1980-1990	
Fuji Copian Corp.	180
JPM Company of SC	108
Mack Trucks, Inc.	894
Carolina Apparel	125
Kennecott Ridgeway Mining Co.	139
Playcraft	13
TOTAL	1459
PLANT LOCATIONS PRIOR TO 1980	
Tarmac America Inc.	12
D & D Foundry	9
Pigeon Granite Co.	5
Phillips Granite Co.	11
Manhatten Shirt	176
Standard Products Co.	451
Uniroyal Tire	299
Winnsboro Concrete	8
Winnsboro Plywood	73
Winnsboro Veneer Co.	6
TOTAL	1050
GRAND TOTAL	2780

Source: S.C. Industrial Directory, 1996; local sources.

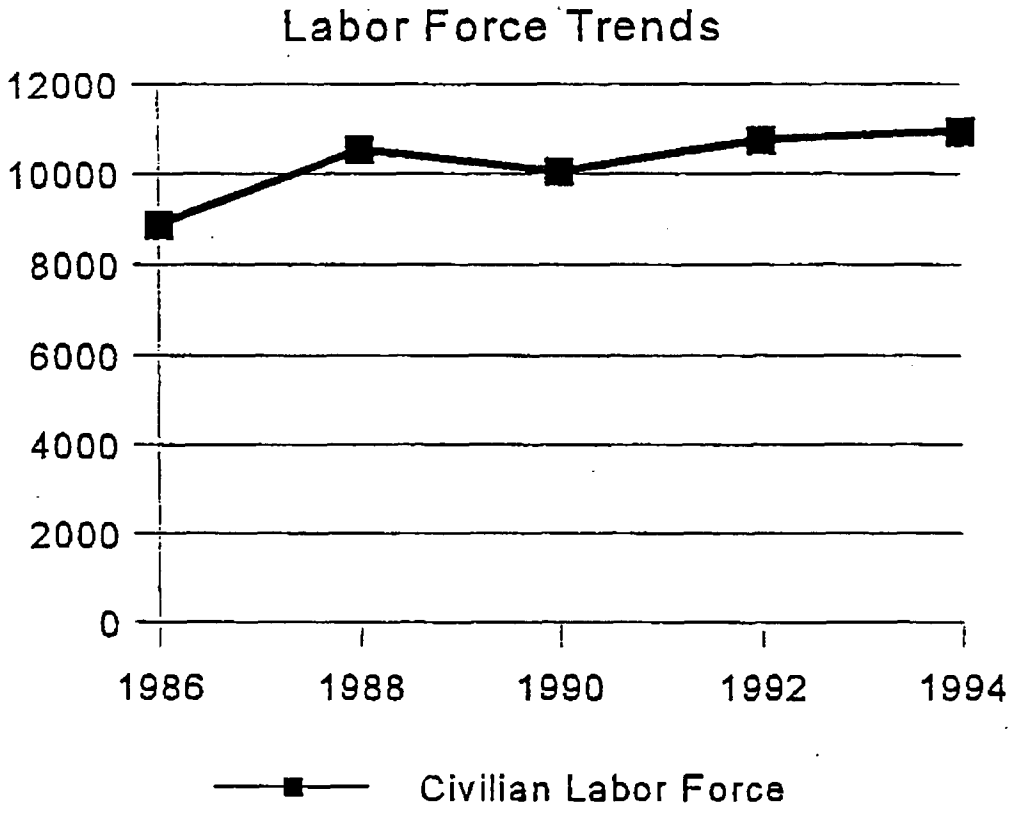


TABLE XVI

FAIRFIELD COUNTY
LABOR FORCE TRENDS, 1986-1994

	Annual Average				
	1986	1988	1990	1992	1994
Civilian Labor Force	8,880	10,550	10,050	10,760	10,960
Employment, Total	8,090	9,960	9,100	9,790	9,890
Unemployment	790	570	950	970	1,070
Percent Labor Force	8.9%	5.4%	9.5%	9.0%	9.7%

Source: S.C. Employment Security Commission, South Carolina's Labor Force in Industry.

SECTION II

ENVIRONMENTAL FEATURES

There are numerous natural environmental conditions that influence the potential use of land. Man has little short-run control over such conditions as climate, geology, soils, wetlands, flood waters, topography, etc. Yet these conditions can and often do present engineering, safety, and economic barriers which limit development potential. Further, unwise use of land in "environmentally sensitive areas" may harm or destroy valuable natural resources. Thus, it is important, from a planning and development perspective, to be aware of the presence and extent of environmental constraints and resources.

This section will dimension such features and conditions to determine their impact on existing and future development in Fairfield Couty.

POSITION IN THE STATE

Fairfield County is positioned on the divide between the Piedmont and the Sandhills. The majority of the county is in the Southern Piedmont Land Resource Area, but about 2,000 acres in the southeast corner lie within the Sand Hills Area.

Fairfield County is located in the Central Midlands Region of South Carolina and lies principally between Chester and Richland Counties north to south, and Kershaw and Newberry Counties east to west. The elevation of the county ranges from slightly less than 200 feet at the confluence of the Broad and Little Rivers to about 625 feet in the upper part of the county.

The county is situated on I-77, between the larger market areas of Columbia and Charlotte, North Carolina, in a position to capitalize on the economic expansion of and growing ties between the two areas.

CLIMATE[2]

Fairfield County, like the rest of South Carolina, has a temperate climate. This is typified by ample rainfall in all seasons, short and usually mild winters, and long, warm summers.

---

2 U. S. Department of Agriculture, SCS, Soil Survey of Chester and Fairfield Counties, South Carolina, 1982.

While there are daily weather variations between specific locations, the annual averages in all parts of the county is similar.

Rainfall is fairly well distributed throughout the year. Winter rainfall is mostly associated with frontal weather; and summer rainfall, with tropical air masses. Winter rains are lighter and steadier than the summer storms which are often violent cloud-bursts of short duration. Annual average precipitation is about 47 inches, sufficient for most crops.

In winter, the average temperature is 44 degrees F. with an average daily minimum of 31 degrees. In summer, the average temperature is 78 degrees, and the average daily maximum is 90 degrees.

Additionally, the climate is conducive to a wide range of outdoor recreational and economic pursuits. Clearly, therefore, such conditions are favorable to future growth and development.

GEOLOGIC FORMATIONS[3]

Nine geologic units underlie Fairfield County. They are: metamorphic granite, granitoid gneiss, mica gneiss, amphibolite, slate and argillites, metavolcanic rock, igneour rock, and gabbro granite units.

The slates and argillites and the metavolcanic rock geologic units, part of the Carolina Slate Belt, are in the southern part of Fairfield County. Slate is a hardened shale. Argillite is a baked clay consisting of fine-grained clastic particles. Metavolcanic rock consists of fine crystalline minerals that are likely to form silts and clays when weathered. The slates and argillites weather rapidly, but the metavolcanic rock weathers at a much slower rate.

Coastal Plain sediment is principally the sands and clays deposited during changes in sea level. The Coastal Plain sediment in the southeastern part of Fairfield County is part of the Tuscaloosa Formation.

Gabbro is a dark, basic igneous rock that is mainly of dark feldspar. It is resistant to weathering except where fractured.

Amphibolite, which means many varieties, consists of dark gray, green, and black iron, magnesium, and silicate minerals, which are generally basic. It is not subject to rapid weathering.

---

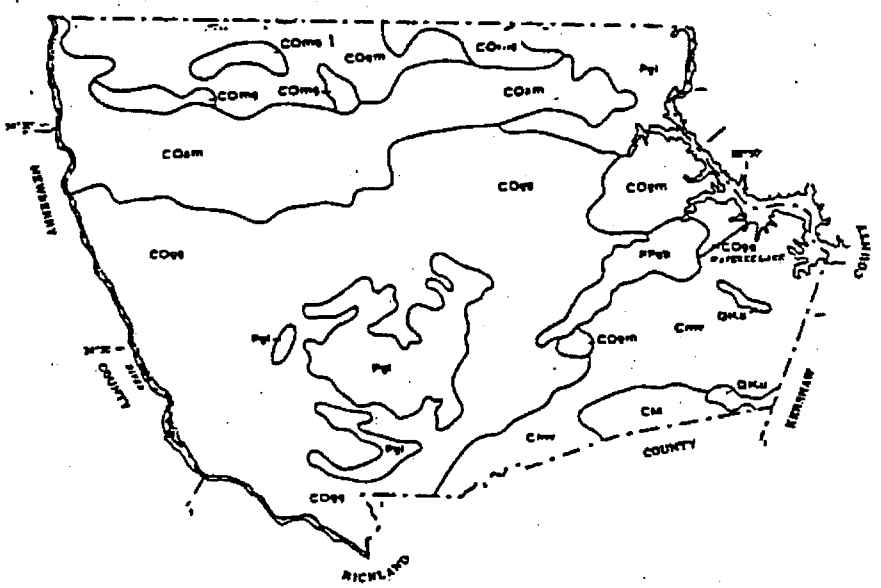
3 Ibid.

Intrusive granite and metamorphic granite are generally high in silicate minerals and feldspar and include some mafic minerals. Both are resistant to weathering except where fractured.

Two different geologic units of gneiss, mica gneiss and granitoid gneiss, occur in Fairfield County. Gneiss is a metamorphic rock consisting of various granular minerals in alternate bands. Mica gneiss is dominantly mica but also contains large amounts of feldspar and quartz. Granitoid gneiss has a considerable amount of quartz. Mica gneiss weathers at a moderate rate, but granitoid gneiss is resistant to weathering.

LEGEND

QKu	Coastal Plain
PPgb	Gabbro
Pgi	Intrusive Granite
COgm	Metamorphic Granite
COgg	Granitoid Gneiss
COmg	Mica Gneiss
COam	Amphibolite
Csa	Slate and Argillite
Cmv	Metavolcanic Rock



SOILS[4]

Soils generally are assessed in terms of their suitability for agricultural purposes and/or urban development---two extreme or opposite uses. Unfortunately, lands best suited for agricultural use have the fewest constraints to urban development. And since development generally follows the path of least resistance, other factors being equal, there is always the potential for conflict whenever such lands exist in an urbanizing environment.

There are 11 soil associations or groups in Fairfield County, with differing characteristics. They are general by definition, requiring more site specific analysis for individual properties, but are helpful as a guide to development, which is the intent of this Plan. A brief description of each follows.

4 Ibid.

(Note: Numbers correspond to accompanying map assignment.)

1. Chewacla-Toccoa

These soils range from poorly drained to well drained. They are nearly level, loamy, and subject to flooding. They are found on broad flood plains along the Broad River comprising about one percent of the soils in Fairfield County. About 60 percent of the unit is Chewacla soils, 30 percent is Toccoa soils, and 10 percent is soils of minor extent.

Chewacla soils are deep and somewhat poorly drained. The subsoil is brown in the upper part and grayish brown or gray in the middle and lower parts. Toccoa soils are deep and well drained. They have a reddish brown underlying horizon.

This unit is mainly woodland. Some tracts are pasture. Flooding and wetness pose severe limitations for cultivated crops as well as urban development.

2. Vaucluse-Blanton

These soils are well drained to moderately well drained, gently sloping, and loamy. They are found in the Sand Hills of Fairfield County, comprising less than one percent of the soils. About 80 percent of this unit is Vaucluse soils, 11 percent is Blanton soils, and the remaining 9 percent is soils of minor extent.

Vaucluse soils are well drained and are slowly permeable. They have a sandy surface layer less than 20 inches thick. Blanton soils are moderately well drained, are moderately permeable, and have a sandy surface layer thickness of 40 inches or more.

This unit is mainly pasture and woodland. A few acres are cultivated. A restricted root zone is the main limitation in the Vaucluse soils, and droughtiness is the main limitation in the Blanton soils.

Suitability is fair to poor for crops and only fair for woodland. Suitability is good to fair for residential and other urban uses.

3. Wilkes-Cataula-Winnsboro

These are well drained, gently sloping to steep, moderately deep and deep clayey soils. The gently sloping to steep soils are found in the western part of Fairfield County. This unit makes up approximately 12 percent of the soils in Fairfield County, of which about 59 percent are Wilkes soils, 22 percent

Cataula, 13 percent Winnsboro, and 6 percent is soils of minor extent.

All these soils are well drained. Wilkes soils are moderately deep, are moderately permeable with brown or olive subsoil. Cataula soils are deep, have a red subsoil, and are slowly permeable. Winnsboro soils are deep, slowly permeable, and have a brown subsoil.

Cataula soils and the gently sloping and sloping Winnsboro soils are on narrow to broad irregularly shaped ridgetops. Wilkes soils and the moderately steep Winnsboro soils are on side slopes adjacent to drainageways.

This unit is mainly pasture and woodland. Some tracts are cultivated. Slope is the main limitation for cultivated crops. A restricted root zone is a limitation in Cataula soils.

In Wilkes soils and the moderately steep Winnsboro soils, suitability is poor for crops and pasture because of the slope. In Cataula soils and the gently sloping Winnsboro soils, it is good to fair for crops. Suitability is fair for woodland throughout and is generally poor for residential and other urban uses.

4. Wilkes-Winnsboro-Mecklenburg

These are well drained, gently sloping to steep, moderately deep and deep clayey soils. These soils occur as broad areas throughout Fairfield County, comprising about 23 percent of the soils. About 49 percent of this association is Wilkes soils, 34 percent Winnsboro, 8 percent Mecklenburg, and 9 percent is soils of minor extent.

All these soils are well drained. Wilkes soils are moderately deep, have moderately slow permeability, and have a brown or olive subsoil. Winnsboro soils are deep, have slow permeability, and a brown subsoil. Mecklenburg soils are deep, have slow permeability and red subsoil.

This unit is mainly pasture and woodland, although some tracts are cultivated.

In Wilkes soils and the moderately steep Winnsboro soils, suitability is poor for crops and pasture because of the slope. In Mecklenburg soils and the gently sloping and sloping Winnsboro soils, it is good to fair for crops. Suitability is fair for woodland throughout the unit. It is poor for residential and other urban uses in most areas because of the steepness of slope, but it is fair in Mecklenburg soils and the gently sloping and sloping Winnsboro soils.

5. Wilkes-Hiwassee-Madison

These are well drained, gently sloping to steep, moderately deep and deep clayey soils. The gently sloping to steep soils are found in the northwestern part of Fairfield County and make up approximately 2 percent of the county. About 54 percent of the unit is in Wilkes soils, 32 percent in Hiwassee, 11 percent in Madison, and the balance in minor soils.

All these soils are well drained. Wilkes soils are moderately deep, moderately permeable, and have a brown or olive subsoil. Hiwassee soils are deep, moderately permeable, and have a dark red subsoil. Madison soils are deep, moderately permeable and have a red subsoil.

Hiwassee soils and the gently sloping and sloping Madison soils are on moderate to broad ridgetops. Wilkes soils and the moderately steep Madison soils are on side slopes adjacent to drainageways.

This unit is mainly in pasture and woodland, although some tracts are cultivated.

In Wilkes soils and the moderately steep Madison soils, suitability is poor for crops and fair to poor for pasture because of slope. In Hiwassee soils and the gently sloping and sloping Madison soils, it is good to fair for crops and pasture. Suitability for woodland is good to fair throughout the unit. It is poor for residential or other urban uses in most of the unit because of steepness of the slope, but is suited to development in Hiwassee soils and in the gently sloping and sloping Madison soils.

6. Appling-Rion-Wateree

These are well drained, gently sloping to steep, deep and moderately deep clayey and loamy soils. They occur throughout Fairfield County, making up about three percent of the soils. About 51 percent of the unit is Appling, 36 percent is Rion, 6 percent is Wateree soils, and 7 percent is soils of minor extent.

Appling and Rion soils are well drained, deep, and moderately permeable. They have a subsoil of brown or yellow sandy clay loam. Wateree soils are excessively drained, moderately deep, and moderately to rapidly permeable. They have a subsoil of brown or yellow sandy loam. Appling soils are found on broad, irregularly shaped ridges. Rion and Wateree soils are generally on narrow to broad side slopes.

This unit is mainly pasture and woodland, although some tracts are cultivated. In Appling soils suitability is good to fair for crops and good for pasture. In Rion and Wateree soil

suitability is poor for crops and fair to poor for pasture because of slope and droughtiness. Suitability is good to fair for woodland throughout the unit. It is poor for residential and other urban uses in the moderately steep or steep Rion and Wateree soils, but it is good to fair in the rest of the unit.

7. Cecil-Pacolet-Appling

These are well drained, gently sloping to moderately steep, deep clayey and loamy soils. They are found throughout Fairfield County. They make up about 19 percent of the soils. Forty-six percent of the unit is in Cecil soils, 32 percent in Pacolet, 6 percent in Appling, and 16 percent in soils of minor extent.

These soils are well drained, deep, and moderately permeable. Cecil and Pacolet soils have a red subsoil. Appling soils have a yellow or yellowish red subsoil. Cecil and Appling soils are on moderate to broad ridgetops. Pacolet soils are found mainly on side slopes adjacent to drainageways.

This unit is mainly pasture and woodland, however, some tracts are cultivated.

Cecil and Appling soils are rated good to fair for crops and pasture. Pacolet soils are generally unsuited for crops and pasture because of slope. Suitability is good for woodland throughout the unit. It is good to fair for residential and other urban uses in Cecil and Appling soils, but relatively poor in Pacolet soils.

8. Madison-Cecil-Hiwassee

These are well drained, gently sloping to moderately steep, deep clayey soils. They make up about 10 percent of the county's soils. About 40 percent of this unit is in Madison soils, 15 percent in Cecil, 14 percent in Hiwassee, and 31 percent in soils of minor extent.

All these soils are deep, well drained, moderately permeable, and have a red subsoil. Hiwassee soils, and the gently sloping and sloping Madison soils are found on narrow to broad ridgetops. Moderately steep Madison soils are on side slopes adjacent to drainageways.

This unit is mainly in pasture and woodland although some tracts are cultivated. Suitability for crops and pasture is generally good to fair. Suitability is good for woodland throughout most of the unit. Suitability for residential and urban uses is good to fair.

9. Pacolet-Cataula-Madison

These are well drained, gently sloping to moderately steep, deep clayey soils. They are found principally in the northwestern part of Fairfield County and make up about 5 percent of the soils. Approximately 60 percent of this unit is in Pacolet soils, 23 percent in Cataula soils, 10 percent in Madison soils, and 7 percent in soils of minor extent.

All these soils are well drained and have a red clayey subsoil. Pacolet and Madison soils are deep and moderately permeable. Cataula soils are deep and slowly permeable. Cataula soils and the gently sloping and sloping Madison soils are on ridgetops and short side slopes at the head of and adjacent to shallow drainageways. Pacolet soils and the moderately steep Madison soils are found on side slopes adjacent to drainageways.

This unit is mainly pasture and woodland although some tracts are cultivated.

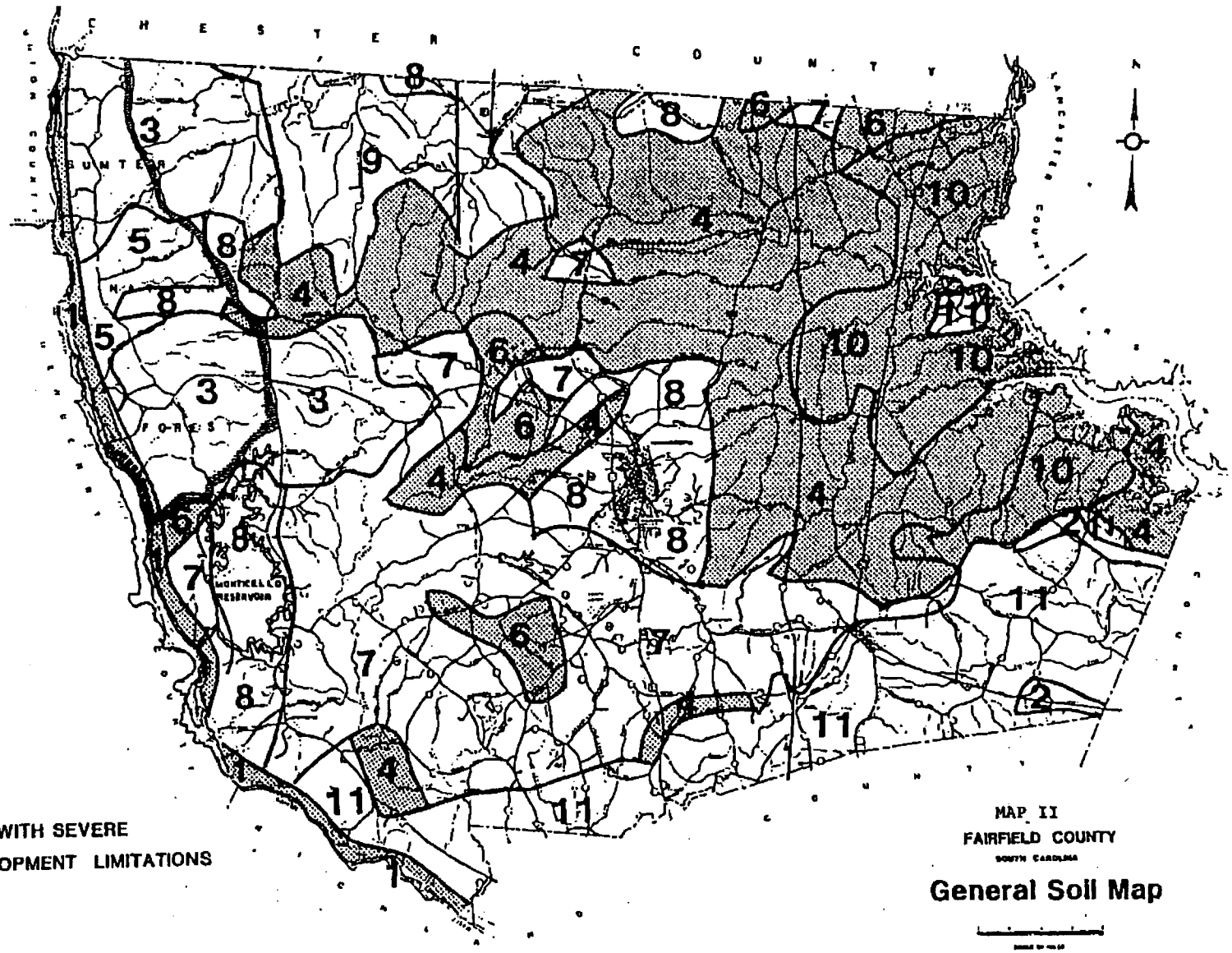
Suitability is poor for crops and only fair for pasture in Pacolet soils and the moderately steep Madison soils because of the slope. It is good to fair for crops and pasture in Cataula soils and the gently sloping and sloping Madison soils. Suitability is fair for woodland. Suitability is poor for residential and other urban uses in most of this unit because of the steepness of slope, but it is good to fair in Cataula soils and the gently sloping and sloping Madison soils.

10. Wateree-Rion-Helena

These are well drained and moderately well drained, gently sloping to steep, moderately deep and deep loamy and clayey soils.

The gently sloping to steep soils are found in the eastern part of Fairfield County. They make up about 9.5 percent of the county. Within this association about 29 percent is in Wateree soils, 28 percent in Rion soils, 5 percent in Helena soils, and 38 percent in soils of minor extent.

Wateree and Rion soils are well drained, moderately deep or deep, moderately permeable, and loamy. They have a yellow or brown subsoil. Helena soils are moderately well drained, deep, and slowly permeable. They have a brownish yellow subsoil. The sloping to steep Wateree and Rion soils are on narrow to broad side slopes adjacent to drainageways. The gently sloping Helena soils are found on broad ridges and narrow side slopes at the heads of and adjacent to drainageways.



SOILS WITH SEVERE DEVELOPMENT LIMITATIONS

MAP II
FAIRFIELD COUNTY
SOUTH CAROLINA

General Soil Map

This unit is mainly used for pasture and woodland, but some small tracts are cultivated.

Wateree and Rion soils have poor suitability for crops and fair to poor suitability for pasture. Helena soils have fair suitability for crops and good to fair suitability for pasture. Suitability for woodland is fair throughout. The suitability for residential use is fair except for the moderately steep and steep Wateree and Rion soils, which have poor suitability for most urban and residential uses.

11. Georgeville-Herndon

These are well drained, gently sloping to strongly sloping, deep clayey soils. They are found mainly in the southern part of Fairfield County, comprising about 15 percent of the soils. About 53 percent of the unit is in Georgeville soils, 21 percent Herndon soils, and 26 percent in soils of minor extent.

Georgeville soils have a red subsoil, and Herndon soils have a brown subsoil. Both have moderate permeability and are high in content of silt throughout.

This unit is used mainly for pasture and woodland. Some tracts are cultivated, however.

Suitability is good to poor for crops, good to fair for pasture, and good for woodland. It is fair to good for residential and other urban uses.

Soils With Limitations To Urban Development

Of the 11 associations in the county, the following four pose predominantly severe limitations to urban development, i.e. septic tank filter fields, building foundations, sewage lagoons, etc. In combination, they comprise approximately 36 percent of the county.

No.	Association
1	Chewacla-Toccoa
4	Wilkes-Winnsboro-Mecklenburg
6	Appling-Rion-Wateree
10	Wateree-Rion-Helena

A few other associations also contain soils with moderate to severe limitations to urban development, but not to the extent of the above referenced ones. For this reason, the data presented herein should be used only as a guide to development. More in-depth analysis is recommended for the above areas, as well as certain other soils in the county, identified by the Soil Survey of Chester and Fairfield Counties, South Carolina

prepared by the U.S. Department of Agriculture.

To the extent practical, policies and regulations should be designed to channel future development away from areas with severe soil conditions or impose building requirements that would properly overcome any limitations. Such development guidelines should:

1. discourage or prohibit large scale urban development in areas without public sewage facilities;

2. mandate tie-ons where existing development may be served by a community sewerage system;

3. monitor development in flood plain and wetland areas;

4. require developers to satisfactorily "overcome" severe soil conditions so as not to adversely affect surrounding properties.

Soils Best Suited To Agricultural Use

Agricultural land or land with agricultural potential may be classified in two categories, prime farmland and additional farmland. Prime farmland accounts for 14 percent of the total land area in Fairfield County. It is defined as soils having the best combination of physical and chemical characteristics for producing food, feed, forage, fiber and oilseed crops. Additional farmlands of statewide importance comprise another 85,509 acres. They are defined as lands that will economically produce high yields of crops when treated and managed according to acceptable farming methods.

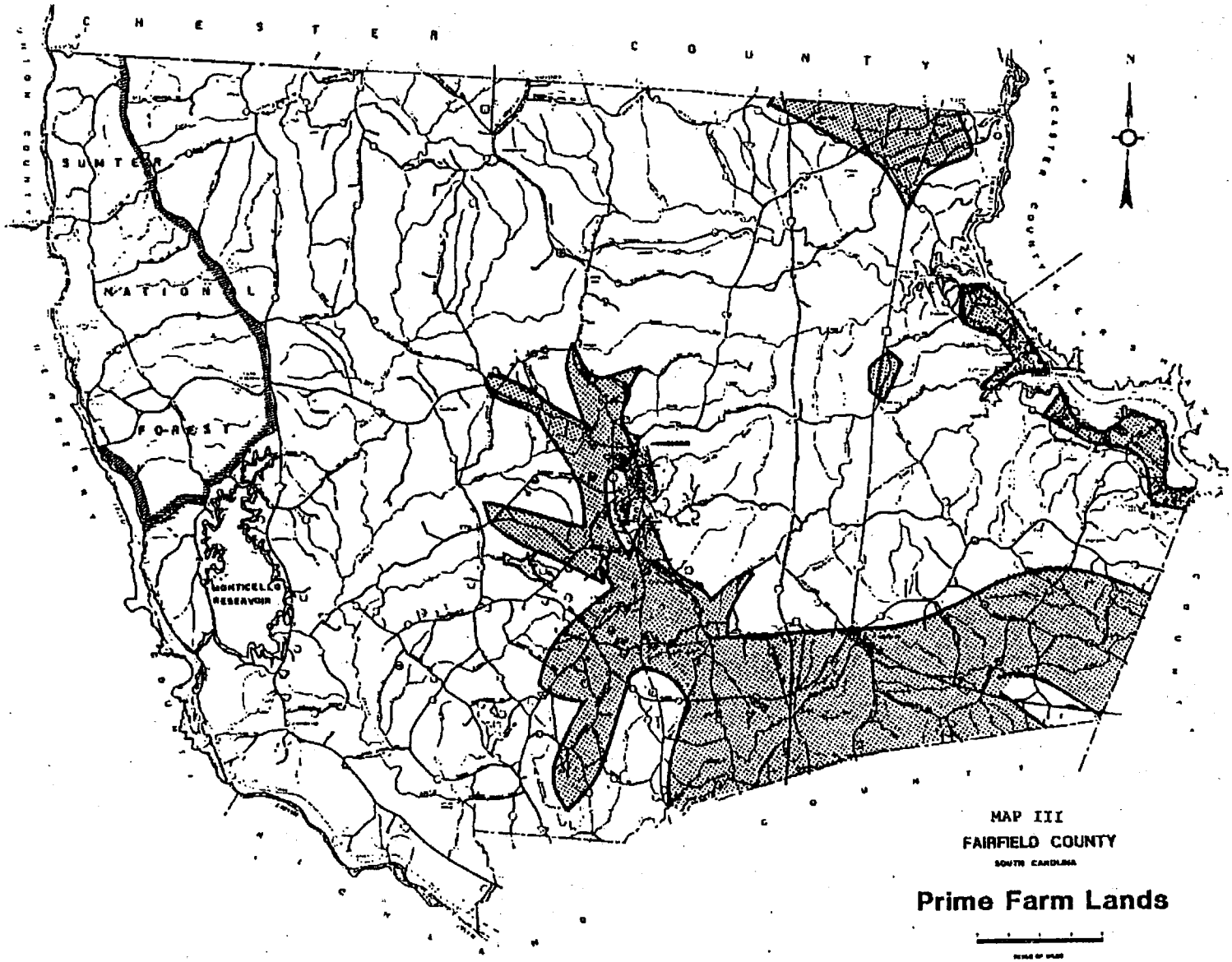
All these lands are not actively cultivated at this time however, according to the latest Census of Agriculture (1987), which shows only 57,293 acres of farmland, with only 19,360 acres in cropland.

Table XVII

Fairfield County
Soil Suitability for Agricultural Purposes

	Acres	% Total
Prime Farmland	59,590	.14
Additional Farmland	85,509	.20

Source: U.S. Department of Agriculture, Important Farmlands Map, 1984.



MAP III

FAIRFIELD COUNTY

SOUTH CAROLINA

Prime Farm Lands

Prime farmlands are found principally in the southeastern part of the county and around the Town of Winnsboro. They are concentrated south of Winnsboro and S.C. 34 east of Winnsboro to the Kershaw County Line. They are also found in pockets around Lake Wateree and in the northeast corner of the county, south of the Mitford community.

Additional farmlands of statewide importance are generally mingled throughout the prime farmland areas, and extend in scattered form beyond such areas, west and north of Winnsboro, and in the vicinity of Dutchmans Creek.

Summary Recommendations

In sum, the soil information presented herein is valid for general planning purposes. But because each association has several different soil types, with varying properties, it is imperative that detailed soil borings and tests be made to determine specific limitations and the degree of such limitations before building on or abandoning a potential site. Additional information and assistance are available from the local U.S.D.A. Soil Conservation Service Office.

TOPOGRAPHY

Topographic conditions, or slope characteristics, can have a profound influence on development, both in terms of potential use and development costs. As slopes become steeper, development costs may increase accordingly, while the uses to which the land may be put may decrease.

The major environmental concerns associated with new development on steeply sloped land is the potential for soil erosion. The Soil Conservation Service (SCS) has identified slope constraints to urban development in 33 of the 42 soil types in the county. Of these, 22 percent have severe slope characteristics.

Just as is the case with steep slope land, low to no slope land also may hinder urban development. Large expanses of flat land may be poorly drained. Often, flat land development requires extensive drainage networks; and in the case of flood plain property, costly dikes may be necessary. Fortunately, there is virtually no "table-top" flat land of any consequence in Fairfield County. Just as fortunately, the county has few areas so extensively sloped as to preclude urban development. But there are concerns that development practices adequately address slope conditions in Fairfield County so as not to create any drainage, erosion or sedimentation problems.

WETLANDS

Wetlands are considered by the state and federal governments to be important to the public interest. As such, they are protected by state and federal laws. Not until April 1986, however, were these laws extended to cover freshwater wetlands. Prior to that time, they were confined to marine and estaurine areas.

This change to the Clean Water Act effectively extends the authority of the U.S. Army Corps of Engineers (Corps) to control wetlands well beyond its previous jurisdiction, to include headwater wetlands and isolated or perched wetlands.

Definition

According to the federal register, "the term wetlands means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

The principal criteria for determining wetlands are (1) hydrology, (2) soils, and (3) vegetation. The following definition is generally applicable, but subject to amendment.

Hydrology

"The soil is either inundated permanently or periodically saturated to the surface at some time during the growing season of the prevalent vegetation. The period of inundation or soil saturation varies according to the hydrologic/soil moisture regime and occurs in both tidal and nontidal situations.

Soil

Soils are present and have been classified as hydric, or they possess characteristics that are associated with anaerobic soil conditions.

Vegetation

The prevalent vegetation consists of macrophytes (species that can be identified without use of ocular magnification) that are typically adapted to habitats having the hydrologic and soil conditions described above. Hydrophytic species due to

morphological, physiological, and/or reproductive adaptation(s) have the ability to persist in anaerobic soil conditions."

Evidence of a minimum of one wetland indicator of either of the three parameters must be found for a site to be designated a wetland. This technical approach should always be applied, unless indicators of one or more parameters cannot be found due to human activities such as land clearing and deposition or fill.

Wetlands generally are found in low-lying areas around creeks and rivers. The USDA, S.C. Soil Survey of Chester and Fairfield Counties, has identified four soils in Fairfield as characteristically wet. They are Armenia, Chewacla, Irdell and Helena.

The U.S. Corps of Engineers, in conjunction with other federal and state agencies, is in the process of mapping all such areas in South Carolina, and has completed mapping for the coastal counties. But, wetlands mapping of Fairfield County has yet to be scheduled.

This does not relieve developers of the responsibility under the new law of securing a "determination of wetlands" from the Corps in the event of their existence. Persons intending to engage in activities involving development within or adjacent to wetlands, as herein defined, should contact the Corps of Engineers for a precise determination of jurisdiction and the consequences of such development.

Jurisdictional Wetlands

Not all wetlands development will require a permit from the Corps. However, no permit will be issued where wetlands are considered and have been determined by the Corps to perform functions important to the public interest. This includes:

(a) Wetlands which serve significant natural biological functions, including food chain production, general habitat and nesting, spawning, rearing and resting sites for aquatic or land species;

(b) Wetlands set aside for study of the aquatic environment or as sanctuaries or refuges;

(c) Wetlands the destruction or alteration of which would affect detrimentally natural drainage characteristics, sedimentation patterns, salinity distribution, flushing characteristics, current patterns, or other environmental characteristics;

(d) Wetlands which are significant in shielding other areas from wave action, erosion, or storm damage. Such wetlands are often associated with barrier beaches, islands, reefs, and bars;

(e) Wetlands which serve as valuable storage areas for storm and flood waters;

(f) Wetlands which are ground water discharge areas that maintain minimum baseflows important to aquatic resources and those which are prime natural recharge areas;

(g) Wetlands which serve significant water purification functions; and

(h) Wetlands which are unique in nature or scarce in quantity to the region or local area.

Where such conditions are found to exist, the Corps will evaluate each request for development on the basis of projected benefits to be derived from the proposed development in relation to the damage to the wetlands resource.

Suffice to say, the new freshwater wetlands legislation makes development of these areas considerably more tenuous. Where, in the past, development was constrained principally by the simple presence of wetlands, now it is further constrained by the need to plan around or mitigate the use and circumstances of development proposed for such areas. Clearly, the presence of wetlands should alert the developer to the need for a "wetlands determination" before proceeding with a project. Failure to secure a wetlands determination and permit, if required, could result in work stopage, restoration of the project site to its original state, fines, or other compensatory action.

While the extent of wetlands is relatively limited in Fairfield County, care must nonetheless be taken where such lands exist.

FLOOD HAZARD AREAS

Flood plains or flood hazard areas, like wetlands, have always restricted the movement of development. And like federal wetlands legislation, federal requirements that local governments regulate and control development in such areas as a prerequisite to flood insurance, has restricted their use for urban purposes even more. In February 1991, Fairfield County enacted a Flo

Drainage Prevention Ordinance, to control the development of such areas.

Following this initial move to meet the minimum requirements for participation in the National Flood Insurance Program (NFIP), the county may wish to consider upgrading its Flood Hazard Rating to secure greater savings to those requiring flood insurance.

Under a new community rating system, (CRS), insurers may qualify for 5 to 40 percent savings on their flood policies, depending on the county's classification.

The new "bonus" program is modeled after the ISO (Insurance Service Office) Commercial Risk Services' fire insurance classification program. CRS has 10 classifications from Class 1 to Class 10. As a community or county takes certain steps to reduce the hazards of flooding beyond the minimum to participate in the Flood Insurance Program, it may qualify for a lower rating. Currently, Fairfield County has a Class 10 rating under the new system, but may qualify for a Class 9 rating with only limited improvements or amendments to its current ordinance. This determination may be made with the use of a "Class 9 Quick Check", developed by NFIP.

Clearly, the opportunity to reduce the hazards of flooding and the cost of flood insurance at the same time is worth pursuing although the extent of such conditions is relatively limited in Fairfield County, confined almost exclusively to creek and river beds. It just makes sense.

SECTION III

LAND USE AND INFRASTRUCTURE

That existing land use patterns and infrastructure influence development is clearly evident. Like uses generally attract like uses. Development is dependent on infrastructure. Established commercial areas generally appeal to new commercial development; prestigious residential subdivisions attract new quality residential construction; and many industrial uses seek out the same facilities and areas for development.

It is essential, therefore, to have a thorough understanding of existing land usage, land use patterns, and existing and planned infrastructure in order to adequately assess those areas of the county in which future growth may be expected. A knowledge of "accepted" land use conditions also helps determine the degree of departure, if any, from established patterns of growth and intensity which may be applied to presently undeveloped areas. Toward these ends, a land use and infrastructure survey, inventory and assessment are included as part of this study.

EXISTING LAND USE

As stated previously, Fairfield County has about 438,425 acres. It ranks 18th in area among the state's 46 counties.

The largest single use of land is forest, accounting for 87 percent of the total. This includes all public, commercial and non-commercial forests, as well as farm woodlands. Non-forested land, including urban or developed land greater than 10 acres account for the remaining 13 percent of the county.

About three percent of the forested land is in public ownership. The largest is the Sumter National Forest in the northwestern part of the county. Private ownership of forested land is dominated by corporations, individuals and the forest industry. Only six percent of the county's forested land is owned and managed by farmers.

Developed or urban land use comprises only two percent of the county. It is centered in and just beyond the Town of Winnsboro. Urban concentrations are also found along the shores of Wateree Lake, around Ridgeway, in the Mitford community, and to a lesser extent around parts of Monticello Lake and Jenkinsville.

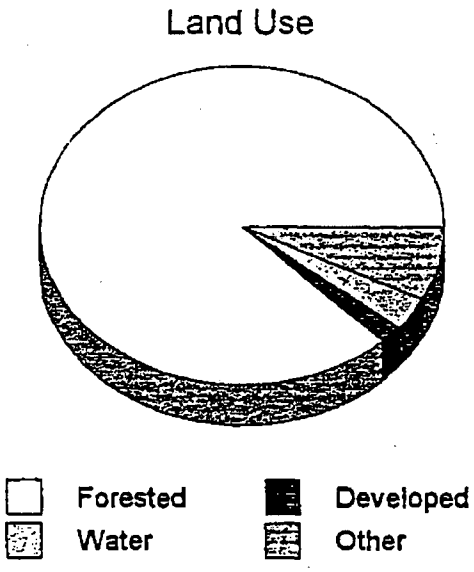


TABLE XVIII
GENERALIZED LAND USE INVENTORY

	Acres	Percent County
TOTAL AREA	438,425	
FORESTED LAND (BY OWNERSHIP)	383,607	.87
Public		
National Forest	11,560	.03
Municipal, County, State	478	.001
Private		
Forest Industries	130,622	.30
Farms (farmers)	29,027	.06
Corporations and Individuals	211,920	.48
NON-FORESTED LAND	54,818	.13
Developed (urban)	7,350	.01
Water	15,416	.04
Other	32,052	.07

Source: USDA, Soil Conservation Service, Forest Statistics for South Carolina, 1986; Important Farmlands Map, Fairfield County, 1984.

Water areas comprise about four percent of the county, principally in the form of Lake Wateree and the Catawba River, in the eastern extremity, and the Monticello Reservoir and Broad River in the western extremity.

Farm Use

The amount of agricultural and farmland has been on the decline since the days of the depression. A recent indicator of this trend is shown by Table XIX. Over a nine year period, between 1978 and 1987, the county lost nearly 20,000 acres of farmland. This was accompanied by a seven percent decline in the number of farms and a 19 percent reduction in the average size of farms. Also, the number of farmers engaged principally in farming declined by 13 percent.

The dominant use of farmland is in forest acreage, in spite of a 37 percent decline between 1978 and 1987. Pasture land, both cultivated and wooded, comprises the second major use of farmland. Only nine percent of the land in farms is devoted to harvested crops, while 16 percent is in other uses.

Neither agricultural land use nor production commands a prominent position in Fairfield County. In comparison with other counties in the state, it ranks no higher than 41st in farmland acreage or market value or products sold, while ranking 18th in total area.

Urban and/or Developed Land Use

Estimates from Table XVIII show the amount of urban and/or developed land to be approximately 7,350 acres, based on population concentrations of 10 or more acres. These measurements were computed by the Soil Conservation Service from detailed Soil Surveys, using a 10-acre grid system. Development of less than 10 acres was not computed.

A second estimate employing "per capita land usage ratios", establishes the number of acres in urban or developed land at about 6,900. This estimate is based on a ratio of 0.308 acres per person (22,295), derived from comparable land use studies. It tends to validate the estimates generated by the Soil Conservation Service, suggesting a range between the two.

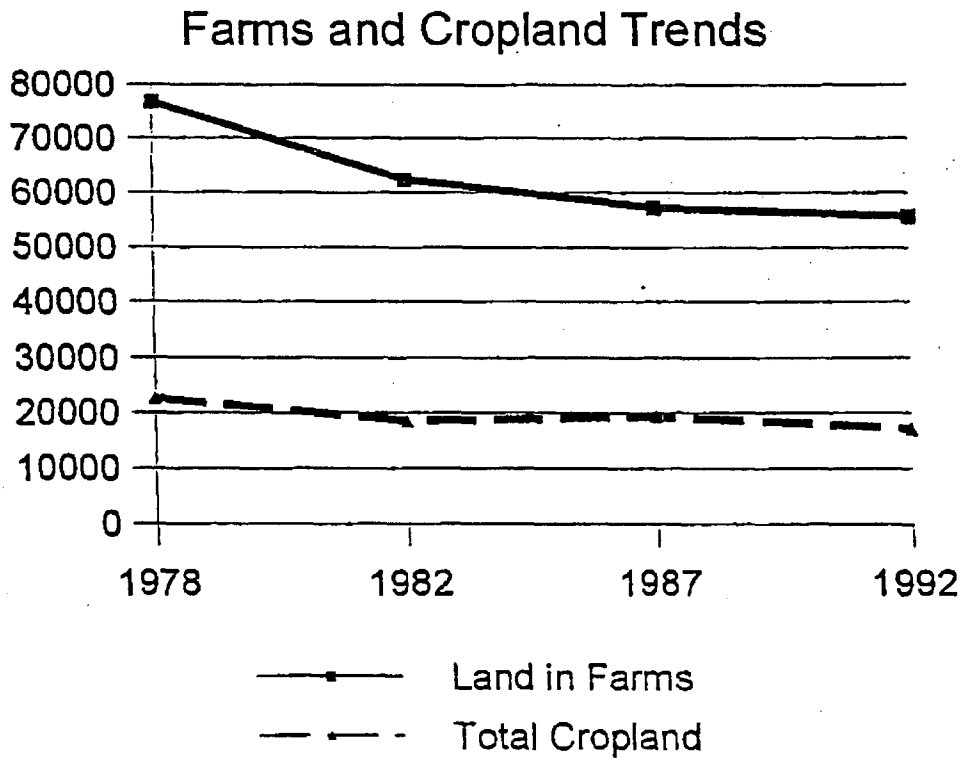
Urban or developed land consists principally of four broad based land use categories: residential, commercial, industrial and service (public and/or private), i.e. religious, medical, governmental, utilities, transportation, etc. A description of their location and specific characteristics within Fairfield County follows.

TABLE XIX

FARMS, LAND IN FARMS AND CROPLANDS
1978-1992

	1978	1982	1987	1992	Change 1978-1992 No.	%
Land In Farms (Acres)	76,794	62,427	57,293	55,712	-21,082	-27
Farms (number)	201	212	186	189	-12	-06
Average Size of Farm	382	295	308	295	-87	-23
Farming Principal Occupation of Farm Operator	76	82	66	69	- 7	-09
Total Cropland (acres)	22,621	18,539	19,360	17,198	-5,413	-24
Harvested Cropland	5,658	5,358	5,154	5,848	+ 190	03

Source: U.S. Department of Commerce, Bureau of Census, 1987 Census of Agriculture, Vol. 1.



General observations reveal:

* Scattered development with concentrations around the seat of county government (Winnsboro) and smaller community clusters, i.e. Ridgeway, Mitford, Jenkinsville.

* Expanses of undeveloped, wood and farm lands.

* Relatively intense development along the Winnsboro By-pass.

* General mixing of development in the unincorporated and unregulated municipal fringe, south of Winnsboro.

* Weak design and construction of most county maintained and farm-to-market roads.

* An influx of alternative low-cost housing in the form of mobile homes.

* Scattered pockets of substandard housing and living conditions.

* An historical presence.

* Underdeveloped resources.

* Rural charm.

* Concentrated development along the shores of Lake Wateree.

* Resource and unfulfilled development potential of the Monticello Reservoir.

* Vital linkage and enhanced accessibility provided by I-77; and

* A bustling industrial complex south of Winnsboro.

Residential Land Use

As mentioned previously, the dominant form of residential use is conventionally built, single-family detached housing. But mobile homes and other manufactured structures are rapidly adding to the county's housing stock. Even multi-family housing is now available in the fringe areas of Winnsboro, where municipal infrastructure is available.

Residential development is found in both isolated and cluster patterns along most county roads. The largest concentrations are located:

(1) South of Winnsboro and to a lesser extent in other fringe areas around the county seat,

(2) Along the shores of Lake Wateree, and

(3) The Mitford community.

Other areas of lesser concentrations include the unincorporated area around Ridgeway, particularly along U.S. 21 into Richland County, the Jenkinsville community, and a few clusters around the Monticello Reservoir. Elsewhere, residential development is characteristically sparse and rural in response to the county's agricultural past.

Commercial Land Use

Traditionally commerce has been the hub of development, occupying the center position. With suburbanization and sprawl, commercial development has followed suit, relocating from the center to more convenient outside service areas. And with improved transportation facilities opening other areas to development, i.e. by-pass routes, controlled access and interstate highways, commerce has gravitated toward such facilities.

Commerce still occupies the center of Winnsboro, but commercial development along the U.S. 321 By-pass and south of town has been impressive in recent years, challenging the dominant core position of the town's Central Business District.

Highway-oriented commercial development, once relatively prominent along U.S. 21 and U.S. 321 has declined since the opening of I-77. But I-77 has yet to attract the commercial activity which is sure to materialize in time.

Like most predominantly rural counties, with scattered residential development, commercial uses beyond the Winnsboro area are found generally in singular locations, at intersections and along the more heavily traveled roads. These sitings allow for maximum visibility and convenience of access to a larger, but sparse geographic area. They are spotted throughout much of the county, with heavier concentrations in the more developed areas, i.e. Mitford, Jenkinsville, and south and west of Ridgeway.

Industrial Land Use

Clearly, industrial and distribution facilities are the most dominant and notable uses of land in the unincorporated areas.

Mack Trucks, Rite Aid, the JPM Company, Standard Products, Uniroyal, Carolina Apparel, the Manhatten Shirt Company, Hon Furniture, Copian Industries, etc. are all located in the unincorporated areas. As a general rule, industry, distribution and warehousing operations tend to locate in proximity to but beyond corporate municipal areas. Such is the case in Fairfield County, where the vast majority of such operations are located.

Recent industrial trends show significant development in the areas south and southeast of Winnsboro, as reflected by the existing land use map.

Service Land Use

Service land uses are scattered throughout the county. They include churches, schools, utilities, governmental buildings and facilities, parks, etc.

Ramifications

Existing land use patterns account for a number of common land use problems, such as incompatible mixed land usage, neighborhood instability, traffic congestion, and strip commercial development.

Mixed land usage and the associated problems of land use incompatibility are found to the north and south of Winnsboro. Much of this is due to the transitional process of older homes giving way to commercial enterprises and other uses. Residential uses are not sufficiently insulated and protected from the negative impact of change occurring around them.

Residential stability is constantly under siege in unprotected transitional areas, such as those south of Winnsboro. Lower intensity uses, i.e. single-family dwellings are pressured for higher intensity development.

Land use intensity, curb cuts, and street alignments have a profound influence on traffic conditions. And there are examples around Winnsboro where improper alignments, excessive or expansive curb cuts, and high intensity development have contributed to traffic congestion and safety hazards.

Strip commercial development is evident and is intensifying along the By-pass. Such development affects not only the movement and safety of traffic, but challenges the purpose of the By-pass, which is to expedite the movement of traffic around the congested center of town. If volumes and congestion along the By-pass reach or surpass those on the original route through Winnsboro, the objective is partially compromised. This is not to say that the By-pass has not served a useful purpose,

particularly as a "development highway", but that it is increasingly less effective in moving traffic around Winnsboro--- the original intent for which it was constructed.

INFRASTRUCTURE

Adequate infrastructure is fundamental to urban and economic development. Although the degree of infrastructure dependence will vary according to the requirements of a use, the status of the following could well determine the development feasibility or potential for any given area of the county.

- Transportation facilities
- Water supplies
- Sanitary sewer service
- Electrical power
- Natural gas
- Fire protection

Transportation Facilities

Urban development in general and economic development in particular are influenced perhaps more by transportation facilities than any other single element.

The principal means of transportation in Fairfield County is, of course, by roadways, augmented by rail and air systems. The majority of the road system is maintained by the State of South Carolina. The capacity of these roads to serve existing and projected development is critical to the planning process. In evaluating that capacity, the South Carolina Department of Transportation categorizes all roadways using a level of service (LOS) concept. This defines roads in terms of their service characteristics, ranging in levels from A to F. An "A" level of service roadway has free flow conditions with relatively low volumes and little or no delays. The other end of the spectrum is an "F" LOS with stop and go operation and average signal delays greater than one minute. Table XX characterizes and defines the various levels of service.

All roadways in Fairfield County are designed to provide a minimum "C" level of service. Where traffic exceeds this designed level of service, improvements are then generally scheduled by the State. Typically, roadways with an LOS of D, E or F will be given top priority for improvements. Based on the absence of any major planned improvements by the Department of Highways and Public Transportation for Fairfield County during the next 10 years, it may be assumed that all roadways are operating at or below Level C, and that none is projected to exceed Level C before the year 2000, at the earliest.

TABLE XX

ROADWAY LEVELS OF SERVICE DESCRIPTIONS

Level of Service A

* Free flow conditions
* Low volumes
* High operating speeds
* Uninterrupted flow
* No restriction on maneuverability
* Drivers maintain desired speed
* Little or no delays

Level of Service B

* Stable flow conditions
* Operating speeds beginning to be restricted

Level of Service C

* Stable flow but speed and maneuverability restricted by higher traffic volumes
* Satisfactory operating speed for urban conditions
* Some delays at signals

Level of Service D

* High density, but stable flow
* Restricted speeds
* Noticeable delays at signals
* Little freedom to maneuver

Level of Service E

* Low, but relatively uniform operating speeds
* Volumes at or near capacity
* Approaching unacceptable delays at signals

Level of Service F

* Forced flow conditions
* Stop and go operation
* Volumes below capacity, may be zero
* Average vehicle delay at signals is greater than one minute

TABLE XXI

TRAFFIC VOLUMES
SELECTED ROADS IN FAIRFIELD COUNTY
1981 - 1990

	1981	1990	Change No.	Change %
I-77	4,700	20,800	16,100	3.43
SC 34, between				
I-77 & Winnsboro	3,500	4,965	1,465	0.42
Ridgeway and Kershaw County	950	2,233	1,283	1.35
Winnsboro and Little River	1,700	1,829	129	0.08
U.S. 321				
South of Winnsboro	4,800	3,694	-1,104	-0.23
North of Winnsboro	4,000	2,606	-1,394	-0.35
By-Pass	5,900	6,258	358	0.06
U.S. 21, between Ridgeway and Chester Co. Line	6,500	1,085	-5,415	-0.83
Old River Road, between				
U.S. 21 & I-77	425	611	186	0.44
I-77 and SC 200	750	1,205	455	0.61
River Road at State Park Bridge	110	437	327	2.97
S.C. 215				
Monticello Reservoir to Chester County Line	900	1,081	181	0.20
Monticello Reservoir to Richland County Line	1,100	1,119	19	0.02

Source: S. C. Department of Highways & Public Transportation, Traffic Volume Maps, Selected Years.

Still, all major roadways should be monitored for change, based on traffic volume increases recorded on selected roadways during the 80s (Table XXI). Traffic on I-77 increased by nearly 350 percent between 1981 and 1990. Much of the increase was due to shifting traffic from parallel roadways, U.S. 321 and U.S. 21, where traffic decreases were recorded.

Other, more internal oriented routes also recorded increases, but none as large as those on I-77. S. C. 34 recorded a significant increase between Winnsboro and I-77, and between Ridgeway and Lake Wateree, but only a slight upward move west of Winnsboro.

Traffic on Old River Road increased as a result of interstate accessibility, along with traffic along River Road, due to increased building on Lake Wateree. West of Winnsboro, traffic volume changes were minor by comparison.

From the traffic volume data recorded during the last decade (1981-90), it is obvious that most development activity is taking place south and east of Winnsboro, with few changes occurring to the north and west. And future traffic volume changes on the major roadways in these areas should be carefully monitored to protect their carrying capacity for projected growth and development.

Water Supplies

There are five public water systems in the county serving approximately 51 percent of the population. Additionally, less than two percent receive water from private residential systems. The balance relies on individual wells.

The five public providers are (1) the Town of Winnsboro, (2) the Town of Ridgeway, (3) the Jenkinsville Water District, (4) the Mid-County Water District, and (5) the Mitford Water District. Of the five public providers, only the Town of Winnsboro draws from a surface supply. The source is from a reservoir in the Jackson Mill Creek watershed, west of Winnsboro.

The reservoir contains about 600 million gallons of water, of which approximately one million gallons per day are consumed. The Town's treatment plant has the capacity to process about two MGD, with about 50 percent excess capacity for growth and new development at this time.

The other four public systems draw from groundwater sources, which have a relatively low yield in Fairfield County. Still, each of the systems is currently operating below capacity, with room for additional growth and development, albeit minimal by comparison with Winnsboro's surface water supply.

There are five private water systems in the county: two serve mobile home parks, two serve nursing homes and one serves a subdivision. Each is relatively small in terms of persons served. There are also two industrial water systems and nine miscellaneous systems serving outlying parks, schools, landings, camps, etc.

The current status of major line implacements and the extent of coverage in the county are shown by the accompanying Water Service Area Map. As may be seen, all intensely developed areas are accessible to a community system.

Sanitary Sewer Service

Community or public sewer systems are not nearly as extensive in the unincorporated areas as are community water systems. They seldom are. Service is confined to three areas--- the Towns of Winnsboro and Ridgeway, with only limited extensions into nearby unincorporated areas, and in the upper part of the county, from the town of Great Falls, in neighboring Chester County, out S.C. 200 to I-77.

Suffice it to say, these areas have the jump on the balance of the county in terms of securing and accommodating higher intensity development. Urban development generally is contingent on sanitary sewerage facilities. Thus, much of the future development in the county may be expected to occur in these three areas, barring the construction of additional treatment facilities.

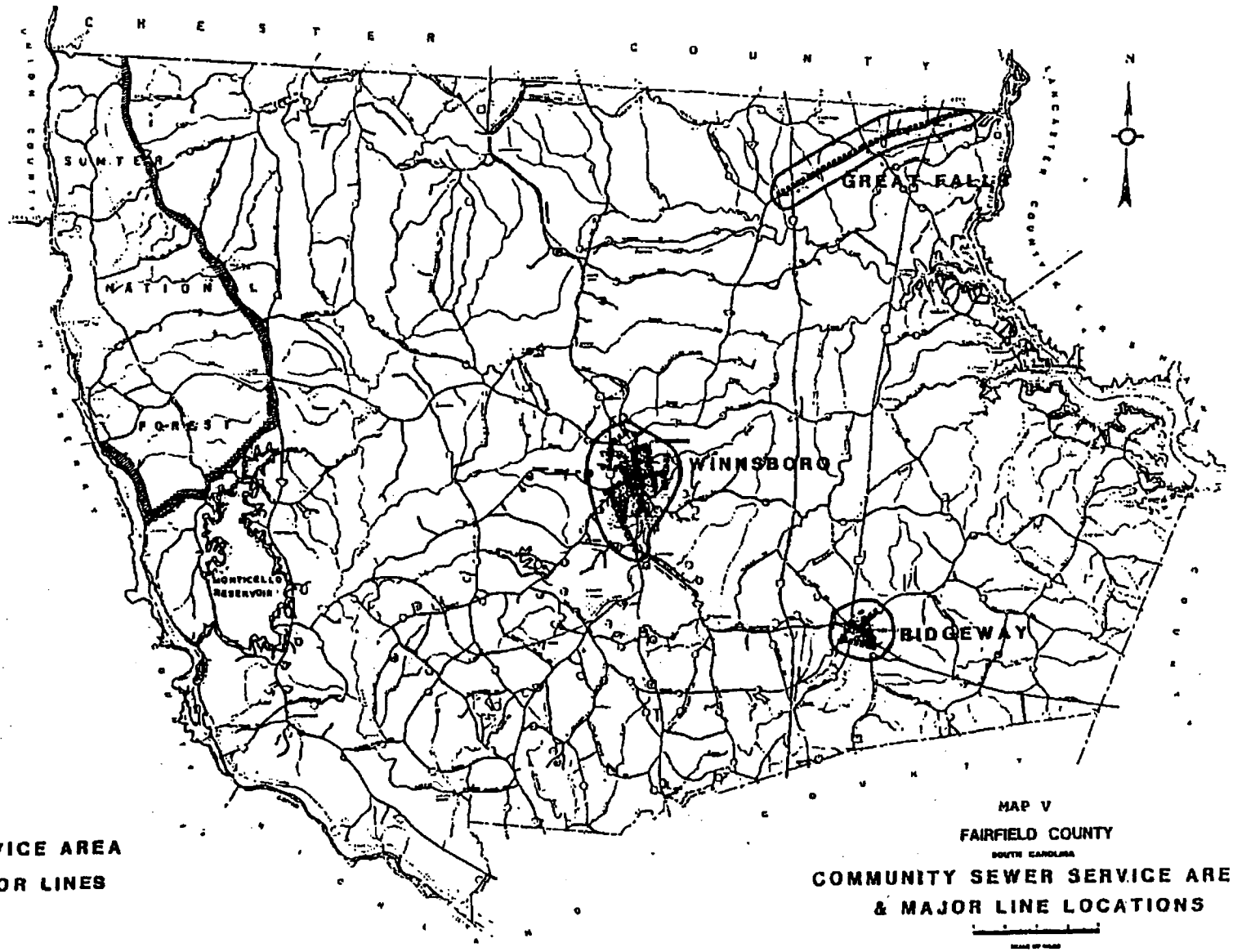
Electrical Power

The availability of electrical power sufficient to meet the needs of development, particularly industrial development, is a given in the site selection process. And electrical power in adequate supply for future development appears assured, with SCE&G's nuclear power plant located in the county.

But not all of the county is served by SCE&G. In fact, there are four electrical providers or distributors in the county:

SCE&G
Fairfield County Electric Cooperative
Town of Winnsboro
Newberry Electric Cooperative

The service areas of each are shown by the accompanying map. Interestingly, the areas with the greatest development potential have not been assigned to any one agency by the South Carolina Public Service Commission. As a result, the competition for customers often leads to confusion and duplicity.



SERVICE AREA

MAJOR LINES

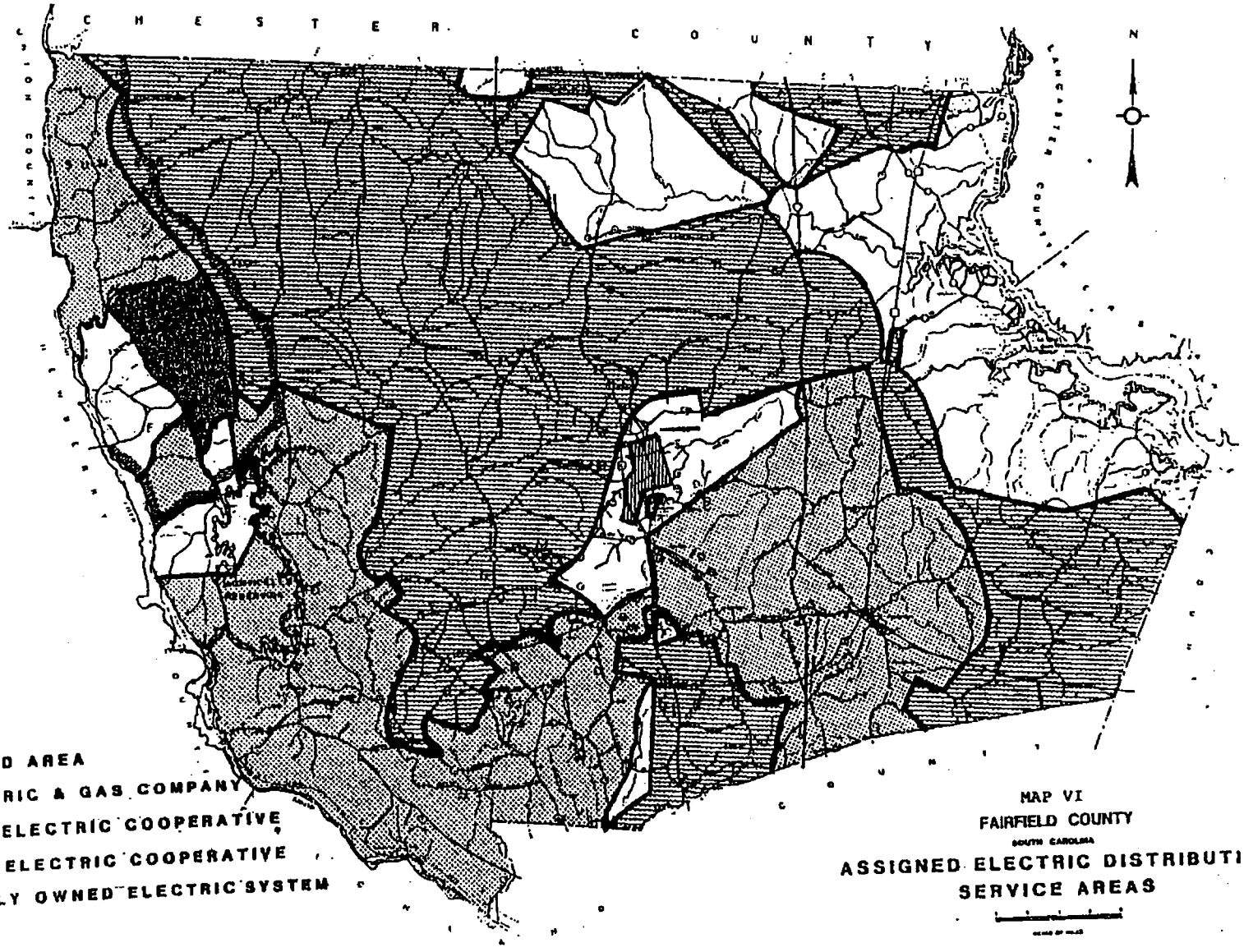
MAP V

FAIRFIELD COUNTY

SOUTH CAROLINA

COMMUNITY SEWER SERVICE AREAS

& MAJOR LINE LOCATIONS



MAP VI
FAIRFIELD COUNTY
SOUTH CAROLINA
ASSIGNED ELECTRIC DISTRIBUTION
SERVICE AREAS

Natural Gas

Natural gas is supplied to the county by the South Carolina Pipe Line Company serving Richtex and SCANA's Sumner Power Plant, west of S.C. 215. The pipeline company also wholesales gas to the Town of Winnsboro which retails and distributes it along U.S. 321 south and west of Winnsboro, and within the Winnsboro area. The town is also in a position to extend natural gas to other areas of the county in support of development, as economically feasible.

While not essential to all industrial operations, the availability of natural gas is a definite plus when recruiting industrial prospects and promoting economic development.

Fire Protection

The availability and level of fire protection has a direct bearing on the security of life and property, and the cost of insurance premiums. As such, it is a matter of considerable concern where development is contemplated, especially multi-million dollar industrial and/or commercial investments.

Fire protection in Fairfield County is provided by the public safety department of the Town of Winnsboro and ten stations operated as part of the county fire service. The county fire departments are funded directly by Fairfield County in its operating budget, out of the proceeds of a 3.1 mill fire tax. The Winnsboro Public Safety Department is funded from the budget of the town, supplemented by fire protection contracts. Some of the individual fire departments in the county are engaged in separate fund raising activities, but most of their apparatus and buildings are owned, and their operating expenses paid by the county.

The 10 stations in the county system are:

Community
Greenbrier
Southeast
Dutchman's Creek
Ridgeway
Jenkinsville
Mitford
Lebanon
Blair
Feasterville

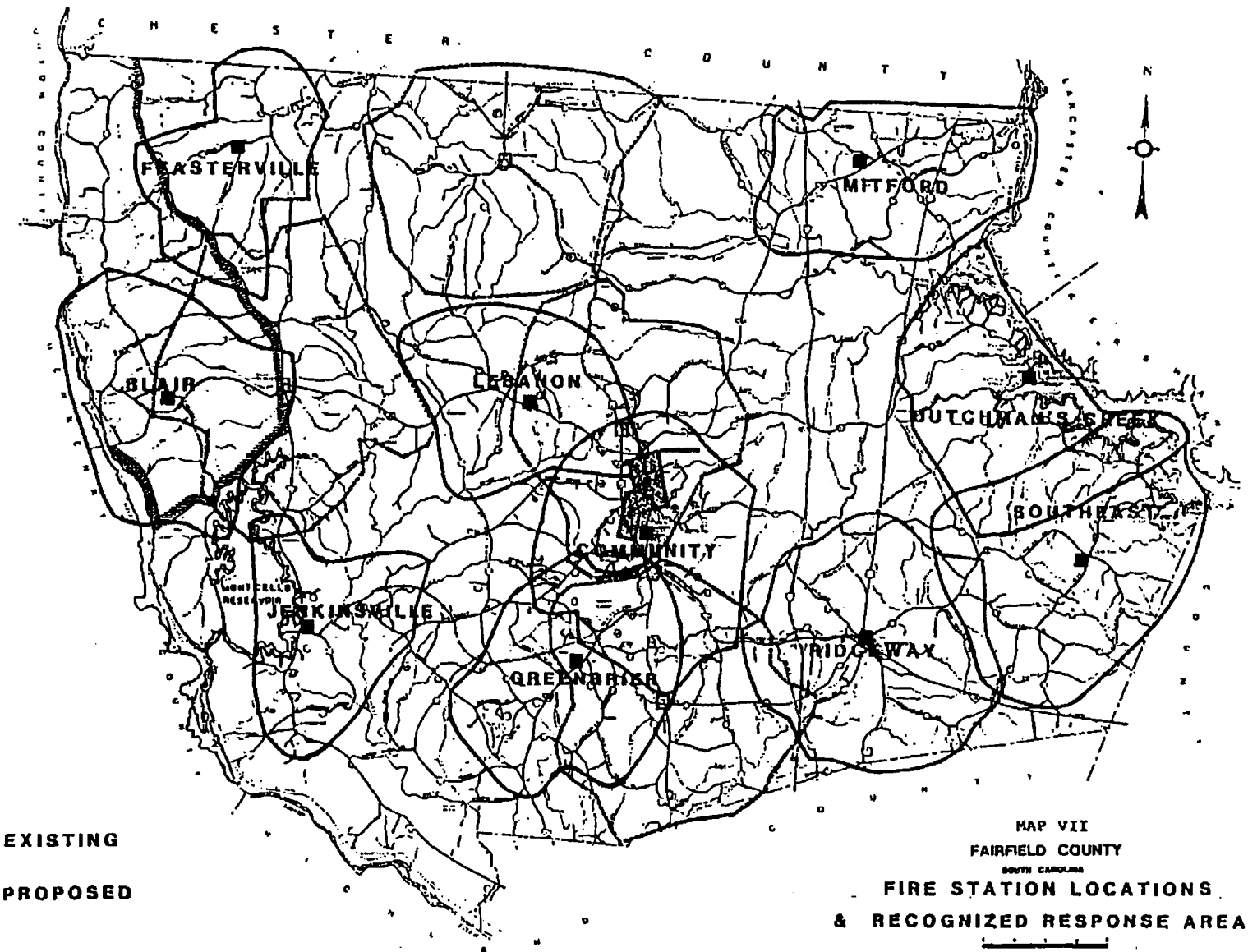
All of the departments except Winnsboro, Community, Ridgeway, and Mitford are rated Class Nine. The district covered by the Winnsboro Fire Department is rated Class Five, although some properties located beyond 1,000 feet of a fire hydrant carry

a lower Class Nine rating. Community also has a split 5-9 rating. Ridgeway and Mitford have split 8-9 ratings. Other areas of the county, located beyond five miles of an existing station are protected to the extent possible under the current system, but are rated Class 10 for purposes of writing insurance, and charged accordingly as "unprotected areas".

In a recently completed Fire Protection Master Plan, by Eckman Associates, four additional stations are recommended to cover about 60 percent of the unprotected properties in the county. Their locations are:

Rt. 321 at Woodward
Rt. 321 north of Winnsboro
Rt. 34 at Salem Crossroads
Rt. 321 at Rt. 30

Already, the county has allocated funding for the first of these stations in the Woodward Area. The proposed stations, together with the location and service areas of existing stations are shown by the accompanying map.



EXISTING

PROPOSED

MAP VII
FAIRFIELD COUNTY
SOUTH CAROLINA
FIRE STATION LOCATIONS
& RECOGNIZED RESPONSE AREAS

Source: Fire Protection Master Plan, Eckman & Associates.

SECTION IV

LAND USE FORECAST

Forecasting the need for and location of land for future development is one of the principal objectives of any land use plan. But, there are no exact standards by which to measure this need. The amount of land required to support the population of a big city, for example, is considerably less per person than the average amount consumed in Fairfield County. It is a matter principally of land availability and economics.

One fairly reliable method for use in determining future land use needs in the county is to relate land use to population. Over the years, our firm has compiled land use and population data from over 30 local surveys. We have found the average consumption of land in unincorporated areas to be approximately .34 acres per person, allocated among the four basic land use classifications as follows:

Table XXIII

Land Use Classification	Land Use Requirements (acres per person)	Percent of Development
Residential	.21	62.0
Commercial	.01	3.0
Industrial	.08	24.0
Service	.04	11.0
TOTAL	.34	100.0

Source: Vismor & Associates, Inc.

Using these allocations for Fairfield County we estimate that about 512 additional acres will be developed by the year 2000, and an additional 340 acres by the year 2010. Not all of it will come from the rural register, of course. There will be some in-filling of existing subdivisions and development in built-up areas around Winnsboro, effectively reducing the need for raw undeveloped land. Still, the impact will be measurable.

Residential use should comprise approximately 62 percent of all new development, accounting for approximately 430 additional acres by the year 2010.

Table XXIV

Land Use Forecast, By Use

	2000	2010
Population (additional)	1,505	1,000
Land Use (additional acres)		
Residential	320	210
Commercial	15	10
Industrial	120	82
Service	57	38
Total (acres)	512	340

Source: Ibid.

Future industrial land use is perhaps the most difficult to estimate with any degree of accuracy, due to a multitude of factors, not the least of which is the county's ability to secure and accommodate new industry.

Fourteen potential sites have been identified by the South Carolina State Development Board ranging in size from 13 to 3,500 acres. However, most are without basic infrastructure, i.e. water and sewer. Only 42 percent of the sites have water and 36 percent have sewer. But these sites have in combination 772 acres with water and 760 with water and sewer, representing far more land than is forecast for industrial development during the life of this Plan. But who is in a position to know how successful the county will be in its quest for new industry?

Suffice it to say, most future industrial development will occur in the unincorporated areas, due to the added overhead (taxes) of a municipal location. And those sites listed by the State, particularily those between Winnsboro and Ridgeway, appear most likely to appeal to new industry. It is important therefore, to set aside some of these areas, and protect them for future industrial use, to the extent practical and feasible---to plan for industrial development in those areas best suited to such operations.

Because of the dependency of commercial uses on residential areas and high volume streets and highways, we may expect to see future commercial development follow the lead of residential movement. Likely, it will occur in the form of small convenience establishments in expanding suburban areas, and become more

intense in areas outside of Winnsboro, and at I-77 interchange locations.

The amount of service land needed through time, again, is directly related to the amount of land used principally for residential purposes. The need in the county is projected to be only 95 additional acres by the year 2010. This includes social, medical, recreational, governmental, religious, and related uses. Many of these uses will continue to be found in the county's two municipalities, thus minimizing their impact in the unincorporated areas.

SECTION V

PLANNING ISSUES AND OBJECTIVES

CITIZEN PARTICIPATION IN THE IDENTIFICATION OF ISSUES AND NEEDS

One of the principal objectives of this program is to provide ample opportunity for citizen participation in the planning process---to allow the public to help identify issues and problems that should be addressed by the Plan. Toward this end, the Planning Commission conducted three public "in-put" meetings in various parts of the county. The meetings were held in Ridgeway, Monticello and Winnsboro. Additionally, a select group of students and teachers were surveyed in the same manner to determine their concerns for the future, and how this planning program should address them.

The format consisted of a presentation by the Commission and its consultant-staff. The presentation consisted of factual background data on trends and conditions within the county, followed by population and development forecast for the various geographic areas. Constraints to and capabilities of development were outlined, and preliminary issues identified.

Having briefed or primed the audience, the agenda then focused on citizen participation. To aid in the process, a survey questionnaire was used to guide the discussion. The questionnaire enlisted participation in the identification of community needs and issues, and solicited guidance in charting a course of action to be taken by the Planning Commission and County Council in addressing such needs and issues.

A total of 121 persons participated in the process. While the number is relatively small, and their views may not be considered a mandate, clearly they represent a "good indication" of what needs to be done to improve and enhance the development process through planning and subsequent implementing activities.

As issues, needs and problems tend to vary from area to area, the questionnaire focused on (1) area identification of the respondent and (2) needs within such area. The areas divided generally along the following lines:

Area	Description
1	East of Winnsboro, including Lake Wateree, Simpson, Rockton and Ridgeway.

2 Winnsboro and South of Winnsboro, including Forest Hills, Bethel and areas surrounding Winnsboro.

3 North and West of Winnsboro, including Mitford, White Oak, Blackstock, Blair, Monticello and Lebanon.

In descending order, the following were identified on the basis of "urgency of need" for each area.

Area #1	Area #2	Area #3
Street improvements	Street improvements	Street improvements
Public Sewer	Housing Improvements	Public Sewer
Land Use Regulations	Land Use Regulations	Land Use Regulations

Several other needs also were identified by a smaller margin of concensus, including the need to improve street lighting in some areas, the need for drainage improvements, the need to address unkept property, junk yards, litter control and animal control. Also, the need to install sidewalks in certain areas was suggested as well as the need to address hazardous industry.

When asked if they thought the county (Council) has a responsibility for improving and/or addressing any of these needs, 77 percent said YES. They want the county to get more involved in these matters, particularly in the areas of land use, housing, pollution control, road maintenance, erosion control and property maintenance.

With regard to specific planning and development issues which should be addressed by this Plan and subsequent implementing programs, citizens at the public in-put meetings were asked to comment on the "needs list" in Table XXV. By a substantial majority, ranging from 60 to 87 percent, those persons attending the meetings favored regulating the development process and protecting the county's amenities and environmental resources from misuse.

Issues on which over 80 percent of the respondents expressed concern and a need to regulate are:

(1) Residential protection
(2) Regulate development on major streets and roads
(3) Certain land uses which could negatively impact the county, i.e. landfills, hazardous waste

TABLE XXV

CITIZEN'S RESPONSES TO PLANNING AND DEVELOPMENT ISSUES AND NEEDS

NEED TO:	YES	NO	NOT SURE
(1) Protect existing neighborhoods, subdivisions and homes from incompatible development?	.87	.08	.05
(2) Protect "prime" farmland?	.74	.12	.14
(3) Regulate development around Lake Monticello and Lake Wateree?	.67	.08	.24
(4) Guide the location and regulate the siting of mobile homes and mobile home parks in the county?	.63	.23	.14
(5) Regulate the location of billboards and outdoor advertising signs?	.66	.12	.22
(6) Regulate development along major streets and roads to ensure safety, and movement of traffic along existing and proposed highways?	.80	.07	.12
(7) Identify and protect for future industrial development, sites with industrial potential?	.60	.07	.31
(8) Require landscaping as part of any new large scale industrial or commercial use?	.69	.13	.17
(9) Adopt guidelines for the location and development of certain land uses which could have a negative impact on the county, such as landfills, hazardous waste dump sites, race tracks, mining operations, nuclear plants, etc.?	.81	.04	.14
(10) Regulate the impact of development on the county's natural resources and environmental amenities?	.74	.05	.21

Source: Responses from 121 persons at three public hearings conducted by the Fairfield County Planning Commission and a select group of students and teachers. Responses expressed by percentage of participants.

dump sites, race tracks, mining operations, nuclear plants, etc.

In the area of infrastructure, resident participants at the three input forums generally were not supportative of additional park facilities or the installation and expansion of water and sewerage systems. However, the students and teachers who were surveyed were in disagreement on the issue of recreation and expressed a need for additional facilities as well as improved maintenance at existing facilities.

Table XVI

Citizens Responses To Infrastructure Needs

NEED FOR:	Additional Recreation Facilities	Community Water System	Community Sewerage System
AREA 1	.67	.46	.33
AREA 2	.61	.35	.16
AREA 3	.58	.38	.19

Note: Percent respondents indicating a need for such facilities.

The following additional facilities were suggested by the resident survey:

(1) Facilities for youth and seniors
(2) Hunting and fishing
(3) Camping
(4) Trails and picnic areas
(5) Golf course
(6) Community center
(7) Ballfields
(8) Tennis courts
(9) Swimming pool
(10) Skating rink

The following areas were identified as needing additional recreational facilities:

(1) Northwest of Winnsboro
(2) Southeast of Ridgeway
(3) Simpson
(4) Greenbriar
(5) Longtown
(6) Blair
(7) Jenkinsville
(8) Blackstock

(9) Mitford
(10) White Oak
(11) Lebanon

SUMMARY LISTING

From the citizens in-put meetings and the data compiled by this study, we are able to identify a number of broader based issues which should be addressed by this Plan. Development related for the most part, they focus on the impact and siting of new and expanded development, as follows:

(1) Growth
(2) Quality Development
(3) Economic Development
(4) Aesthetics
(5) Transportation
(6) Housing
(7) Infrastructure
(8) Resource Preservation
(9) Recreation

AMPLIFICATION OF ISSUES, OBJECTIVES AND RECOMMENDED RESPONSES

Each of the above broad-based issues is amplified in this section. Here specific objectives are established and appropriate responses to implementation recommended, as follows.

ISSUE: GROWTH

OBJECTIVE: TO ACCOMMODATE PROJECTED GROWTH IN AN ORDERLY MANNER, AND TO AMELIORATE ITS IMPACT ON EXISTING LAND USES AND ENVIRONMENTAL RESOURCES

RESPONSE:

This is a fundamental planning issue. At the core is the approach to be taken by the Planning Commission and County Council. It may opt to continue with its current "hands off" policy, relying principally on developers and market conditions to shape the future of the county, or it may adopt planning policies and land use controls to help guide the development process.

Clearly, the county will have little say in the process, this plan notwithstanding, if it fails to take a stronger position on development issues. But how should the county plan for future development? It should start by building a Plan that recognizes market and economic influences, and channel

development accordingly, in an orderly fashion---enhancing rather than compromising environmental and living conditions.

Trying to plan where within the county certain types of development should occur can be difficult. However, for a starter, continued in-filling of established residential subdivisions and partially developed areas should be encouraged. It makes sense economically, especially where roads, water and sewer lines, etc. are in place. A policy to encourage in-filling also represents a positive response to the conservation of prime farmland and other natural resources. Still, much of the anticipated growth will be in the form of new housing complexes, expanded subdivisions, and scattered housing. Also, new industrial and commercial development is expected. Where?

Movement is expected to follow in the directions indicated by Map X. And, these areas should be readied for development, with plans for facilities and controls.

Contrary to popular belief in many unregulated areas, growth and development, per se, do not necessarily equate to prosperity or community enhancement. Improper development may adversely impact existing land use and environmental resources. To ensure against such occurrences, the county should consider for adoption standards and regulations to address the following:

a. Buffering Between Potentially Incompatible Uses

Buffering is a proven means of ameliorating differences between uses. Noted architect Frank Lloyd Wright succinctly captured the essence of buffers when he observed that "greenery hides a multitude of sins". Buffers are intended to screen or block vision, noise pollutants, or other by-products which might negatively impact existing development. Simply put, they offer a means of protecting existing uses from any negative impacts of new development and, as such, are recommended for orderly development.

b. Building Heights

The maximum height to which buildings and structures may be erected seldom is considered to be a problem, particularly in unincorporated areas where high-rise development is not likely to occur. However, if and when confronted by a project considered to be out of scale, it will be too late to remedy the situation without land use controls. Suffice it to say, high-rise structures can adversely affect existing

development, particularly low-rise, single-family residential uses. Yet, too little attention generally has been given this particular issue.

c. Building Setbacks and Curb Cuts

Setback and curb cut regulations can help limit future spending on highway widening projects, prevent encroachment by neighboring uses, and reduce the hazard of turning maneuvers on major streets and highways.

d. Performance and Siting Standards for Manufacturing Uses

Performance standards can protect against air and noise pollution, vibration, fumes, odor, glare, and other negative by-products of some manufacturing and related uses.

They can also check or substantially modify the location and operation of potentially incompatible uses such as dump sites, salvage yards, hazardous waste facilities, etc.

e. Erosion and Sediment Control

Erosion is a problem in parts of Fairfield County, due to its rolling terrain. And it is often compounded by development, where proper preventive measures are not employed during and after construction. Where there is erosion there is also a problem with sedimentation, drainage and water pollution. Drainage and storm water run off are addressed by the county's Subdivision Ordinance, but the issue of erosion as a negative by-product of the development process remains unaddresssed. To remedy the situation, the county should enact legislation prescribing "best management practices" where earth disturbing development is taking place.

ISSUE: QUALITY DEVELOPMENT

OBJECTIVE: TO FOSTER QUALITY DEVELOPMENT

RESPONSE:

That projected growth will generate new and expanded development is certain. What is not so certain is the quality of that development.

It is not enough to want quality development. In order to make it happen, the county should:

a. Regulate the Use of Land

Use requirements are rudimentary to the protection of land values and the promotion of quality development. They can prevent the "junk yard" from locating next to or across the street from a quality residential area, thus assuring land use compatibility, stable land values, and the promotion of "land use compatibility".

b. Enact Landscaping Requirements, for all non-residential and multi-family projects. They will add greatly to the aesthetic qualities of such projects.

c. Enact Open Space Requirements, for all multi-family and attached single-family projects. They will establish a proper relationship between high-density housing and needed open space, adding greatly to the quality of such housing. The county has such requirements for mobile home parks, but not multi-family housing projects.

ISSUE: ECONOMIC DEVELOPMENT

OBJECTIVE: TO STIMULATE AND ACCELERATE ECONOMIC DEVELOPMENT

RESPONSE:

This issue is critical to the continued growth and prosperity of the county. Toward this end, the following sub-goals are recommended:

a. To more aggressively seek industrial and business development with the appointment of a professional coordinator.

b. To build upon the existing base of business and industry by using current assets to attract industries that complement these assets.

c. To increase the number of new firms at an annual average of three per year.

d. To maintain or increase the current percentage of the work force in manufacturing jobs.

e. To identify and protect industrially suited sites for future industrial development.

f. To create a more favorable environment for existing industry by protecting them from encroachment by potentially incompatible uses.

g. To develop a high profile industrial park.

h. To support and develop a strong agri-business environment, including forestry, farming, housing, etc.

i. To aggressively pursue the development of programs designed to attract "retirees" to Fairfield County.

Currently, the State Development Board and the Economic Development Council of the Midlands represent the county in its efforts to secure new economic development. But more in the way of a county economic development office may be needed. And, indeed, such a move is being considered by County Council.

Additionally, the county should move to create a more favorable industrial climate by protecting potential industrial sites, as well as existing industry.

There are several industrially developing areas south of Winnsboro and along the S.C. 34 corridor between Winnsboro and I-77. Also, some 14 potential sites with approximately 3,500 acres have been listed with the South Carolina State Development Board for industrial development. And the county is considering the development of an industrial park on I-77, between S.C. 34 and Peach Road.

But unless these sites are secured through options or acquisition they may not be available if and when needed for industrial development. And the loss of good industrial sites could compromise the county's ability to secure much needed industry. It is simply not feasible however for the county to purchase and facilitate all properties with industrial potential, or wise to focus its attention solely on the development of one industrial park, although such a facility is needed. Through its regulatory power, the county can protect at no additional cost, those properties judged best suited to industry. Also the county can help maintain an industrial environment for its existing industries by, again, calling on its regulatory power to preclude encroachment by residential and other incompatible uses.

The county may enact land use regulations to protect industrially suited sites exclusively for manufacturing and related uses. Such a measure is strongly suggested by this

Plan. Being prepared with sites and facilities is half the battle. The other half is recruiting and job training. And, while there is help from the state and Economic Development Council of the Midlands with recruiting and job training, the primary responsibility for securing sites and creating an environment favorable to industry rests with local officials.

ISSUE: AESTHETICS

OBJECTIVE: TO PRESENT AND MAINTAIN AN AESTHETICALLY PLEASING ENVIRONMENT

RESPONSE:

Salvage yards, billboard clutter and "junky" development can contribute to aesthetic pollution. There are examples of such pollution in the county. Yet, there is nothing the county can do at this time to address or improve the situation.

The Sierra Club has identified South Carolina as a state in which outdoor signs and billboards have been allowed to clutter and blight the environment. While such abuses are not yet visible along I-77 in Fairfield County, it is simply a matter of time, particularly along I-77, unless measures are taken to regulate such uses. With increased traffic, increased usage of billboards may be expected. While there is nothing inherently wrong with billboards, they can pollute the environment if not properly sited, sized and located with respect to their surroundings. And there are some areas where they may be completely out of character. But without development regulations the county is powerless to do anything about billboards.

Also, aesthetic regulations would be helpful in screening salvage yards and other unsightly uses. The enactment of an "Existing Building Code" and "Standard Housing Code" would help clean up some of the blighted structural conditions in the county, and go a long way toward making Fairfield a cleaner more aesthetically pleasing place in which to live.

ISSUE: TRANSPORTATION

OBJECTIVE: TO IMPROVE ACCESS TO I-77 AND PROMOTE HIGHWAY SAFETY ON EXISTING AND PROPOSED STREETS AND ROADS

RESPONSE:

With so little attention paid to land use and its impact on the transportation network, it is little wonder that the "designed carrying capacity" and safety of most roads are compromised over time.

establishing a National Homeownership Trust Fund.

Title IV, HOPE Program, providing homeownership and opportunity for people everywhere.

Title VIII, Housing For Persons With Special Needs, providing assistance to the elderly and persons with disabilities.

b. Utilization of existing housing programs, i.e.:

Title V, Housing Assistance-Public, Section 8, and Foster Care Assistance

Title VI, Preservation of Affordable Rental Housing - Prepayment clauses on Section 236, 221(d)3 housing and other preservation provisions.

Title VII, Rural Housing

Title VIII, Housing for Persons With Special Needs - Section 202 and McKinney

Title XI, Community Development Block Grants

c. Greater involvement by local governments, to include:

(1) Inventorying available land for housing development;

(2) Supporting the cost of land planning and engineering to reduce future improvement problems;

(3) Assembling land and clearing titles including lots lost to delinquent taxes and vacant improved lots for in-fill;

(4) Making housing packages available to private developers on a competitive basis; and

(5) Supporting the Building Materials Bank for recycling excess materials from construction sites.

d. Greater involvement by the Central Midlands Regional Planning Council, the private sector and the banking industry.

To guard against this happening on the roads and highways in Fairfield County, consideration should be given to the adoption of curb cut and setback controls.

Setbacks will reduce the hazards to driving and permit future street widening at the most economical scale.

Curb cut controls can be especially effective in reducing the hazards of turning maneuvers, and maintaining highway use efficiency.

More importantly from an economic development standpoint is to better access I-77. The SHIMS Plans (Strategic Highway Plan For Improving Mobility and Safety) is designed to promote economic development by supplementing the interstate system with an integrated network of four-lane roads and highways. Yet no such improvements are proposed by the Plan for Fairfield County.

Clearly, S.C. 34 should be considered for inclusion in the SHIMS Plan as well as an additional access interchange and frontage road at the Peach Road crossing of I-77, in the southeastern part of of the county. These improvements would greatly enhance the economic development potential of the county, as advocated by the SHIMS Plan.

ISSUE: HOUSING

OBJECTIVE: TO MAKE DECENT HOUSING AND LIVING CONDITIONS AVAILABLE TO ALL RESIDENTS OF FAIRFIELD COUNTY

RESPONSE:

Housing trends and conditions discussed previously speak to the housing needs of low and moderate income families in Fairfield County. A strategy to meet these needs is outlined in the Central Midlands Comprehensive Housing Affordability Strategy (CHAS), 1991. Specific recommendations in the Plan call for:

a. Utilization of new federal housing programs included in the National Affordable Housing Act of 1990, i.e.:

   Title II, Home Program, providing matching grants for rehabilitation, new construction, site improvements, acquisition, tenant based rental assistance, financing cost and relocation benefits.

   Title III, Homeownership Incentives, providing assistance to first-time home buyers by

ISSUE: INFRASTRUCTURE

OBJECTIVE: TO EXTEND WATER AND WASTEWATER SERVICE AND FACILITIES TO ACCOMMODATE PROJECTED GROWTH AND DEVELOPMENT

RESPONSE:

Growth of the county is contingent on the availability of water and sewer. And while prevailing low density patterns over much of it preclude countywide coverage, such facilities are essential to higher intensity development.

With the County Planning Commission responsible for land use planning, five different agents---Winnsboro, Ridgeway, Mitford Water District, Mid-County Water District and the Jenkinsville Water District---responsible for providing water, and three different agents responsible for providing sewer (Winnsboro, Ridgeway, and Great Falls) to the unincorporated areas of the county, the need for a close working relationship among these groups is obvious. One cannot properly function without the other. Cooperation and mutual support are essential to the orderly, planned development of the county, at the most efficient scale.

ISSUE: RESOURCE PRESERVATION AND ENHANCEMENT

OBJECTIVE: TO CONSERVE AND PROTECT THE COUNTY'S NATURAL AND HISTORIC RESOURCES

RESPONSE:

Due to the non-replenishable nature of the county's natural and historic resources, care should be exercised in their use and/or development.

Included among such uses and facilities in Fairfield County are the following:

a. Prime farmlands

b. Water resources; i.e. Lake Wateree, Monticello Reservoir, Winnsboro Reservoir, the Broad River, and smaller creeks and ponds.

c. Historical buildings and places listed by Table XXVII.

d. Woodlands.

The retention of prime farmlands for agricultural purposes should be encouraged and fostered to the extent practical and feasible. The county may help by legislating the use of such lands exclusively for agricultural and related purposes.

Conserving and protecting water resources may be accomplished in part through the enactment of development and use controls on adjoining property. Conservation easements along the Broad River, similar to those employed by SCE&G around the Monticello Reservoir would be helpful. Both should be pursued in an effort to control development along the banks of the county's water resources.

Preservation of designated landmarks, buildings and areas of historical significance must be viewed in the larger context of controlling development around and adjacent to such places. Toward this end, emphasis should be placed on the design of development controls to ensure land use compatibility. On the following page is an inventory and map showing the location of historical places in Fairfield County.

Obviously, the entire county will not be built-out by the year 2010. Nor is full development encouraged or desired. Considerable land acreage not essential to future development will remain undeveloped. But which lands?

This question is directed at the heart of planning. Land will remain undeveloped with or without planning, for the simple reason that the market cannot support full development within the time frame of this Plan. But without planning and land use regulations, there could be a loss of land resources, i.e. farmlands, river and creek vistas, hunting areas and an imbalance of development and needed open space.

The Plan should speak to the issue of conservation, and identify areas and resources better left undeveloped during the next 18 years. But it may need reinforcement from the county in the way of land use regulations in order to achieve implementation.

Also, measures should be taken to:

a. Channel development into the more urbanized areas of the county where it can be better and more efficiently served with water, sewer, fire protection, etc.

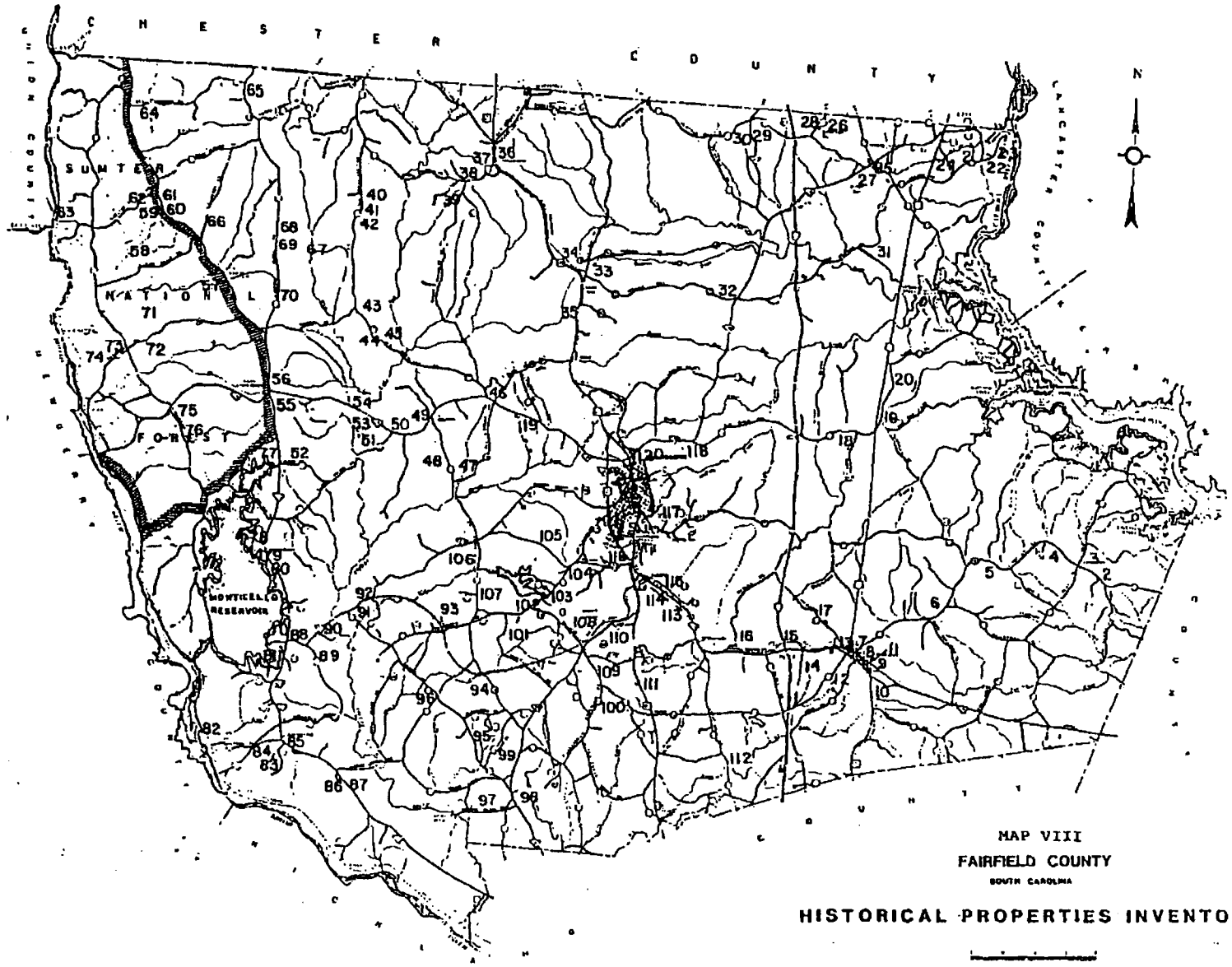
b. Discourage the extension of public facilities into the rural areas not projected for development, thereby limiting other than rural density development.

TABLE XXVII

INVENTORY OF HISTORICAL PLACES

1. Blink Bonnie
2. Longtown Baptist Cemetery
3. Bryant Hill Cemetery
4. Longtown Presbyterian Church
5. The Dixon House
6. The Hunter House
7. St. Stephen's Episcopal Church
8. Almwell Presbyterian Church
9. Ruff's Chapel
10. Longleaf
11. Ruff and Company
12. The Century House
13. Ridgeway Baptist Church
14. Mount Hope
15. Cedar Tree
16. Vaughan House
17. Valencia
18. Cason Family Cemetery
19. Durham House
20. Boulware Walls Burying Ground
21. Rocky Mount Battle Marker
22. Johnston Home
23. Rocky Creek Canal
24. Deputary Creek
25. Bethesda Methodist Church
26. Mt. Zion Baptist Church
27. Caldwell House, Mitford Community
28. Grafton House
29. Covenanter Cemetery
30. Covenanter Marker
31. Camp Welfare
32. Mt. Olivet Presbyterian Church
33. White Oak ARP Church
34. Robert E. Patrick Home
35. Galloway-Moore House
36. Concord Presbyterian Church
37. M. T. Patrick Home
38. Lewis Place
39. Calvin Brice Place
40. New Hope ARP Church
41. Dr. Walter Brice House
42. Tom "Shanty" Brice Place
43. Stevenson Home
44. Balwearie
45. Albion
46. The Jane Turner Place
47. Remains of Old Jackson Creek Presbyterian Church
48. The Old Manse
49. Lebanon Presbyterian Church
50. W. K. Turner Home
51. Dr. Hardy Liston Birthplace
52. Martin Place
53. Lemmon Place
54. The Bell Place
55. Happy Valley
56. Salem Presbyterian Church
57. Site of Hans Wagner Fort
58. Old Feaster Cemetery
59. Liberty Universalist Church
60. Feasterville Female and Male Academy
61. The Robert W. Coleman House
62. Clanmore
63. Shelton
64. Cool Branch Baptist Church
65. Beaver Creek Baptist Church
66. Coleman Cemetery
67. Old Yongue Burying Ground
68. Later Yongue Cemetery
69. Mobley Meeting House
70. Means Cemetery
71. Lyles-Feaster Home
72. Ivy Hall
73. Long House
74. Old Lyles Cemetery
75. Rock Creek Baptist Church
76. Fonti Flora
77. McCrorey-Liston School
78. Dawkins House
79. Monticello Methodist Church
80. Davis Plantation Home
81. White Hall AME Church
82. Parr Shoals
83. Chappell Place
84. Mayfair
85. Shiloh Methodist Church
86. Fair View
87. High Point
88. Little River Baptist Church
89. Holley Place
90. Ebenezer ARP Church
91. Kincaid Manor-Heyward Hall
92. Anderson Quarry
93. Union Memorial Presbyterian Church
94. Ashford House
95. Old Horeb Presbyterian Church Site
96. Site of Mason's Meeting House
97. Trapp Home
98. Crooked Run Baptist Church
99. Bethel Methodist Church
100. Thomas C. Camak Home
101. Brown-Rexrode House
102. Hawthorne-Brown House
103. Warren Castles House
104. Old Furman Building
105. Fairfield Baptist Church
106. The Oaks
107. The Bob Lemmon Place
108. Kelly Miller School
109. Greenbrier Methodist Church
110. William Estes Home
111. Thomas Nightingale's Cowpen
112. Site of Brooms's Mill
113. Thomas Woodward, the Regulator
114. Anvil Rock
115. Tocaland
116. Hunstanton
117. Dr. Daniel Jackson Sanders
118. Wylie House
119. Clowney Place
120. Winnsboro, County Seat

Source: Map of Historic Fairfield, Prepared by Fairfield County



MAP VIII
FAIRFIELD COUNTY
SOUTH CAROLINA

HISTORICAL PROPERTIES INVENTORY

The loss of some open land resources may not be anything to be alarmed over, but the steady erosion of such land will jeopardize the county's legacy to future generations.

ISSUE: RECREATION

OBJECTIVE: TO PROVIDE A COMPREHENSIVE AND BALANCED SYSTEM OF PARKS AND RECREATION FACILITIES

RESPONSE:

Recreation facilities seldom influence development, but they do complement it. They are essential to a balanced social environment. And with growth will come demand for more parks and recreational facilities, although support for more parks appears to be only luke warm according to the citizen in-put forums.

Recreational facilities in Fairfield County are provided by federal, state, county, city and private sponsors.

The federal government owns and manages approximately 11,560 acres in the Sumter National Forest, located in the northwest corner of the county. This facility provides hiking, riding and wilderness experiences, concentrating on recreational activities that require a lot of land.

The state owns and operates a large facility on Lake Wateree (Lake Wateree State Park). It includes a multitude of open space and water-oriented activities and facilities.

The Town of Winnsboro has a comprehensive recreation program, with two in-town parks, one of which (Fortunes) contains a swimming pool.

The Fairfield County Recreation Commission manages nine parks countywide, with a tenth being developed at this time. The location and assets at each are listed and shown by the following table and map.

Additionally, there is in the county a Recreation Association, with athletic facilities south of Winnsboro. Also, SCANA provides water-oriented recreation activities at its "Recreation Lake," north of Meadowlake Road, and fishing and boating on the Reservoir Lake.

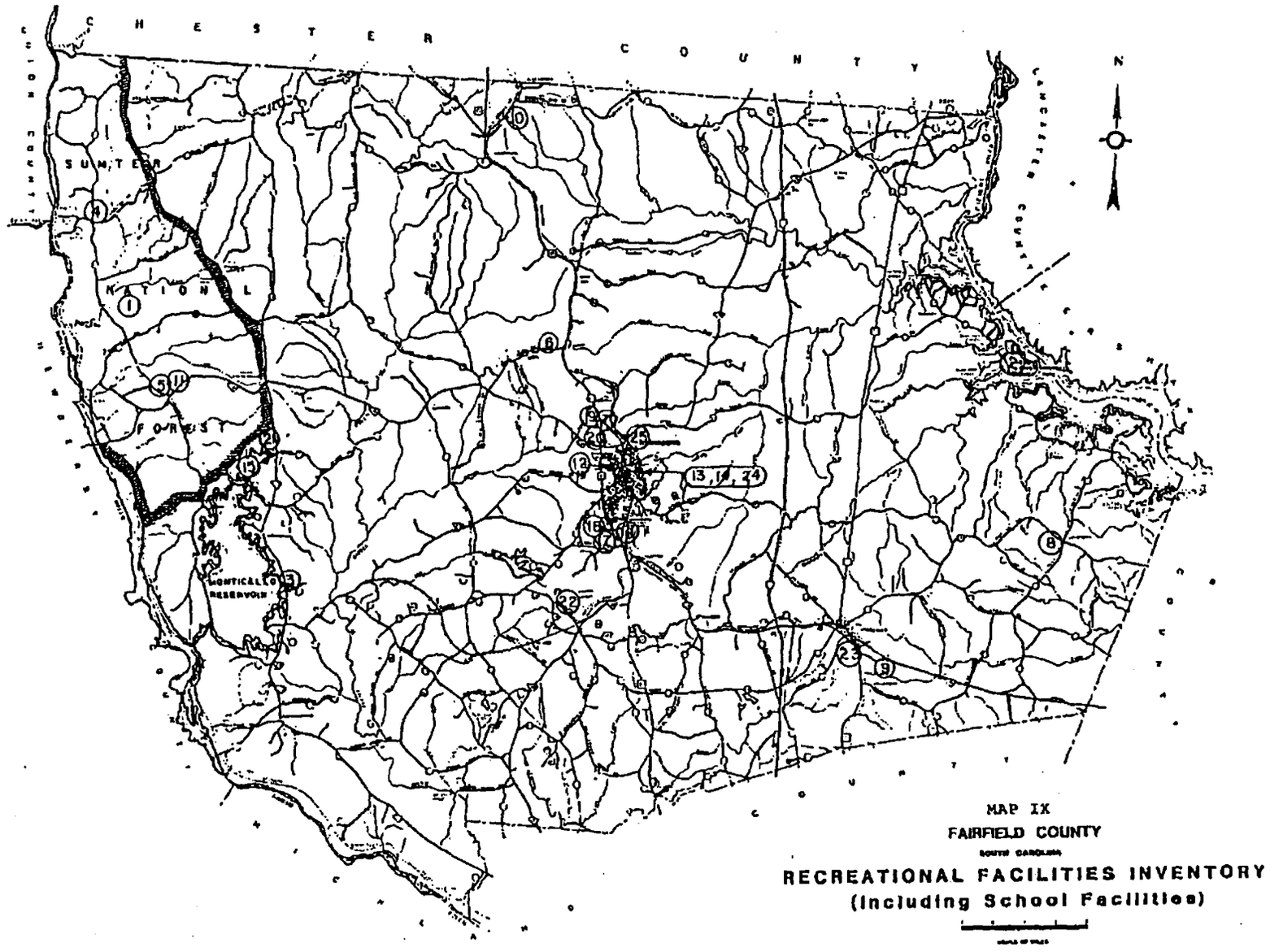
Finally, the School Board makes it many facilities available for public use through the Fairfield County Recreation Commission.

TABLE XXVIII

RECREATION FACILITY INVENTORY
(Including School Facilities)

Operator/Name	Map Reference	Acres	Facilities
Federal			
Sumter National Forest	1	11,560	Hiking, riding, outdoor experiences
State			
Lake Wateree State Park	2	72	Outdoor and water-oriented facilities, i.e. campground, picnic area, boat ramp
County			
Lake Monticello Park	3	25	Tennis courts, ballfield, basketball court, picnic facilities, fishing
Shelton Park	4	2	Basketball court and playground
Blair Park	5	4	Basketball court, playground, picnic facilities
Adger Park	6	16	Basketball court, playground
Community Center	7	3.5	Multi-purpose gym, tennis courts, Commission Office
Rufus Belton Park	8	5.5	Ballfield, basketball court, playground, picnic shelters
Ridgeway-Centerville	9	14.5	Basketball court, tennis, picnic shelters
Blackstock Park	10	3	Ballfield
Unnamed Park	11	4	Being developed--proposed ballfield
Garden Street Park	12	4	Ballfield, concession facilities
Municipal (Winnsboro)			
Fortunes Spring Park	13	9	Swimming pool, playground, picnic and jogging facilities
City Park	14	2	Basketball court, playground
Other			
SCANA Recreation Lake	15	NA	Skiing, fishing, swimming
Fairfield Recreation Association Drawdy Park	16	4	Ballfields (2)
Schools			
Fairfield Central High	17	--	Stadium, gym, practice field
Fairfield Middle School	18	--	Gym, assembly grounds
Fairfield Primary School	19	--	Playground, 3/4 gym
Fairfield Intermediate	20	--	3/4 gym
McCrorey Liston Elem.	21	--	Gym, playground
Kelly Miller Elem.	22	--	Playground
Geiger Elem.	23	--	Playground
Gorden Early Childhood	24	--	Playground
Richard Winn Academy (Private)	25	--	Gym, multi-purpose ballfield

Source: Field Survey, Vismor & Associates, Inc.; Fairfield County Recreation Commission; Recommendations for Recreation, CMH Associates, 1987.



MAP IX
FAIRFIELD COUNTY
SOUTH CAROLINA
RECREATIONAL FACILITIES INVENTORY
(Including School Facilities)

SECTION VI

COMPREHENSIVE DEVELOPMENT PLAN, 2010

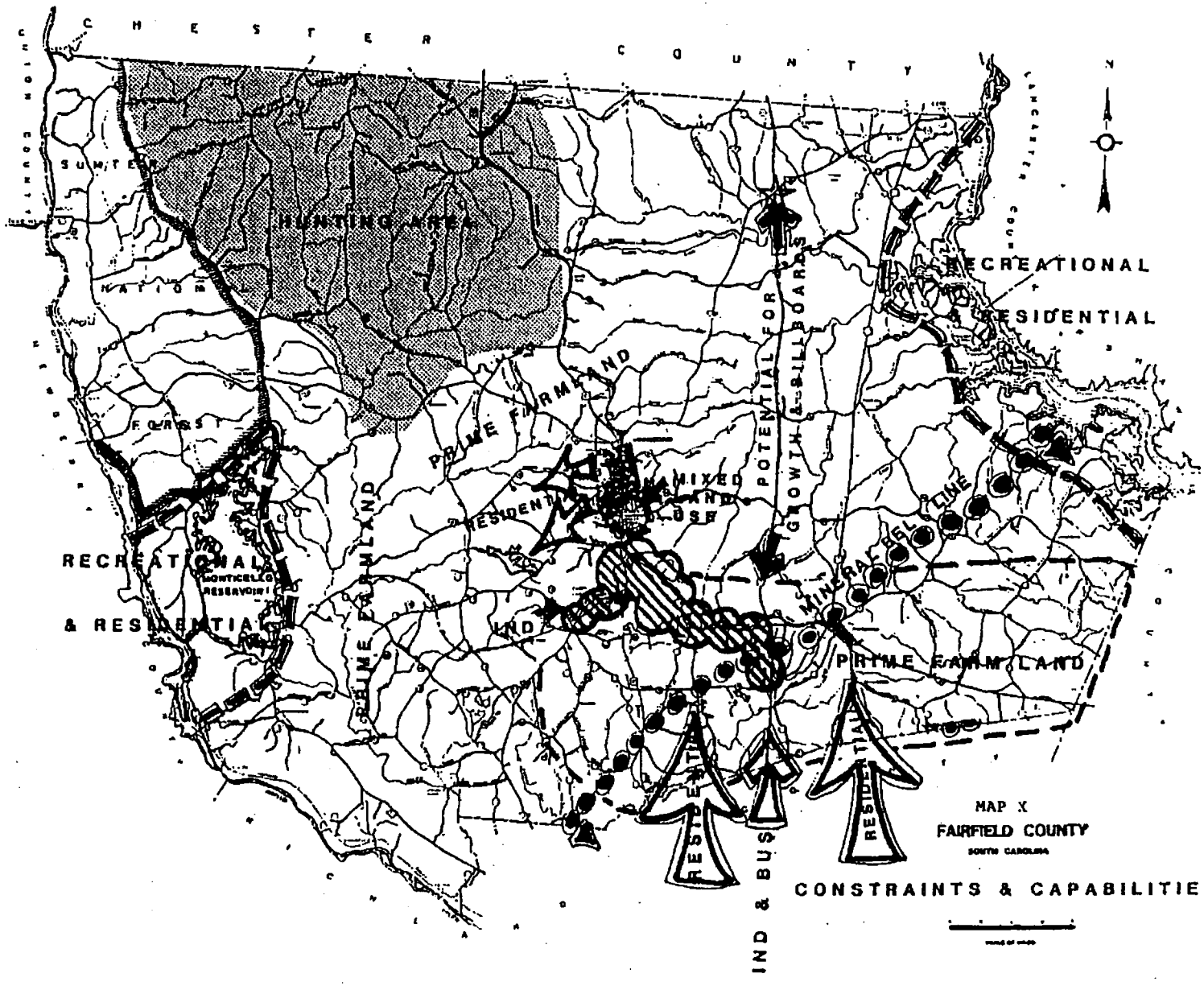
In reviewing the various factors affecting development, i.e. projected growth, existing land use, economic conditions, development trends, and the other elements responsible for development, a skeletal framework begins to take shape. Forces already at work have provided us with a foundation. This Plan is designed to build on that foundation---not alter what has been done or start anew, but guide future development in a manner that will complement and enhance social and economic conditions in the county, and lend order to the development process.

But the trends in process point to impending conflict. Areas of the county with the greatest development potential---in the southeast corner---contain most of the county's prime farmlands and mineral deposits. They are also in the line of expanding industrial and residential development north of Columbia, principally along I-77. By nature, these uses are inherently incompatible, setting the stage for conflict.

The potential for conflict is further compounded by neighboring Richland County's Comprehensive Plan for the I-77 corridor, which designates much of the contiguous area in Richland County for "development", meaning any number of uses under certain conditions. The logic in this approach is to maximize flexibility in meeting future development proposals "as the area has no particular development trend, but has potential for various uses."

East of SR 227 (Hood Road in Fairfield County), the Richland County Plan recommends low-density residential development. Assuming a continuation of "like development" into Fairfield County, east of Hood Road, similar low-density residential development may be expected. Development patterns along the I-77 corridor into Fairfield County will be shaped entirely by economics, on a first come basis, according to the Richland County Plan.

These "planned" scenarios mirror current development trends based principally on economics and locational preference. But they do little to remedy the potential for conflict in Fairfield County or insert order into the development process.



MAP X
FAIRFIELD COUNTY
SOUTH CAROLINA

CONSTRAINTS & CAPABILITIES

LAND USE PLAN ELEMENT

The Land Use Plan Element of the Comprehensive Plan is designed to do both---bring order and compatibility to the development process---establishing goals and objectives for the various areas of the county. Based in part on factors influencing development, projected needs and potential, goals and objectives are embodied in the following generalized Land Use Classifications, which are portrayed by the use of symbols on the accompanying Comprehensive Development Plan Map.

Land Use Map Symbol	Generalized Land Use Area Classification
GD	General Development
●	Commercial Clusters, within 500'
RC-D	Residential Conservation and Development
IND	Industrial Development
RR	Rural Development-Resource Preservation

GD, General Development

Areas so designated are projected to accommodate most of the future growth and development in the county. As a result, multiple uses (residential, commercial and industrial) are expected in these areas, tempered principally by market conditions. Here "highest and best use" options are advocated by the Plan. But with general, open-ended development options, there is inherent potential for land use conflicts mentioned previously. To prevent this, the Plan recommends the adoption of development standards for these areas:

(1) to ensure that adequate buffers, screens, and setbacks will be provided between potentially incompatible uses;

(2) to address storm drainage and sedimentation problems created by new development;

(3) to regulate outdoor advertising and help prevent visual blight and obstruction to travel;

(4) to control operational nuisances of non-residential uses such as outdoor lighting, noise, etc.

(5) to ensure the adequate provision of open space in large scale and multi-family projects;

(6) to require uniform setbacks along major streets and roads for visual clearance and future road widening;

(7) to enhance the outcome of development with required landscaping and amenities;

(8) to ensure the provision of adequate off-street parking and loading;

(9) to control the location of certain potentially hazardous, obnoxious, or offensive uses;

(10) to protect environmental resources in the path of development, i.e. trees, historical places, etc.

Standards addressing the above will make it possible to exercise flexibility in the use of one's property in these areas, so long as the proposed use is developed and sited in a manner that will not infringe on the rights of neighboring property owners or compromise values.

Objective

The objective of this classification is to permit land use and development flexibility in an effort to meet market conditions and demands---to encourage the "highest and best use of land", while protecting existing land uses and environmental resources from any negative by-products or fall-out from new and expanded development.

● Commercial Clusters

Where the symbol ● is established on the Plan Map, commercial development is recognized as a viable option to the larger land use designation within which the symbol is contained. Within generally 500 feet of the symbol commercial concentrations and clusters are recommended to meet the retail and service needs of area residents.

Objective

The objective of this land use designation is to meet in orderly concentrations the need for commercial development in areas dominated by residential and/or rural uses, and to discourage strip commercial development.

RC-D, Residential Conservation and Development

Without some type of land use regulations or development standards, it is difficult to maintain quality subdivisions and protect existing residential areas.

Even deed restricted subdivisions are vulnerable to incompatible development from all sides, as peripheral lots are exposed to and unprotected from neighboring development, whatever the use.

Residential security is of prime concern in any community. But all residential areas in unincorporated Fairfield County lie unprotected. Many already have been compromised as a result, by mixed, incompatible land uses.

Still, all is not lost. There remains homogeneous quality subdivisions within the county, as well as a number of nearby sites with residential potential. However, both need and warrant "protective zoning". Without it, they are vulnerable to an intrusion of mixed and potentially incompatible land uses.

Objective

Areas designated RC-D on the accompanying Plan Map are designed to protect existing residential uses and nearby areas with residential potential, exclusively for residential purposes, and to restrict or prohibit any use of land which would compromise or otherwise infringe on the prevailing character of established and planned residential areas.

IND, Industrial Development

Specific sites within the designated IND on the Plan Map have been investigated and found to have industrial potential. Most are relatively level, facilitated by or planned for water and sewer, and easily accessible. Many have rail.

Such conditions uniquely qualify these areas for most industrial uses, prompting their reservation principally for future industrial development. The availability of suitable industrial sites is fundamental to industrial development. Where good sites exist, they should be retained, principally if not exclusively for industrial development.

One of the tenets of land use planning is to channel development in such a manner as to maximize its contribution to the community. Where there is a need for industrial development, and there exist the necessary sites and infrastructure to support it, care should be taken to encourage and accommodate the industrial use of such areas. Other uses which would preclude the industrial development of such areas, and subsequently compromise the county's ability to attract industry should be prohibited.

Objective

The objective of this classification is to preserve and protect existing industry and potential industrial sites from encroachment by incompatible and inappropriate development. While not excluding all other uses from these areas, they are recommended principally for manufacturing, warehousing, wholesaling, research, technical operations, and similar uses.

RR, Rural Development-Resource Preservation

Most areas classified RR on the Plan Map generally are outside the path of projected development, characteristically rural and predominantly undeveloped at this time. Moreover, few changes to these areas are anticipated during the life of this Plan. This is not to minimize the importance of these areas to the county however. Open lands, woodlands and wetlands are essential to clean air, water, wildlife, many natural cycles, and a balanced environment, among other things. As a result, they should be protected from encroachment or misuse.

This also includes the retention of agricultural lands, equine farm lands, water resources and historical places, many of which are located in the RR Area shown on the Plan Map. The importance of these areas may be measured in economic terms. And their protection and enhancement are considered critical to the future well being and general welfare of the county.

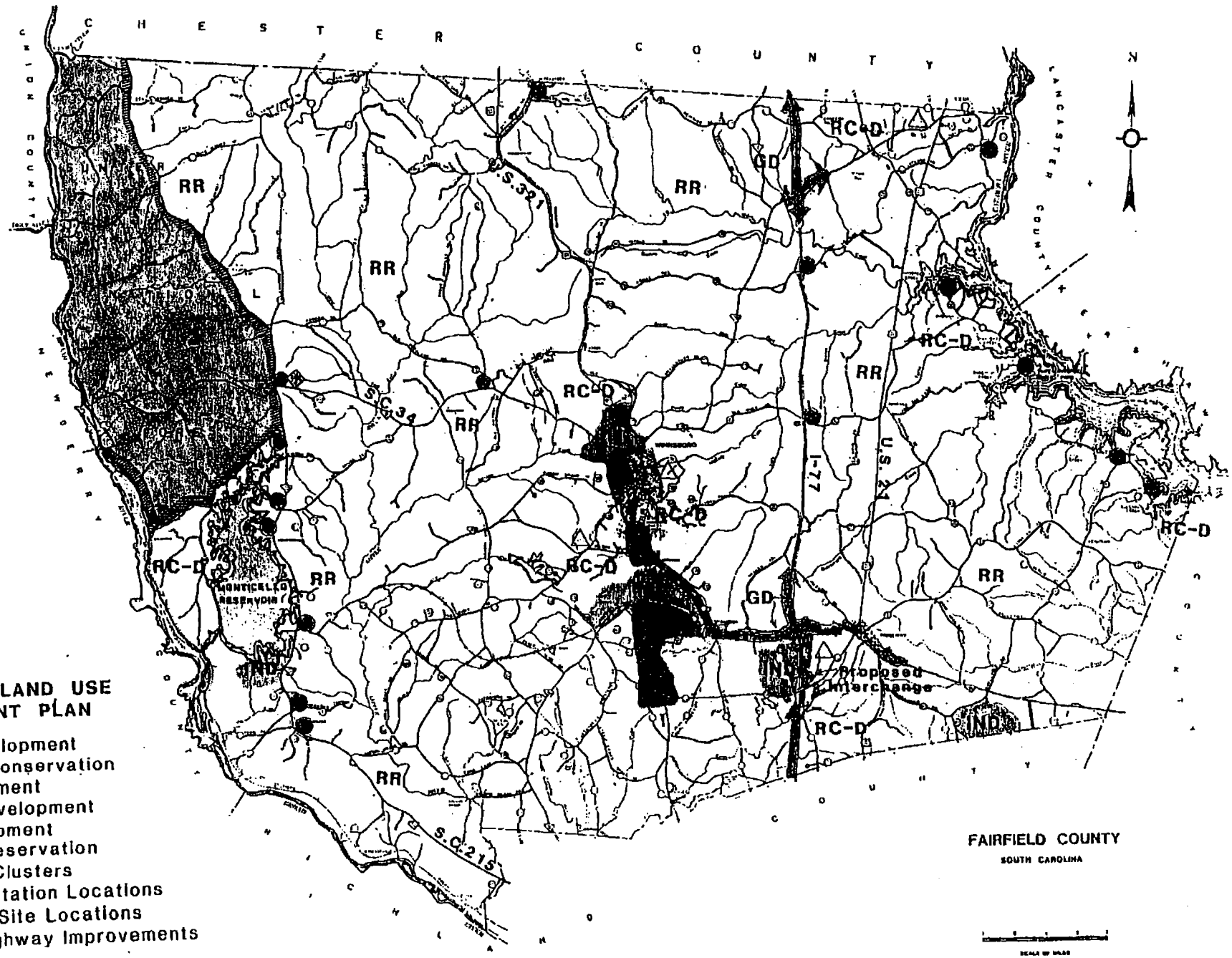
Just as important to the preservation effort is the development of agri-industrial uses to capitalize on these resources. And what better place to locate such uses than in the rural areas from which the resources are produced. Agri-industrial development, therefore, is viewed not as an incompatible use within the RR Areas shown on the Plan Map, but in a complementary role as a means of more economically utilizing the county's rural resources, without compromising rural values.

Additionally, two major resources targeted for conservation and preservation are waterways and historical places. Waterways

TABLE XXIX

SUMMARY LAND USE PLAN LEGEND

Use Classification	Recommended Density (No. Residential Units Per Acre)	Principal Use(s) Recommended
General Development (GD)	(12) per acre with water and sewer (2) per acre with water, but not sewer (1) per acre without water or sewer	Commercial, business, light industrial, multi-family, motels, commercial recreation, residential, institutional and mobile home parks.
Residential Conservation and Development (RC-D)	(4) units per acre	Single and multi-family residential uses, townhouses, condominiums, patio homes, triplexes, duplexes, and individual mobile homes, but not mobile home parks.
Industrial Development (IND)	(1) unit per 10 acres	Industrial, warehousing, distribution, wholesaling, storage, research and testing facilities and plants.
Rural Development-Resource Conservation (RR)	Not less than (1) per acre	Agricultural and support uses, single-family dwellings, mobile homes and small scale convenience and service commercial uses, hunting and fishing lodges, open air recreation, marinas, and agri-industrial uses.



COMPREHENSIVE LAND USE AND DEVELOPMENT PLAN

- General Development
- RC-D Residential Conservation & Development
- IND Industrial Development
- RR Rural Development
- Resource Preservation
- Commercial Clusters
- Future Fire Station Locations
- Future Park Site Locations
- Proposed Highway Improvements

Proposed Fire Protection Projects

Comprehensive recommendations for improving and expanding fire protection in the county are contained in the county's Fire Protection Master Plan, 1990. Suffice it to say, the key project elements of the Plan call for constructing four new stations, one of which is now underway (Map VII). Cost estimates and priorities are contained in the Plan, as well as other project details designed to improve fire protection throughout Fairfield County.

DEVELOPMENT POLICIES

In addition to the above, the following development policies are hereby established. They form the basis for the planning process by providing a means to evaluate land use proposals for compliance with overall community goals.

(1) General Policies

(a) Encourage planned and orderly growth consistent with the county's Land Use Plan, the capability of the natural resource base and the county's ability to extend or provide the necessary supporting public services and facilities to accommodate development.

(b) Provide for the conservation and protection of natural and historic resources through the proper use and management of land, water, soil, forest and mineral deposits.

(c) Assure that appropriated public funds provide needed public services and facilities in the most cost-effective manner.

(2) Residential Policies

(a) Provide opportunities for an appropriate mix of dwelling types, sites and prices in order to meet the current and projected housing needs of county residents in accordance with their financial capabilities and preferences.

(b) Encourage new housing development to strive toward the best principles of site planning and residential design through the enforcement of the county's subdivision regulations and building codes.

(c) Promote new and innovative approaches to residential development which will expand the variety of housing opportunities and/or minimize public and private costs.

(d) Encourage traditional and non-traditional residential development, including two-family unit structures, modular homes and mobile homes, to locate in subdivisions or parks so as to discourage strip development along major highways.

(e) Ensure through the enforcement of appropriate development standards, that the level and type of residential development will be compatible with the physical limitations of the land and established land uses in an area. Also, ensure that the transitions in size, site standards and other characteristics from residential area to residential area are compatible.

(f) Coordinate the expansion of residential development with information regarding potential impacts on schools, water and sewer systems, drainage, transportation systems, and effects on the environment.

(g) Encourage the maintenance and/or improvement of the individual character and identity of established neighborhoods, communities and rural settlements.

(h) Enhance the county's existing supply of housing stock by promoting appropriate conservation practices, supporting rehabilitation and encouraging the replacement of dilapidated structures.

(i) Support both public and private means of providing additional low and moderate income housing as needed and seek assistance to upgrade existing housing for lower income groups.

(3) <u>Commercial Policies</u>

(a) Require that commercial establishments incorporate adequate site design standards in regard to building locations, off-street parking, loading, signs and landscaping to ensure minimal interference to traffic movement and impact on

adjacent land uses.

(b) Encourage the clustering of commercial shopping facilities in nodes which are convenient to population concentrations.

(c) Discourage the spread of strip-type commercial development.

(d) Prohibit the encroachment of incompatible commercial development into established residential areas.

(e) Promote the adaptive reuse of existing structures when appropriately located for commercial use.

(f) Coordinate the growth of commercial development with information regarding the potential impact on community facilities, utilities, transportation, adjacent and nearby land uses and effects on the environment.

(4) Industrial Policies

(a) Encourage industrial growth that provides quality employment opportunities and makes effective use of the county's resources.

(b) Encourage the development of industrial uses in areas which will maximize the potential for safe, efficient and compatible operations while minimizing excessive infrastructure improvements and service costs to both industry and government.

(c) Seek to establish and maintain a balanced relationship between industrial, commercial and residential growth to ensure a stable and healthy tax base.

(d) Pursue the development of planned industrial districts and discourage the location of industrial uses in rural or natural resource areas.

(e) Encourage the development and/or expansion of industrial uses which do not produce excessive noise, smoke, dust or other particulate matter, vibration, toxic or noxious waste materials, odors, fire and explosive hazards or other detrimental impacts.

(f) Promote the location of industrial uses in areas which have compatible soils, drainage and other

environmental characteristics which do not pose severe constraints to site preparation.

(g) Coordinate the location of industrial development with the provision of appropriate road, rail, and pipeline facilities and information regarding potential impacts on community facilities, utilities, adjacent and nearby land uses and effects on the environment.

(h) Identify and reserve appropriate lands for future industrial development and protect these lands as well as existing industry from encroachment by interim land uses which would detract from or preclude their future industrial utility.

(5) Public Services and Community Facility Policies

(a) Extend and improve public services and facilities on a priority basis into areas with an existing need or into areas where the timing for development is approximately planned.

(b) Coordinate all capital improvement plans of the various utility providers in the unincorporated areas of the county to assure they are mutually supportive and comply with overall growth and development concepts.

(c) Identify and establish an appropriate mechanism to provide a thorough assessment of the availability of public services and facilities prior to making decisions which impact undeveloped areas of the county.

(d) Promote development in those undeveloped areas of the county presently served or planned for water, sewer and other services.

(e) Discourage the use of septic tanks and settling ponds for all but low-density residential development in the Rural Development and Resource Preservation areas.

(6) Transportation Policies

(a) Coordinate the development of county transportation facilities with regional system improvements to promote the efficient provision of transportation services and to reduce travel time and congestion.

(b) Ensure adequate rights-of-way for future road improvements and expansions. Right-of-way dedication requirements and building setback lines will be maintained for a heirarchical system of roads based on anticipated level and nature of future use.

(c) Protect the safety and traffic-carrying capacity of interchange areas and major thoroughfares from adverse adjacent land development by minimizing curb cuts along such corridors.

(d) Ensure the provision of safe and adequate parking facilities suitable to each type of development, and establish requirements that vehicular circulation within new development areas function efficiently and safely.

(e) Enact legislation to protect the county's airport.

(7) Open Space and Recreation Policies

(a) Ensure the availability and accessibility of a variety of active and passive recreational opportunities for all persons in the county, including the physically, socially and economically handicapped.

(b) Secure adequate future sites for recreation activities by identifying land and water areas having the best combinations of natural features, size and location suited for the type of experience to be provided. These sites should be acquired by the county or some other public entity and dedicated to recreation development and use.

(c) Preserve the overall positive qualities of the natural environment which give the county its character, and preserve those areas which have important recreational, scenic, historic, archeological, educational and aesthetic values.

(d) Encourage land development practices that reserve open space within or close to developed sites. Such open space should preserve the land's natural features and provide opportunities for the development of active recreation facilities.

(e) Achieve efficient use of multi-purpose open spaces which help to define development concentration, serve as buffers between dissimilar development and/or protect sensitive natural areas.

(8) Natural Resource Utilization and Conservation Policies

(a) Maintain and enhance the present quality of the county's natural environment and resources as a priceless attribute which should be shared, enjoyed, protected and passed on to future generations.

(b) Protect natural resources from development which would create significant negative environmental or economic impacts. Floodplains, steep slopes, and wetlands are natural features that, when developed, could create significant negative impacts on the surrounding environs.

(c) Ensure that the development of land and water resources proceeds in a manner consistant with resource capabilities.

(d) Protect water quality by limiting development in hydrologically sensitive areas and preserving areas which are necessary for watershed protection.

(e) Provide opportunities for agricultural uses in appropriate areas of the county and protect such areas from the indiscriminate encroachment of incompatible land uses.

(f) Use land for the purpose for which it is best suited based on its resources capabilities and land use suitabilities.

(g) Support the protection of historic, architectural, archaeological and cultural resources in the county and establish appropriate rules, regulations and ordinances to enhance and protect these resources.

SECTION VII

PLAN IMPLEMENTATION

Moving from the drawing board to reality is seldom an easy task in any endeavor. It is particularly difficult where the proper tools for implementation are not in place. Such is the case in Fairfield County.

But what can be done to reach the goals and objectives of this Plan? To start with, the county can begin a media blitz to secure public backing, then move to enact the necessary legislation for implementation.

Chronologically, the recommended process is as follows:

(1) Air the plan at public meetings and through the media.

(2) Adopt the plan as an official guide to future development.

(3) Maintain the plan.

(4) Coordinate the plan with the plans of other agencies operating in the county.

(5) Enact development and land use regulations to assure plan compliance and implementation.

AIR THE PLAN

Public awareness and participation in the land planning process are essential to its acceptance and use as a guide to development. Developers, realtors, property owners, agencies, and the general public alike are responsible for many individual decisions influencing future development. Consequently, they should have a hand in the making and execution of it. With public participation and support, implementation may be assured. Clearly, it is essential. It can promote public understanding of the planning process and expose proposed plans and policies to a broad spectrum of interest, whose reaction may make significant improvements in original proposals.

There are several ways in which to secure citizen involvement and support. It may be accomplished through public hearings, announcements, citizen advisory meetings, selected contacts with community leaders, etc. Also, the dissemination of copies of the Plan to interested groups and conducting informal

discussions have proven to be successful.

The final vehicle for effecting citizen participation may be accomplished through the process of educating the public at large. Throughout the critical initial years of the Plan, news releases and editorials are encouraged.

ADOPT THE PLAN

The Plan should be given official status, not only by the Fairfield County Planning Commission, but by the County Council as well. It should be adopted by both bodies as a guide to future development.

By so doing, it will elevate the status of the Plan to an official document. Any changes or deviations thereafter would require an amendment to the Plan, thus assuring greater compliance.

MAINTAIN THE PLAN

No plan is truly comprehensive and no long-range plan provides more than approximate guidelines to future development. A plan is an organized selection of what appears at a particular time to be the best means to reach what seems to be desirable objectives. Both the objectives and the means for reaching them change however, and there must be continuing assessment if the plan is to retain its utility. There also must be an enlarging scope for planning in response to a growing awareness that socio-economic as well as physical improvements lie within the realm of public planning.

This document represents what now appears to be desirable goals and objectives, based on the best knowledge available. As new data are available, it should be analyzed to see whether revisions to the Plan are needed. As new means of implementation become available, the Plan should be reviewed to see what changes might be in order. As change evolves, it should be reflected by the Plan.

This process should be virtually continuous, but in no instance should it be at less than five-year intervals, according to the state code.

COORDINATE THE PLAN

Cooperation and coordination with other decision-making agencies in the county, the Towns of Winnsboro, Ridgeway and neighboring Great Falls, the state, the region, and the federal

government, the Recreation Commission, Fairfield United Action, the Recreation Association, the School Board and other county agencies can spell the difference between success and failure. Interaction with these agencies will help to ensure full cooperation in the implementation of the Plan, and improve the efficiency of the development process.

ENACT DEVELOPMENT AND LAND USE REGULATIONS TO ASSURE PLAN COMPLIANCE AND IMPLEMENTATION

Currently the county has a number of codes and ordinances designed to impact the development process and improve the outcome, including:

(1) A Mobile Home Park Ordinance
(2) A Subdivision Ordinance
(3) A Flood Damage Prevention Ordinance
(4) A Building Code
(5) An Electrical Code

Still, these regulations are insufficient to implement many of the goals and objectives outlined by this Plan. More is needed in the way of (1) development regulations and/or (2) land use restrictions. Without such regulations, implementation of this Plan will be limited. This is a Plan, nothing more; it neither requires nor mandates any action on the part of anyone. And until such time as requirements are imposed, the development process will remain unaltered.

But what type of regulations should the county adopt? There are several alternatives it may consider.

First, there is zoning. A Zoning Ordinance can regulate and control the use and development of land in accord with this Plan. But zoning, per se, is seldom a popular issue, particularly in the more rural areas such as Fairfield County.

A second alternative is a concept referred to generally as "performance zoning" or "development standards". It may embrace regulations and concepts found in zoning and subdivision ordinances, and more. These regulations are becoming increasingly popular in counties where attitudes are hardened toward zoning. They differ from conventional land use (zoning) regulations by concentrating on <u>how to</u> achieve good development rather than segregating development on the basis of use. The <u>type of use</u> proposed for development is seldom regulated. The emphasis is on development standards, thus minimizing negative by-products and enhancing sound development practices. Conventional (zoning) regulations generally reverse this concept, concentrating on the regulation of use rather than the multi-faceted impact of development.

This is not to say that conventional zoning and use districting is not a viable development option. It is. In fact, it is the suggested alternative for certain areas of the county. But for those designated for general development, there is a need for more flexibility in responding to market conditions and encouraging the highest and best use of property. These needs are better addressed by the concept of Performance or Development Standards.

Seldom is the highest and best use principal challenged unless it produces negative results, i.e. infringes on the property rights of others, devalues neighboring property, damages the environment, creates traffic or health hazards, strains existing utilities and public facilities, etc. If these and related public interests are protected and perhaps enhanced through the development process, then it is possible for each property owner to build or develop his or her land to its highest and best use. And the right to do so is universally supported. Such is the case with a Performance or Development Standards Ordinance. Property owners are afforded maximum flexibility in responding to market options, provided they act responsibly and in accord with acceptable development criteria, as promulgated by the Ordinance.

Thus, this concept provides for land use flexibility, with emphasis on not how the land is used, but how it is developed.

Clearly, this approach has merit in Fairfield County, where the vast majority of land is still undeveloped, and land use intensity is relatively low outside the Winnsboro area. But there are other areas where modified zoning may be needed to achieve the objectives of the various land use designations.

Exclusive industrial zoning is recommended for those areas identified as having unique industrial potential. Their conservation for such purposes is essential to the future economic well being of the county.

Exclusive residential zoning is recommended for existing quality neighborhoods and nearby areas with residential potential. The protection of these areas against incompatible development is essential to the provision, maintenance and stability of quality residential development in the unincorporated areas of the county.

Protection of the county's natural attributes also is recommended as a means of conserving rural resource areas for future generations.

Therefore, the suggested approach for Fairfield County is a type of "hybrid" ordinance---one containing only a few u

districts, with the primary focus on development and performance standards.

Such an ordinance, properly drafted, could give the county sufficient flexibility to accommodate projected growth, while providing safeguards against development that might compromise existing resources or land uses.

Under this arrangement, regulations will vary from one area classification to another, depending on the development objectives of each. But such regulations would not relate to or control the use of land except in designated Use Zones, where land use regulations are needed and recommended to achieve stated plan objectives.

CONCLUSION

This document is to be used as a reference and guide to the future development of Fairfield County. It speaks to specific as well as general issues and concerns identified by the research and planning. The Plan represents an attempt to better infuse long-range planning into the day-to-day decisions affecting development.

The Plan should not be viewed as a static or rigid document, but as an elastic guide to development, accommodating change within its broader confines. As such, it should be reviewed regularly for accountabililty, as required by the state codes. In this way, it will remain an effective and current blueprint for development.

Section 4 4 Ref b

V 4.4-11

ESTIMATED VS. ACTUAL REVENUES
FY 1992-93 TO FY 2005-06

REVENUES	FY 2004-05			FY 2005-06		
	Original Estimate	Actual	Over (Under) Estimate	Original Estimate	Actual	Over (Under) Estimate
Tax Revenues:						
Individual Income	1,979,363,905	2,215,376,042	236,012,137	2,158,416,916	2,608,227,193	449,810,277
Sales and Use	2,249,617,591	2,318,474,848	68,857,257	2,396,065,472	2,544,980,402	148,914,930
Corporate Income	120,215,669	186,268,596	66,052,927	143,276,281	257,853,944	114,575,663
Other Taxes	568,286,038	606,795,298	38,509,260	582,251,192	582,320,107	68,915
Total Tax Revenues	**4,917,483,203**	**5,326,914,784**	**409,431,581**	**5,280,011,861**	**5,993,381,646**	**713,369,785**
Limited Medicaid Earnings	0	0	0	0	0	0
Motor Vehicle Licenses	60,612,419	57,626,280	(2,986,139)	56,758,315	51,110,914	(5,647,401)
Earned on Investments	16,000,000	26,074,492	10,074,492	25,000,000	69,852,997	44,852,997
Departmental Revenue	55,970,800	50,457,812	(5,512,988)	55,467,697	49,056,211	(6,411,486)
Nonrecurring Revenue	92,262,378	90,275,080	(1,987,298)	13,495,926	13,589,652	93,726
Other Revenues	39,552,775	39,712,183	159,408	42,358,971	49,035,157	6,676,186
Total Revenues	**5,181,881,575**	**5,591,060,631**	**409,179,056**	**5,473,092,770**	**6,226,026,577**	**752,933,807**

SOURCE: Comptroller General's Year End Reports.

Prepared
October 31, 2006 (Est. vs. Actual)

Section 4.4 Ref 7

(US BEA 2006)

UNITED STATES DEPARTMENT OF COMMERCE
Economic and Statistics Administration
BUREAU OF ECONOMIC ANALYSIS
Washington, D.C. 20230

October 17, 2006

Scott Flickinger
900 Trail Ridge Road
Aiken, SC 29803

Dear Mr. Flickinger:

Enclosed are the RIMS II multipliers you requested for Columbia, SC Region 2. Please see attachment for region definition.

The output, earnings, and employment multipliers can be found on the enclosed CD-ROM. The multipliers are based on the Bureau of Economic Analysis' 1997 benchmark input-output accounts for the U.S. and 2003 regional accounts data. The industries in RIMS II incorporate the North American Industry Classification System. See Appendix B for a complete list of the RIMS II detailed industries. The CD-ROM also includes distribution costs tables based on the BEA's 2003 annual input-output accounts for the U.S. For more information on the contents of the CD-ROM, please see the README.TXT file.

The CD-ROM contains a JAVA-based retrieval program (RIMS II Viewer) that can be used to access the multipliers. **Due to recent changes in the Viewer, JAVA 5.0 must be installed.** If you have not previously installed this software, select the JAVA 5.0 box during the installation process. A separate JAVA folder will be installed in C:\Program Files. A Viewer icon is no longer automatically placed on the computer's desktop. You will be given the option to create a desktop icon during the installation process.

Information on the RIMS II model can found in the third edition of the RIMS II handbook, ARegional Multipliers: A User Handbook for the Regional Input-Output Modeling System.© This handbook is located on BEA's web site, http://www.bea.gov/rims.htm.

If you have any questions, please feel free to call me at (202) 606-5343.

Sincerely,

Rebecca Bess

Rebecca Bess
Regional Economist
Regional Economic Analysis Division

ECONOMICS AND STATISTICS ADMINISTRATION

SCD-441

COLUMBIA, SC REGION 2

1) Fairfield County, SC
2) Lexington County, SC
3) Newberry County, SC
4) Richland County, SC

RIMS II Multipliers (1997/2003)
Table 1.4 Total Multipliers for Output, Earnings, and Employment by Detailed Industry
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
1111A0 Oilseed farming	1.6442	0.2414	10.7232	2.8076	2.1074
1111B0 Grain farming	1.6132	0.2351	10.4676	2.8052	2.1324
111200 Vegetable and melon farming	1.6699	0.3153	16.2622	2.1934	1.6659
1113A0 Fruit farming	1.7546	0.3915	26.0578	2.0779	1.4155
111335 Tree nut farming	1.7649	0.4093	27.7265	2.0068	1.3954
111400 Greenhouse and nursery production	1.5842	0.3946	17.7751	1.6620	1.5055
111910 Tobacco farming	1.0000	0.0000	0.0000	0.0000	0.0000
111920 Cotton farming	1.8324	0.3371	16.0288	2.9940	2.1839
1119A0 Sugarcane and sugar beet farming	1.0000	0.0000	0.0000	0.0000	0.0000
1119B0 All other crop farming	1.6347	0.2450	12.8186	2.7713	1.8086
112100 Cattle ranching and farming	1.8372	0.2628	11.8173	3.1366	2.3843
112300 Poultry and egg production	1.6969	0.2407	9.8620	2.8582	2.1325
112A00 Animal production, except cattle and poultry and eggs	1.7872	0.2568	10.7559	3.0646	2.3946
113A00 Forest nurseries, forest products, and timber tracts	1.7948	0.3385	12.9318	3.6204	5.1719
113300 Logging	1.8554	0.3580	11.7575	2.2452	2.5284
114100 Fishing	1.0000	0.0000	0.0000	0.0000	0.0000
114200 Hunting and trapping	1.0000	0.0000	0.0000	0.0000	0.0000
115000 Agriculture and forestry support activities	1.9120	0.6477	29.6154	1.6487	1.4591
211000 Oil and gas extraction	1.4499	0.2922	6.1091	1.7813	3.3408
212100 Coal mining	1.0000	0.0000	0.0000	0.0000	0.0000
212210 Iron ore mining	1.0000	0.0000	0.0000	0.0000	0.0000
212230 Copper, nickel, lead, and zinc mining	1.0000	0.0000	0.0000	0.0000	0.0000
2122A0 Gold, silver, and other metal ore mining	1.7037	0.4264	11.7105	1.8249	2.2960
212310 Stone mining and quarrying	1.7570	0.4529	12.1845	1.8556	2.3897
212320 Sand, gravel, clay, and refractory mining	1.7446	0.4651	12.8415	1.7801	2.1915
212390 Other nonmetallic mineral mining	1.0000	0.0000	0.0000	0.0000	0.0000
213111 Drilling oil and gas wells	1.0000	0.0000	0.0000	0.0000	0.0000
213112 Support activities for oil and gas operations	1.0000	0.0000	0.0000	0.0000	0.0000
21311A Support activities for other mining	1.0000	0.0000	0.0000	0.0000	0.0000
2211A0 Power generation and supply	1.5144	0.3284	7.7931	1.8219	3.1255
221200 Natural gas distribution	1.3449	0.2210	5.5004	1.7893	2.6698
221300 Water, sewage and other systems	1.8191	0.4713	14.3302	2.0160	2.4043
230000 Construction	2.1207	0.6451	21.6584	1.9258	2.0452
311111 Dog and cat food manufacturing	1.5306	0.2239	6.2024	2.5695	3.7585
311119 Other animal food manufacturing	1.6471	0.2481	7.1084	2.8476	3.9724
311211 Flour milling	1.7830	0.2853	8.6530	3.2743	4.1707
311212 Rice milling	1.0000	0.0000	0.0000	0.0000	0.0000
311213 Malt manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311221 Wet corn milling	1.0000	0.0000	0.0000	0.0000	0.0000
311222 Soybean processing	1.0000	0.0000	0.0000	0.0000	0.0000

(Continued)

RIMS II Multipliers (1997/2003)
Table 1.4 Total Multipliers for Output, Earnings, and Employment by Detailed Industry
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
311223 Other oilseed processing	1.0000	0.0000	0.0000	0.0000	0.0000
311225 Fats and oils refining and blending	1.0000	0.0000	0.0000	0.0000	0.0000
311230 Breakfast cereal manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311310 Sugar manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311320 Confectionery manufacturing from cacao beans	1.0000	0.0000	0.0000	0.0000	0.0000
311330 Confectionery manufacturing from purchased chocolate	1.5613	0.2554	10.9077	2.4819	1.8635
311340 Nonchocolate confectionery manufacturing	1.6120	0.2981	10.5224	2.2535	2.0724
311410 Frozen food manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311420 Fruit and vegetable canning and drying	1.0000	0.0000	0.0000	0.0000	0.0000
311511 Fluid milk manufacturing	1.7388	0.2459	8.0203	2.7911	3.4982
311512 Creamery butter manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311513 Cheese manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311514 Dry, condensed, and evaporated dairy products	1.0000	0.0000	0.0000	0.0000	0.0000
311520 Ice cream and frozen dessert manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311611 Animal, except poultry, slaughtering	1.7492	0.2347	8.6804	2.6939	2.8786
311612 Meat processed from carcasses	1.7562	0.2725	8.7225	2.8454	3.1968
311613 Rendering and meat byproduct processing	1.0000	0.0000	0.0000	0.0000	0.0000
311615 Poultry processing	2.5176	0.4004	15.4580	3.4104	3.1112
311700 Seafood product preparation and packaging	1.0000	0.0000	0.0000	0.0000	0.0000
31181A Bread and bakery product, except frozen, manufacturing	1.7102	0.4089	13.3521	1.8339	1.9234
311813 Frozen cakes and other pastries manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311821 Cookie and cracker manufacturing	1.6354	0.3047	8.6732	2.2170	2.7236
311822 Mixes and dough made from purchased flour	1.0000	0.0000	0.0000	0.0000	0.0000
311823 Dry pasta manufacturing	1.7687	0.2790	8.0321	3.0195	3.8542
311830 Tortilla manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311911 Roasted nuts and peanut butter manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311919 Other snack food manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311920 Coffee and tea manufacturing	2.0243	0.3595	12.1229	4.1258	3.5659
311930 Flavoring syrup and concentrate manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311941 Mayonnaise, dressing, and sauce manufacturing	1.6507	0.2473	7.2165	2.8383	3.5194
311942 Spice and extract manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
311990 All other food manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
312110 Soft drink and ice manufacturing	1.6237	0.2606	7.0377	2.5783	3.7487
312120 Breweries	1.0000	0.0000	0.0000	0.0000	0.0000
312130 Wineries	1.0000	0.0000	0.0000	0.0000	0.0000
312140 Distilleries	1.0000	0.0000	0.0000	0.0000	0.0000
312210 Tobacco stemming and redrying	1.0000	0.0000	0.0000	0.0000	0.0000
312221 Cigarette manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
312229 Other tobacco product manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
313100 Fiber, yarn, and thread mills	1.0000	0.0000	0.0000	0.0000	0.0000

(Continued)

RIMS II Multipliers (1997/2003)
Table 1.4 Total Multipliers for Output, Earnings, and Employment by Detailed Industry
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
313210 Broadwoven fabric mills	1.8796	0.3761	11.7619	2.3772	2.6284
313220 Narrow fabric mills and schiffli embroidery	1.8670	0.4569	16.1426	1.9908	1.8846
313230 Nonwoven fabric mills	1.8669	0.3376	9.7839	2.5622	3.0238
313240 Knit fabric mills	1.0000	0.0000	0.0000	0.0000	0.0000
313310 Textile and fabric finishing mills	1.8872	0.3514	11.4568	2.6410	2.6765
313320 Fabric coating mills	1.0000	0.0000	0.0000	0.0000	0.0000
314110 Carpet and rug mills	1.7473	0.2801	8.5996	2.7377	2.8714
314120 Curtain and linen mills	1.8120	0.3448	11.9859	2.3913	2.2549
314910 Textile bag and canvas mills	1.8418	0.4565	17.8091	1.9224	1.7363
314992 Tire cord and tire fabric mills	2.0041	0.3571	10.4524	2.8413	3.0821
31499A Other miscellaneous textile product mills	1.7909	0.4040	13.3798	2.0445	2.0885
315111 Sheer hosiery mills	1.0000	0.0000	0.0000	0.0000	0.0000
315119 Other hosiery and sock mills	1.7488	0.4148	15.2948	1.9313	1.8356
315190 Other apparel knitting mills	1.0000	0.0000	0.0000	0.0000	0.0000
315200 Cut and sew apparel manufacturing	1.7804	0.3731	13.4119	2.1594	2.0619
315900 Accessories and other apparel manufacturing	1.8742	0.4483	14.8310	2.0437	2.1349
316100 Leather and hide tanning and finishing	1.0000	0.0000	0.0000	0.0000	0.0000
316200 Footwear manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
316900 Other leather product manufacturing	1.6217	0.3773	15.1247	1.8165	1.6245
321113 Sawmills	2.3329	0.4158	13.4954	3.3910	3.7571
321114 Wood preservation	2.4306	0.4029	13.2039	4.4361	4.3675
32121A Veneer and plywood manufacturing	2.3369	0.4627	14.7427	2.9156	3.2449
32121B Engineered wood member and truss manufacturing	2.1322	0.4507	15.7621	2.4415	2.3470
321219 Reconstituted wood product manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
321911 Wood windows and door manufacturing	2.0279	0.4435	14.4530	2.3447	2.4704
321912 Cut stock, resawing lumber, and planing	2.3091	0.4367	16.6640	3.0396	2.4164
321918 Other millwork, including flooring	2.2767	0.4780	15.6782	2.6371	2.7447
321920 Wood container and pallet manufacturing	2.2664	0.4954	19.8696	2.4447	2.0026
321991 Manufactured home, mobile home, manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
321992 Prefabricated wood building manufacturing	2.1157	0.4546	16.0290	2.4952	2.3673
321999 Miscellaneous wood product manufacturing	2.1322	0.4997	19.2831	2.2468	1.9654
322110 Pulp mills	1.0000	0.0000	0.0000	0.0000	0.0000
3221A0 Paper and paperboard mills	1.8438	0.3190	8.3683	2.8582	5.1111
322210 Paperboard container manufacturing	2.1455	0.3983	10.3771	2.7372	3.9096
32222A Coated and laminated paper and packaging materials	1.9523	0.3321	8.9500	3.0618	4.4288
32222B Coated and uncoated paper bag manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
322225 Flexible packaging foil manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
322226 Surface-coated paperboard manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
322231 Die-cut paper office supplies manufacturing	2.1525	0.4021	12.4858	2.9788	2.9002
322232 Envelope manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000

(Continued)

RIMS II Multipliers (1997/2003)
Table 1.4 Total Multipliers for Output, Earnings, and Employment by Detailed Industry
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
322233 Stationery and related product manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
322291 Sanitary paper product manufacturing	1.7633	0.2648	7.0006	3.1768	5.2694
322299 All other converted paper product manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
32311A Commercial printing	2.0297	0.5111	15.7058	2.0087	2.1779
323116 Manifold business forms printing	1.9913	0.4048	11.4445	2.3616	2.8919
323117 Books printing	1.0000	0.0000	0.0000	0.0000	0.0000
323118 Blankbook and looseleaf binder manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
323121 Tradebinding and related work	1.9178	0.6148	22.8052	1.6833	1.6314
323122 Prepress services	1.8632	0.6246	16.1789	1.6315	2.1341
324110 Petroleum refineries	1.0000	0.0000	0.0000	0.0000	0.0000
324121 Asphalt paving mixture and block manufacturing	1.8292	0.3525	8.4224	2.9060	7.2564
324122 Asphalt shingle and coating materials manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
324191 Petroleum lubricating oil and grease manufacturing	1.6718	0.3655	8.4206	2.0998	3.9542
324199 All other petroleum and coal products manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325110 Petrochemical manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325120 Industrial gas manufacturing	1.6518	0.3011	7.4743	2.5353	4.1498
325130 Synthetic dye and pigment manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325180 Other basic inorganic chemical manufacturing	1.7365	0.3368	8.2168	2.5341	4.6311
325190 Other basic organic chemical manufacturing	1.6526	0.2791	7.0591	2.8656	5.5076
325211 Plastics material and resin manufacturing	1.5790	0.2465	6.2812	2.7191	4.7982
325212 Synthetic rubber manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325221 Cellulosic organic fiber manufacturing	1.7608	0.3776	9.4653	2.2227	3.4511
325222 Noncellulosic organic fiber manufacturing	1.7052	0.3242	8.3283	2.5123	3.9410
325311 Nitrogenous fertilizer manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325312 Phosphatic fertilizer manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325314 Fertilizer, mixing only, manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325320 Pesticide and other agricultural chemical manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325400 Pharmaceutical and medicine manufacturing	1.5734	0.2824	7.4495	2.3374	3.4027
325510 Paint and coating manufacturing	1.6661	0.2942	7.8314	2.4388	3.4106
325520 Adhesive manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325611 Soap and other detergent manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325612 Polish and other sanitation good manufacturing	1.6163	0.2681	7.2536	2.6445	3.7336
325613 Surface active agent manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325620 Toilet preparation manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325910 Printing ink manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325920 Explosives manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
325991 Custom compounding of purchased resins	1.0000	0.0000	0.0000	0.0000	0.0000
325992 Photographic film and chemical manufacturing	1.7148	0.3399	8.3250	2.2095	3.7375
325998 Other miscellaneous chemical product manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
326110 Plastics packaging materials, film and sheet	1.8774	0.3424	9.2329	2.5087	3.4095

(Continued)

RIMS II Multipliers (1997/2003)
Table 1.4 Total Multipliers for Output, Earnings, and Employment by Detailed Industry
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
326120 Plastics pipe, fittings, and profile shapes	1.9029	0.3545	10.7373	2.5228	2.7005
326130 Laminated plastics plate, sheet, and shapes	1.9804	0.4025	11.1905	2.4769	3.0946
3261A0 Foam product manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
326160 Plastics bottle manufacturing	1.9241	0.3508	9.9380	2.5346	3.1430
326192 Resilient floor covering manufacturing	1.6183	0.2895	6.7110	2.2073	4.4884
32619A Plastics plumbing fixtures and all other plastics products	1.8555	0.4096	12.4605	2.0730	2.2659
326210 Tire manufacturing	1.8095	0.3740	9.7496	2.1777	3.1626
326220 Rubber and plastics hose and belting manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
326290 Other rubber product manufacturing	1.7796	0.3963	11.9949	2.0565	2.3023
327111 Vitreous china plumbing fixture manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
327112 Vitreous china and earthenware articles manufacturing	1.9303	0.5677	19.4043	1.8214	1.8198
327113 Porcelain electrical supply manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
327121 Brick and structural clay tile manufacturing	1.8940	0.5092	14.3709	1.9160	2.3694
327122 Ceramic wall and floor tile manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
32712A Clay refractory and other structural clay products	1.0000	0.0000	0.0000	0.0000	0.0000
327125 Nonclay refractory manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
327213 Glass container manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
32721A Glass and glass products, except glass containers	1.8117	0.4133	11.1472	2.0781	2.7402
327310 Cement manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
327320 Ready-mix concrete manufacturing	1.8880	0.4190	11.3935	2.3528	2.9946
327331 Concrete block and brick manufacturing	1.9161	0.4791	14.0417	2.1119	2.5354
327332 Concrete pipe manufacturing	1.8173	0.4504	12.7574	1.9765	2.4682
327390 Other concrete product manufacturing	1.8935	0.5037	14.3850	1.9291	2.3293
327410 Lime manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
327420 Gypsum product manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
327910 Abrasive product manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
327991 Cut stone and stone product manufacturing	2.0348	0.5720	19.3360	1.9842	1.9934
327992 Ground or treated minerals and earths manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
327993 Mineral wool manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
327999 Miscellaneous nonmetallic mineral products	1.7461	0.3893	10.5049	2.0557	2.7615
331111 Iron and steel mills	1.7923	0.3318	8.5222	2.6705	4.5171
331112 Ferroalloy and related product manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
331210 Iron, steel pipe and tube from purchased steel	1.0000	0.0000	0.0000	0.0000	0.0000
331221 Rolled steel shape manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
331222 Steel wire drawing	1.0000	0.0000	0.0000	0.0000	0.0000
331311 Alumina refining	1.0000	0.0000	0.0000	0.0000	0.0000
331312 Primary aluminum production	1.0000	0.0000	0.0000	0.0000	0.0000
331314 Secondary smelting and alloying of aluminum	1.7397	0.2932	9.7881	3.3339	3.0735
331315 Aluminum sheet, plate, and foil manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
331316 Aluminum extruded product manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000

(Continued)

RIMS II Multipliers (1997/2003)
Table 1.4 Total Multipliers for Output, Earnings, and Employment by Detailed Industry
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
331319 Other aluminum rolling and drawing	1.0000	0.0000	0.0000	0.0000	0.0000
331411 Primary smelting and refining of copper	1.3700	0.1800	5.1445	2.0466	2.5665
331419 Primary nonferrous metal, except copper and aluminum	1.0000	0.0000	0.0000	0.0000	0.0000
331421 Copper rolling, drawing, and extruding	1.0000	0.0000	0.0000	0.0000	0.0000
331422 Copper wire, except mechanical, drawing	1.0000	0.0000	0.0000	0.0000	0.0000
331423 Secondary processing of copper	1.0000	0.0000	0.0000	0.0000	0.0000
331491 Nonferrous metal, except copper and aluminum, shaping	1.0000	0.0000	0.0000	0.0000	0.0000
331492 Secondary processing of other nonferrous	1.0000	0.0000	0.0000	0.0000	0.0000
331510 Ferrous metal foundries	1.7967	0.4798	12.2155	1.8598	2.6009
33152A Aluminum foundries	1.7266	0.4412	12.7070	1.3445	2.2079
33152B Nonferrous foundries, except aluminum	1.0000	0.0000	0.0000	0.0000	0.0000
332111 Iron and steel forging	1.8058	0.3956	10.4160	2.0498	2.7277
332112 Nonferrous forging	1.5242	0.3214	8.4882	1.7697	2.3179
332114 Custom roll forming	1.0000	0.0000	0.0000	0.0000	0.0000
33211A All other forging and stamping	1.8981	0.4627	13.7986	1.9850	2.2171
332211 Cutlery and flatware, except precious, manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
332212 Hand and edge tool manufacturing	1.8370	0.4657	14.1450	1.9179	2.1101
332213 Saw blade and handsaw manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
332214 Kitchen utensil, pot, and pan manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
332311 Prefabricated metal buildings and components	2.0863	0.4414	12.1687	2.4766	3.1345
332312 Fabricated structural metal manufacturing	1.8582	0.3899	11.1221	2.1892	2.6158
332313 Plate work manufacturing	1.8782	0.4859	12.7932	1.8567	2.4265
332321 Metal window and door manufacturing	1.7383	0.3739	12.6161	2.0493	2.0092
332322 Sheet metal work manufacturing	1.8517	0.4585	14.1317	1.9121	2.0682
332323 Ornamental and architectural metal work manufacturing	1.8813	0.4505	14.2568	1.9780	2.0644
332410 Power boiler and heat exchanger manufacturing	1.7695	0.4322	13.5145	1.8699	2.0015
332420 Metal tank, heavy gauge, manufacturing	1.9111	0.4543	13.1278	2.0343	2.3652
332430 Metal can, box, and other container manufacturing	1.6761	0.2752	7.5722	2.5726	3.4511
33299A Ammunition manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
332994 Small arms manufacturing	1.7749	0.4338	12.0400	1.9578	2.3969
332995 Other ordnance and accessories manufacturing	1.6590	0.4664	17.0741	1.6397	1.5940
332500 Hardware manufacturing	1.7266	0.3887	11.6400	1.9498	2.1845
332600 Spring and wire product manufacturing	1.6841	0.3968	11.6857	1.8282	2.0996
332710 Machine shops	1.8785	0.5746	17.5249	1.7505	1.9384
332720 Turned product and screw, nut, and bolt manufacturing	1.7877	0.4745	14.3108	1.8093	2.0355
332811 Metal heat treating	1.7491	0.4142	12.6650	1.9499	2.1683
332812 Metal coating and nonprecious engraving	1.8483	0.3858	12.3294	2.1616	2.1999
332813 Electroplating, anodizing, and coloring metal	1.8736	0.5616	16.5008	1.7379	2.0137
332910 Metal valve manufacturing	1.6521	0.3625	11.1694	1.9246	2.0917
332991 Ball and roller bearing manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000

(Continued)

RIMS II Multipliers (1997/2003)
Table 1.4 Total Multipliers for Output, Earnings, and Employment by Detailed Industry
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
332996 Fabricated pipe and pipe fitting manufacturing	1.8518	0.4132	11.9278	2.0759	2.4111
332997 Industrial pattern manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
332998 Enameled iron and metal sanitary ware manufacturing	1.6477	0.3273	10.4557	2.0252	2.0850
332999 Miscellaneous fabricated metal product manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333111 Farm machinery and equipment manufacturing	1.7805	0.3445	9.8210	2.4092	2.8687
333112 Lawn and garden equipment manufacturing	1.8280	0.3022	9.4067	3.0251	2.9499
333120 Construction machinery manufacturing	1.8276	0.3493	9.6652	2.5439	3.2402
333131 Mining machinery and equipment manufacturing	1.7639	0.3762	10.4568	2.1382	2.6430
333132 Oil and gas field machinery and equipment	1.0000	0.0000	0.0000	0.0000	0.0000
333210 Sawmill and woodworking machinery	1.0000	0.0000	0.0000	0.0000	0.0000
333220 Plastics and rubber industry machinery	1.0000	0.0000	0.0000	0.0000	0.0000
333291 Paper industry machinery manufacturing	1.7802	0.4345	12.0075	1.9522	2.4105
333292 Textile machinery manufacturing	1.7833	0.4663	13.5318	1.8691	2.1706
333293 Printing machinery and equipment manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333294 Food product machinery manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333295 Semiconductor machinery manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333298 All other industrial machinery manufacturing	1.7820	0.4473	11.8974	1.9187	2.5176
33331A Automatic vending, commercial laundry and drycleaning machinery	1.7745	0.3786	11.2907	2.1378	2.3724
333313 Office machinery manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333314 Optical instrument and lens manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333315 Photographic and photocopying equipment manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333319 Other commercial and service industry machinery manufacturing	1.8157	0.4282	12.4731	2.0503	2.3782
333411 Air purification equipment manufacturing	1.7873	0.4217	14.0532	1.9892	1.9739
333412 Industrial and commercial fan and blower manufacturing	1.7885	0.4291	11.6843	1.9468	2.4491
333414 Heating equipment, except warm air furnaces	1.7241	0.3863	11.7221	1.9689	2.1702
333415 AC, refrigeration, and forced air heating	1.8089	0.3749	11.2427	2.3754	2.6662
333511 Industrial mold manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333512 Metal cutting machine tool manufacturing	1.8735	0.4796	13.0697	2.0284	2.5829
333513 Metal forming machine tool manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333514 Special tool, die, jig, and fixture manufacturing	1.9441	0.6339	17.1958	1.7129	2.1275
333515 Cutting tool and machine tool accessory manufacturing	1.8815	0.5411	15.4073	1.8200	2.1600
33351A Rolling mill and other metalworking machinery	1.0000	0.0000	0.0000	0.0000	0.0000
333611 Turbine and turbine generator set units manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
33361A Speed changers and mechanical power transmission equipment	1.0000	0.0000	0.0000	0.0000	0.0000
333618 Other engine equipment manufacturing	1.7059	0.3049	8.1367	2.4963	3.4100
333911 Pump and pumping equipment manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333912 Air and gas compressor manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333913 Measuring and dispensing pump manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333921 Elevator and moving stairway manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333922 Conveyor and conveying equipment manufacturing	1.8310	0.4636	12.6735	1.9172	2.3921

(Continued)

RIMS II Multipliers (1997/2003)
Table 1.4 Total Multipliers for Output, Earnings, and Employment by Detailed Industry
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
333923 Overhead cranes, hoists, and monorail systems	1.7834	0.3785	11.3823	2.1809	2.4035
333924 Industrial truck, trailer, and stacker manufacturing	1.8876	0.3946	10.9427	2.4374	3.0531
333991 Power-driven handtool manufacturing	1.6394	0.3198	9.0856	2.1826	2.7376
333992 Welding and soldering equipment manufacturing	1.7206	0.3888	10.4768	1.9622	2.5110
333993 Packaging machinery manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333994 Industrial process furnace and oven manufacturing	1.7824	0.4360	13.2213	1.9547	2.1574
333995 Fluid power cylinder and actuator manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
333996 Fluid power pump and motor manufacturing	1.7578	0.4338	11.9759	1.9592	2.4280
33399A Scales, balances, and miscellaneous general purpose machinery	1.7468	0.4412	12.2351	1.8691	2.2952
334111 Electronic computer manufacturing	1.6870	0.2778	7.3629	2.9414	4.5188
334112 Computer storage device manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
334113 Computer terminal manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
334119 Other computer peripheral equipment manufacturing	1.8623	0.4256	11.8929	2.2722	2.7800
334210 Telephone apparatus manufacturing	1.5812	0.3013	8.5721	2.1268	2.5548
334220 Broadcast and wireless communications equipment	1.6719	0.3702	9.4794	1.9802	2.7469
334290 Other communications equipment manufacturing	1.7971	0.4495	12.6735	1.9961	2.4217
334300 Audio and video equipment manufacturing	1.6627	0.2975	8.7080	2.5173	2.9864
334411 Electron tube manufacturing	1.8759	0.4311	10.9758	2.2182	3.2657
334413 Semiconductors and related device manufacturing	1.5057	0.2775	7.5329	2.1092	2.7762
33441A All other electronic component manufacturing	1.7649	0.4175	11.7452	2.0156	2.4507
334510 Electromedical apparatus manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
334511 Search, detection, and navigation instruments	1.0000	0.0000	0.0000	0.0000	0.0000
334512 Automatic environmental control manufacturing	1.7527	0.4466	11.7933	1.8868	2.4908
334513 Industrial process variable instruments	1.8418	0.5022	14.9658	1.8999	2.2662
334514 Totalizing fluid meters and counting devices	1.0000	0.0000	0.0000	0.0000	0.0000
334515 Electricity and signal testing instruments	1.6313	0.3992	11.6858	1.7987	2.0857
334516 Analytical laboratory instrument manufacturing	1.9272	0.5296	15.5857	1.9933	2.6194
334517 Irradiation apparatus manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
33451A Watch, clock, and other measuring and controlling device manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
334611 Software reproducing	1.5855	0.4050	9.4476	1.6037	2.3194
334612 Audio and video media reproduction	1.0000	0.0000	0.0000	0.0000	0.0000
334613 Magnetic and optical recording media manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
335110 Electric lamp bulb and part manufacturing	1.8460	0.3910	12.1888	2.2696	2.3723
335120 Lighting fixture manufacturing	1.7946	0.3873	10.6855	2.2476	2.9311
335211 Electric housewares and household fan manufacturing	1.7438	0.3228	8.8303	2.5262	3.4157
335212 Household vacuum cleaner manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
335221 Household cooking appliance manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
335222 Household refrigerator and home freezer manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
335224 Household laundry equipment manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
335228 Other major household appliance manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000

(Continued)

RIMS II Multipliers (1997/2003)
Table 1.4 Total Multipliers for Output, Earnings, and Employment by Detailed Industry
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
335311 Electric power and specialty transformer manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
335312 Motor and generator manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
335313 Switchgear and switchboard apparatus manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
335314 Relay and industrial control manufacturing	1.9698	0.4728	12.8340	2.2374	2.8820
335911 Storage battery manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
335912 Primary battery manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
335921 Fiber optic cable manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
335929 Other communication and energy wire manufacturing	1.7569	0.3056	7.8081	2.5464	4.1117
335930 Wiring device manufacturing	1.7491	0.3968	10.7773	2.0358	2.6097
335991 Carbon and graphite product manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
335999 Miscellaneous electrical equipment manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
336110 Automobile and light truck manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
336120 Heavy duty truck manufacturing	2.0002	0.3101	7.4670	3.7724	9.3774
336211 Motor vehicle body manufacturing	1.8244	0.3408	9.7083	2.6749	3.3279
336212 Truck trailer manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
336213 Motor home manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
336214 Travel trailer and camper manufacturing	1.8225	0.3713	9.3945	2.2859	3.4705
336300 Motor vehicle parts manufacturing	1.8328	0.3755	9.3583	2.3559	3.7671
336411 Aircraft manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
336412 Aircraft engine and engine parts manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
336413 Other aircraft parts and equipment	1.0000	0.0000	0.0000	0.0000	0.0000
336414 Guided missile and space vehicle manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
33641A Propulsion units and parts for space vehicles and guided missiles	1.0000	0.0000	0.0000	0.0000	0.0000
336500 Railroad rolling stock manufacturing	1.9144	0.3689	9.5921	2.6394	3.8119
336611 Ship building and repairing	1.0000	0.0000	0.0000	0.0000	0.0000
336612 Boat building	1.8795	0.3777	10.5935	2.2761	2.8173
336991 Motorcycle, bicycle, and parts manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
336992 Military armored vehicles and tank parts manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
336999 All other transportation equipment manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
337110 Wood kitchen cabinet and countertop manufacturing	1.9748	0.4924	17.8613	1.9898	1.8995
337121 Upholstered household furniture manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
337122 Nonupholstered wood household furniture manufacturing	1.9777	0.4882	19.4656	2.0280	1.7612
337124 Metal household furniture manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
337127 Institutional furniture manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
33712A Other household and institutional furniture	1.0000	0.0000	0.0000	0.0000	0.0000
337211 Wood office furniture manufacturing	1.9251	0.4855	15.5186	1.9779	2.1134
337212 Custom architectural woodwork and millwork	1.8833	0.5561	20.0503	1.7096	1.6822
337214 Office furniture, except wood, manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
337215 Showcases, partitions, shelving, and lockers	1.9037	0.4896	14.9880	1.8816	2.0772
337910 Mattress manufacturing	1.7765	0.3540	11.9774	2.3139	2.2702

(Continued)

RIMS II Multipliers (1997/2003)
Table 1.4 Total Multipliers for Output, Earnings, and Employment by Detailed Industry
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
337920 Blind and shade manufacturing	1.7912	0.3908	14.2446	2.0813	1.9113
339111 Laboratory apparatus and furniture manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
339112 Surgical and medical instrument manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
339113 Surgical appliance and supplies manufacturing	1.6770	0.3884	10.9769	1.9272	2.3329
339114 Dental equipment and supplies manufacturing	1.7391	0.4447	10.8152	1.8767	2.7999
339115 Ophthalmic goods manufacturing	1.7396	0.4411	15.9654	1.8890	1.7977
339116 Dental laboratories	1.7827	0.5580	16.3949	1.6588	1.9104
339910 Jewelry and silverware manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
339920 Sporting and athletic goods manufacturing	2.0183	0.4440	13.1794	2.5090	2.9922
339930 Doll, toy, and game manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
339940 Office supplies, except paper, manufacturing	1.7714	0.3808	10.4702	2.0960	2.6817
339950 Sign manufacturing	1.9198	0.5364	16.0668	1.8221	2.0665
339991 Gasket, packing, and sealing device manufacturing	1.7334	0.4449	11.8122	1.7822	2.3188
339992 Musical instrument manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
339994 Broom, brush, and mop manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
339995 Burial casket manufacturing	1.0000	0.0000	0.0000	0.0000	0.0000
339999A Buttons, pins, and all other miscellaneous manufacturing	1.6760	0.4459	13.4265	2.0136	2.2865
420000 Wholesale trade	1.8265	0.5402	15.6649	1.7799	2.2470
4A0000 Retail trade	1.9182	0.5775	24.9904	1.8060	1.5955
481000 Air transportation	1.8416	0.4657	16.8266	2.0483	2.4170
482000 Rail transportation	1.8371	0.4765	11.9643	1.9065	2.9084
483000 Water transportation	1.8714	0.3959	13.4419	2.7558	2.7299
484000 Truck transportation	2.0227	0.5261	17.5419	2.1470	2.2559
485A00 Transit and ground passenger transportation	2.0647	0.6947	41.3150	1.7611	1.3400
486000 Pipeline transportation	1.9634	0.5209	13.9537	2.2238	3.9149
48A000 Scenic and sightseeing transportation and support activities for transportation	2.0993	0.6815	19.8469	1.8990	2.2961
492000 Couriers and messengers	1.8530	0.6026	23.8501	1.6605	1.6054
493000 Warehousing and storage	1.9846	0.7130	25.5130	1.5910	1.6390
511110 Newspaper publishers	1.9464	0.6143	20.2949	1.7246	1.7914
511120 Periodical publishers	1.8577	0.4797	14.5105	1.9367	2.1773
511130 Book publishers	1.6622	0.3832	11.4930	1.9282	2.2262
5111A0 Database, directory, and other publishers	1.7182	0.4001	10.5333	1.9477	2.6450
511200 Software publishers	1.8156	0.5858	14.9539	1.6749	2.5362
512100 Motion picture and video industries	1.7837	0.4691	26.3658	1.8582	1.4671
512200 Sound recording industries	1.5852	0.3045	10.7935	2.1729	2.1970
513100 Radio and television broadcasting	2.0635	0.5836	14.8394	2.0334	3.1879
513200 Cable networks and program distribution	1.9212	0.4516	12.8599	2.1436	2.7815
513300 Telecommunications	1.8048	0.4250	12.0829	2.0742	2.6470
514100 Information services	2.0896	0.8305	31.9938	1.5938	1.5839
514200 Data processing services	1.9739	0.7242	18.2542	1.6382	2.4278

(Continued)

Region Definition: Fairfield, SC; Lexington, SC; Newberry, SC; Richland, SC

RIMS II Multipliers (1997/2003)
Table 1.4 Total Multipliers for Output, Earnings, and Employment by Detailed Industry
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
52A000 Monetary authorities and depository credit intermediation	1.6438	0.3976	12.1159	1.8710	2.2824
522A00 Nondepository credit intermediation and related activities	1.7163	0.4232	12.6430	1.9804	2.5664
523000 Securities, commodity contracts, investments	2.0824	0.7889	25.0059	1.6909	1.8681
524100 Insurance carriers	2.2684	0.5895	17.6750	2.5498	2.9819
524200 Insurance agencies, brokerages, and related	1.7425	0.5181	15.9505	1.6933	1.9119
525000 Funds, trusts, and other financial vehicles	1.8900	0.4132	13.4000	3.6347	3.6563
531000 Real estate	1.5843	0.2576	10.8233	2.6132	2.2654
S00800 Owner-occupied dwellings	1.2727	0.0723	2.4682	0.0000	0.0000
532100 Automotive equipment rental and leasing	1.6035	0.3153	12.0233	2.1662	2.0993
532A00 General and consumer goods rental except video tapes and discs	1.7438	0.4902	17.3149	1.7613	1.8692
532230 Video tape and disc rental	1.6512	0.3666	22.3146	1.8221	1.3780
532400 Machinery and equipment rental and leasing	1.5908	0.3417	10.0925	1.9539	2.6175
533000 Lessors of nonfinancial intangible assets	1.0000	0.0000	0.0000	0.0000	0.0000
541100 Legal services	2.0455	0.8207	20.2101	1.5766	2.2447
541200 Accounting and bookkeeping services	2.0096	0.8108	30.9555	1.5483	1.5482
541300 Architectural and engineering services	1.9074	0.6811	20.3902	1.6491	2.0163
541400 Specialized design services	1.9094	0.6535	32.2291	1.6804	1.4573
541511 Custom computer programming services	1.9779	0.8074	19.6529	1.5488	2.3447
541512 Computer systems design services	2.0467	0.8294	21.5181	1.5910	2.2801
54151A Other computer related services, including facilities management	1.8360	0.5124	16.0297	1.9058	2.3667
541610 Management consulting services	2.0257	0.8010	28.5161	1.5811	1.6902
5416A0 Environmental and other technical consulting services	1.8614	0.6602	25.6961	1.6155	1.6167
541700 Scientific research and development services	2.0597	0.7809	21.7777	1.6261	2.0724
541800 Advertising and related services	1.7762	0.5173	17.8783	1.7521	1.9056
541920 Photographic services	1.8502	0.5906	18.3900	1.6782	1.9796
541940 Veterinary services	2.0581	0.6829	18.8926	1.7739	2.3799
5419A0 All other miscellaneous professional and technical services	1.5176	0.3159	7.7915	1.9285	3.8450
550000 Management of companies and enterprises	2.0483	0.7674	20.3504	1.6212	2.0448
561300 Employment services	1.7711	0.7403	41.6398	1.4244	1.2555
561500 Travel arrangement and reservation services	2.1206	0.6945	28.8033	1.8964	1.6739
561100 Office administrative services	1.9267	0.7165	21.5015	1.6215	2.0015
561200 Facilities support services	1.8286	0.6857	21.6754	1.5427	1.7702
561400 Business support services	1.8181	0.5703	26.3525	1.7087	1.5188
561600 Investigation and security services	1.9081	0.7806	35.9844	1.5020	1.3849
561700 Services to buildings and dwellings	1.9967	0.6389	35.1283	1.8062	1.4596
561900 Other support services	1.7762	0.5038	24.3352	1.7701	1.5087
562000 Waste management and remediation services	2.0835	0.5865	16.4713	2.0765	2.7465
611100 Elementary and secondary schools	2.2179	0.7840	41.9376	1.6935	1.4098
611A00 Colleges, universities, and junior colleges	2.1588	0.7709	34.5483	1.6462	1.5143
611B00 Other educational services	1.8772	0.5393	29.7652	1.8695	1.4793

(Continued)

Region Definition: Fairfield, SC; Lexington, SC; Newberry, SC; Richland, SC

RIMS II Multipliers (1997/2003)
Table 1.4 Total Multipliers for Output, Earnings, and Employment by Detailed Industry
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
621A00 Offices of physicians, dentists, and other health practitioners	1.9966	0.8069	20.1541	1.5498	2.1623
621600 Home health care services	1.9912	0.8129	37.3903	1.5457	1.4220
621B00 Other ambulatory health care services	2.1024	0.7345	22.6640	1.7890	2.1291
622000 Hospitals	2.0565	0.7282	23.2799	1.6932	1.9423
623000 Nursing and residential care facilities	2.1040	0.8071	37.4867	1.6190	1.4960
624400 Child day care services	1.9172	0.5906	44.0974	1.7165	1.2700
624A00 Social assistance, except child day care services	2.1193	0.7358	40.6383	1.7115	1.3907
711100 Performing arts companies	1.8952	0.6636	49.5642	1.6211	1.2526
711200 Spectator sports	1.9655	0.8098	46.4706	1.5137	1.3037
711A00 Promoters of performing arts and sports and agents for public figures	1.7957	0.5786	42.3936	1.6583	1.2871
711500 Independent artists, writers, and performers	1.9821	0.6374	30.5106	1.7996	1.6978
712000 Museums, historical sites, zoos, and parks	2.2197	0.6984	23.8904	1.9229	2.2421
713940 Fitness and recreational sports centers	2.0729	0.6575	39.6772	1.7592	1.3563
713950 Bowling centers	1.9265	0.6042	34.8254	1.7146	1.3572
713A00 Other amusement, gambling, and recreation industries	1.8842	0.6097	28.0663	1.6630	1.4689
7211A0 Hotels and motels, including casino hotels	1.8089	0.5719	25.9173	1.6475	1.4682
721A00 Other accommodations	1.7772	0.4361	18.2128	1.9555	1.7390
722000 Food services and drinking places	2.0017	0.6430	41.8385	1.6753	1.2965
8111A0 Automotive repair and maintenance, except car washes	1.9462	0.5249	22.0243	1.9137	1.6762
811192 Car washes	1.7436	0.5054	37.1981	1.7025	1.2625
811200 Electronic equipment repair and maintenance	1.8471	0.6288	23.6367	1.5986	1.5888
811300 Commercial machinery repair and maintenance	1.7486	0.5550	21.1094	1.5981	1.5766
811400 Household goods repair and maintenance	1.6510	0.4343	21.6928	1.7257	1.4632
812100 Personal care services	1.8861	0.6029	32.9484	1.6836	1.4006
812200 Death care services	1.8197	0.5350	21.8177	1.7501	1.6294
812300 Drycleaning and laundry services	1.8966	0.6135	31.5434	1.6724	1.4117
812900 Other personal services	1.7144	0.3271	15.9801	2.3457	1.7294
813100 Religious organizations	2.0152	0.7841	36.2603	1.5123	1.3899
813A00 Grantmaking and giving and social advocacy organizations	2.1725	0.6759	28.0253	2.0247	1.8832
813B00 Civic, social, professional and similar organizations	2.2232	0.7063	29.1152	1.8995	1.7230
491000 Postal service	1.8606	0.7414	19.3334	1.4739	1.8943
S00A00 Other government enterprises	1.8977	0.4800	15.2655	2.1020	2.3206
H00000 Households	1.2691	0.3557	13.8314	0.0000	0.0000

Region Definition: Fairfield, SC; Lexington, SC; Newberry, SC; Richland, SC

RIMS II Multipliers (1997/2003)
Table 2.4 Total Multipliers for Output, Earnings, and Employment by Industry Aggregation
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
1. Crop and animal production	1.7187	0.2617	11.9772	2.5859	1.9025
2. Forestry, fishing, and related activities	1.8683	0.3857	15.0079	2.1373	2.0491
3. Oil and gas extraction	1.4537	0.2934	6.1724	1.7889	3.3754
4. Mining, except oil and gas	1.7547	0.4546	12.2926	1.8335	2.3259
5. Support activities for mining	1.0000	0.0000	0.0000	0.0000	0.0000
6. Utilities*	1.5136	0.3259	7.8259	1.8222	3.0591
7. Construction	2.1278	0.6466	21.6326	1.9302	2.0427
8. Wood product manufacturing	2.3345	0.4560	15.7928	3.1263	3.4040
9. Nonmetallic mineral product manufacturing	1.8712	0.4513	12.6096	2.0927	2.6674
10. Primary metal manufacturing	1.7956	0.3409	9.2504	2.6074	3.7958
11. Fabricated metal product manufacturing	1.8555	0.4279	12.4897	2.0521	2.3815
12. Machinery manufacturing	1.7444	0.3761	10.5677	2.1010	2.5966
13. Computer and electronic product manufacturing	1.7069	0.3384	9.4088	2.2910	2.9191
14. Electrical equipment and appliance manufacturing	1.8121	0.3462	9.5850	2.4716	3.1736
15. Motor vehicle, body, trailer, and parts manufacturing	1.8753	0.3629	8.9056	2.5217	4.3407
16. Other transportation equipment manufacturing	1.9103	0.3729	10.0642	2.5339	3.4333
17. Furniture and related product manufacturing	1.9510	0.4885	17.2967	1.9884	1.9301
18. Miscellaneous manufacturing	1.9046	0.4773	13.6412	2.0029	2.4194
19. Food, beverage, and tobacco product manufacturing	2.1335	0.3539	12.4435	3.1521	3.4685
20. Textile and textile product mills	1.8960	0.3823	12.2476	2.3586	2.4410
21. Apparel, leather, and allied product manufacturing	1.7652	0.4033	14.4369	2.0039	1.9385
22. Paper manufacturing	1.9236	0.3404	9.1855	2.9174	4.8052
23. Printing and related support activities	2.0338	0.4959	14.4913	2.0604	2.3736
24. Petroleum and coal products manufacturing	1.7805	0.3572	8.4566	2.5761	5.7205
25. Chemical manufacturing	1.7152	0.3267	8.3360	2.5461	4.1660
26. Plastics and rubber products manufacturing	1.8315	0.3773	10.4071	2.2502	2.9658
27. Wholesale trade	1.8280	0.5386	15.4684	1.7747	2.2188
28. Retail trade	1.9153	0.5730	24.6948	1.7916	1.5766
29. Air transportation	1.8310	0.4847	17.0503	2.0439	2.4491
30. Rail transportation	1.8352	0.4767	12.0433	1.9073	2.9276
31. Water transportation	1.8655	0.3976	13.6084	2.7677	2.7637
32. Truck transportation	2.0265	0.5271	17.5391	2.1511	2.2556
33. Transit and ground passenger transportation*	2.0723	0.6944	41.1936	1.7606	1.3361
34. Pipeline transportation	1.9783	0.5270	13.8201	2.2501	3.8774
35. Other transportation and support activities*	1.8827	0.6817	20.3998	1.5637	1.8300
36. Warehousing and storage	1.9787	0.7058	25.1811	1.5749	1.6177
37. Publishing including software	1.8477	0.5156	15.6162	1.8205	2.0372
38. Motion picture and sound recording industries	1.7589	0.4468	24.4581	1.8662	1.4769
39. Broadcasting and telecommunications	1.8720	0.4584	12.6832	2.0838	2.7251
40. Information and data processing services	2.0088	0.7509	23.4748	1.6211	1.8676

(Continued)

Region Definition: Fairfield, SC; Lexington, SC; Newberry, SC; Richland, SC

RIMS II Multipliers (1997/2003)
Table 2.4 Total Multipliers for Output, Earnings, and Employment by Industry Aggregation
COLUMBIA, SC REGION 2

INDUSTRY	Multiplier				
	Final Demand			Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Earnings/4/ (dollars)	Employment/5/ (jobs)
41. Federal Reserve banks, credit intermediation and related services	1.6670	0.4036	12.0402	1.8955	2.3468
42. Securities, commodity contracts, investments	2.0811	0.7843	24.8076	1.6810	1.8532
43. Insurance carriers and related activities	2.3659	0.6005	17.9789	2.4659	2.8171
44. Funds, trusts, and other financial vehicles	1.8991	0.4113	13.2831	3.6180	3.6244
45. Real estate	1.4023	0.1489	5.9037	3.4518	2.8250
46. Rental and leasing services and lessors of intangible assets	1.6256	0.3501	12.8106	1.9834	2.0143
47. Professional, scientific, and technical services	1.9583	0.7214	20.8421	1.6073	1.9679
48. Management of companies and enterprises	2.0475	0.7628	20.2311	1.6115	2.0328
49. Administrative and support services	1.8893	0.6828	34.2226	1.5797	1.3877
50. Waste management and remediation services	2.0967	0.5894	16.6981	2.0867	2.7843
51. Educational services	2.0552	0.6791	32.7707	1.6907	1.4766
52. Ambulatory health care services	2.0186	0.7892	21.0428	1.5808	2.0696
53. Hospitals and nursing and residential care facilities	2.0620	0.7336	27.0932	1.6627	1.7003
54. Social assistance	2.0272	0.6651	41.9413	1.7004	1.3223
55. Performing arts, museums, and related activities	1.9762	0.6528	38.2826	1.7213	1.3928
56. Amusements, gambling, and recreation	1.9319	0.6164	30.5862	1.6780	1.4224
57. Accommodation	1.8082	0.5512	24.7710	1.6734	1.4876
58. Food services and drinking places	2.0134	0.6408	41.7117	1.6696	1.2926
59. Other services*	1.9220	0.5699	24.7743	1.7704	1.5684
60. Households	1.2816	0.3577	13.9321	0.0000	0.0000

Region Definition: Fairfield, SC; Lexington, SC; Newberry, SC; Richland, SC

Footnotes for Tables 1.4 and 2.4

*Includes Government enterprises.

1. Each entry in column 1 represents the total dollar change in output that occurs in all industries for each additional dollar of output delivered to final demand by the industry corresponding to the entry.

2. Each entry in column 2 represents the total dollar change in earnings of households employed by all industries for each additional dollar of output delivered to final demand by the industry corresponding to the entry.

3. Each entry in column 3 represents the total change in number of jobs that occurs in all industries for each additional 1 million dollars of output delivered to final demand by the industry corresponding to the entry. Because the employment multipliers are based on 2003 data, the output delivered to final demand should be in 2003 dollars.

4. Each entry in column 4 represents the total dollar change in earnings of households employed by all industries for each additional dollar of earnings paid directly to households employed by the industry corresponding to the entry.

5. Each entry in column 5 represents the total change in number of jobs in all industries for each additional job in the industry corresponding to the entry.

NOTE.--Multipliers are based on the 1997 Benchmark Input-Output Table for the nation and 2003 regional accounts data.

SOURCE.--Regional Input-Output Modeling System (RIMS II), Regional Economic Analysis Division, Bureau of Economic Analysis.

Appendix B.—RIMS II Detailed Industries

Detailed industry code and title	Related 1997 NAICS codes
AGRICULTURE, FORESTRY, FISHING, AND HUNTING	
1110 Crop production	
1111A0 Oilseed farming	11111, 11112
1111B0 Grain farming	11113, 11114, 11115, 11116, 11119
111200 Vegetable and melon farming	1112
1113A0 Fruit farming	11131, 11132, 111331-4, 111336, 111339
111335 Tree nut farming	111335
111400 Greenhouse and nursery production	1114
111910 Tobacco farming	11191
111920 Cotton farming	11192
1119A0 Sugarcane and sugar beet farming	11193, 111991
1119B0 All other crop farming	11194, 111992, 111998
1120 Animal production	
112100 Cattle ranching and farming	1121
112300 Poultry and egg production	1123
112A00 Animal production, except cattle and poultry and eggs	1122, 1124, 1125, 1129
1130 Forestry and logging	
113A00 Forest nurseries, forest products, and timber tracts	1131, 1132
113300 Logging	1133
1140 Fishing, hunting and trapping	
114100 Fishing	1141
114200 Hunting and trapping	1142
1150 Agriculture and forestry support activities	
115000 Agriculture and forestry support activities	115
MINING	
2110 Oil and gas extraction	
211000 Oil and gas extraction	211
2121 Coal mining	
212100 Coal mining	2121
2122 Metal ores mining	
212210 Iron ore mining	21221
212230 Copper, nickel, lead, and zinc mining	21223
2122A0 Gold, silver, and other metal ore mining	21222, 21229
2123 Nonmetallic mineral mining and quarrying	
212310 Stone mining and quarrying	21231
212320 Sand, gravel, clay, and refractory mining	21232
212390 Other nonmetallic mineral mining	21239
2130 Support activities for mining	
213111 Drilling oil and gas wells	213111
213112 Support activities for oil and gas operations	213112
21311A Support activities for other mining	213113-5
UTILITIES	
2211 Power generation and supply	
2211A0 Power generation and supply	2211 (1)
2212 Natural gas distribution	
221200 Natural gas distribution	2212
2213 Water, sewage and other systems	
221300 Water, sewage and other systems	2213
CONSTRUCTION	
2300 Construction	
230000 Construction	23

Detailed industry code and title	Related 1997 NAICS codes
MANUFACTURING	
3110 Food manufacturing	
311111 Dog and cat food manufacturing	311111
311119 Other animal food manufacturing	311119
311211 Flour milling	311211
311212 Rice milling	311212
311213 Malt manufacturing	311213
311221 Wet corn milling	311221
311222 Soybean processing	311222
311223 Other oilseed processing	311223
311225 Fats and oils refining and blending	311225
311230 Breakfast cereal manufacturing	31123
311310 Sugar manufacturing	31131
311320 Confectionery manufacturing from cacao beans	31132
311330 Confectionery manufacturing from purchased chocolate	31133
311340 Nonchocolate confectionery manufacturing	31134
311410 Frozen food manufacturing	31141
311420 Fruit and vegetable canning and drying	31142
311511 Fluid milk manufacturing	311511
311512 Creamery butter manufacturing	311512
311513 Cheese manufacturing	311513
311514 Dry, condensed, and evaporated dairy products	311514
311520 Ice cream and frozen dessert manufacturing	31152
311611 Animal, except poultry, slaughtering	311611
311612 Meat processed from carcasses	311612
311613 Rendering and meat byproduct processing	311613
311615 Poultry processing	311615
311700 Seafood product preparation and packaging	3117
31181A Bread and bakery product, except frozen, manufacturing	311811-2
311813 Frozen cakes and other pastries manufacturing	311813
311821 Cookie and cracker manufacturing	311821
311822 Mixes and dough made from purchased flour	311822
311823 Dry pasta manufacturing	311823
311830 Tortilla manufacturing	31183
311911 Roasted nuts and peanut butter manufacturing	311911
311919 Other snack food manufacturing	311919
311920 Coffee and tea manufacturing	31192
311930 Flavoring syrup and concentrate manufacturing	31193
311941 Mayonnaise, dressing, and sauce manufacturing	311941
311942 Spice and extract manufacturing	311942
311990 All other food manufacturing	31199
3121 Beverage manufacturing	
312110 Soft drink and ice manufacturing	31211
312120 Breweries	31212
312130 Wineries	31213
312140 Distilleries	31214
3122 Tobacco manufacturing	
312210 Tobacco stemming and redrying	31221
312221 Cigarette manufacturing	312221
312229 Other tobacco product manufacturing	312229
3130 Textile mills	
313100 Fiber, yarn, and thread mills	3131
313210 Broadwoven fabric mills	31321
313220 Narrow fabric mills and schiffli embroidery	31322
313230 Nonwoven fabric mills	31323
313240 Knit fabric mills	31324
313310 Textile and fabric finishing mills	31331
313320 Fabric coating mills	31332
3140 Textile product mills	
314110 Carpet and rug mills	31411
314120 Curtain and linen mills	31412
314910 Textile bag and canvas mills	31491
314992 Tire cord and tire fabric mills	314992
31499A Other miscellaneous textile product mills	314991, 314999
3150 Apparel manufacturing	
315111 Sheer hosiery mills	315111

Appendix B.—RIMS II Detailed Industries

Detailed industry code and title	Related 1997 NAICS codes
315119 Other hosiery and sock mills	315119
315190 Other apparel knitting mills	31519
315200 Cut and sew apparel manufacturing	3152
315900 Accessories and other apparel manufacturing	3159
3160 Leather and allied product manufacturing	
316100 Leather and hide tanning and finishing	3161
316200 Footwear manufacturing	3162
316900 Other leather product manufacturing	3169
3210 Wood product manufacturing	
321113 Sawmills	321113
321114 Wood preservation	321114
32121A Veneer and plywood manufacturing	321211-2
32121B Engineered wood member and truss manufacturing	321213-4
321219 Reconstituted wood product manufacturing	321219
321911 Wood windows and door manufacturing	321911
321912 Cut stock, resawing lumber, and planing	321912
321918 Other millwork, including flooring	321918
321920 Wood container and pallet manufacturing	32192
321991 Manufactured home, mobile home, manufacturing	321991
321992 Prefabricated wood building manufacturing	321992
321999 Miscellaneous wood product manufacturing	321999
3221 Pulp, paper, and paperboard mills	
322110 Pulp mills	32211
3221A0 Paper and paperboard mills	32212, 32213
3222 Converted paper product manufacturing	
322210 Paperboard container manufacturing	32221
32222A Coated and laminated paper and packaging materials	322221-2
222B Coated and uncoated paper bag manufacturing	322223-4
225 Flexible packaging foil manufacturing	322225
322226 Surface-coated paperboard manufacturing	322226
322231 Die-cut paper office supplies manufacturing	322231
322232 Envelope manufacturing	322232
322233 Stationery and related product manufacturing	322233
322291 Sanitary paper product manufacturing	322291
322299 All other converted paper product manufacturing	322299
3230 Printing and related support activities	
32311A Commercial printing	323110-5, 323119
323116 Manifold business forms printing	323116
323117 Books printing	323117
323118 Blankbook and looseleaf binder manufacturing	323118
323121 Tradebinding and related work	323121
323122 Prepress services	323122
3240 Petroleum and coal products manufacturing	
324110 Petroleum refineries	32411
324121 Asphalt paving mixture and block manufacturing	324121
324122 Asphalt shingle and coating materials manufacturing	324122
324191 Petroleum lubricating oil and grease manufacturing	324191
324199 All other petroleum and coal products manufacturing	324199
3251 Basic chemical manufacturing	
325110 Petrochemical manufacturing	32511
325120 Industrial gas manufacturing	32512
325130 Synthetic dye and pigment manufacturing	32513
325180 Other basic inorganic chemical manufacturing	32518
325190 Other basic organic chemical manufacturing	32519
3252 Resin, rubber, and artificial fibers manufacturing	
325211 Plastics material and resin manufacturing	325211
325212 Synthetic rubber manufacturing	325212
6221 Cellulosic organic fiber manufacturing	325221
222 Noncellulosic organic fiber manufacturing	325222
3253 Agricultural chemical manufacturing	
325311 Nitrogenous fertilizer manufacturing	325311
325312 Phosphatic fertilizer manufacturing	325312
325314 Fertilizer, mixing only, manufacturing	325314
325320 Pesticide and other agricultural chemical manufacturing	32532
3254 Pharmaceutical and medicine manufacturing	
325400 Pharmaceutical and medicine manufacturing	3254
3255 Paint, coating, and adhesive manufacturing	
325510 Paint and coating manufacturing	32551
325520 Adhesive manufacturing	32552
3256 Soap, cleaning compound, and toiletry manufacturing	
325611 Soap and other detergent manufacturing	325611
325612 Polish and other sanitation good manufacturing	325612
325613 Surface active agent manufacturing	325613
325620 Toilet preparation manufacturing	32562
3259 Other chemical product and preparation manufacturing	
325910 Printing ink manufacturing	32591
325920 Explosives manufacturing	32592
325991 Custom compounding of purchased resins	325991
325992 Photographic film and chemical manufacturing	325992
325998 Other miscellaneous chemical product manufacturing	325998
3260 Plastics and rubber products manufacturing	
326110 Plastics packaging materials, film and sheet	32611
326120 Plastics pipe, fittings, and profile shapes	32612
326130 Laminated plastics plate, sheet, and shapes	32613
3261A0 Foam product manufacturing	32614, 32615
326160 Plastics bottle manufacturing	32616
326192 Resilient floor covering manufacturing	326192
32619A Plastics plumbing fixtures and all other plastics products	326191, 326199
326210 Tire manufacturing	32621
326220 Rubber and plastics hose and belting manufacturing	32622
326290 Other rubber product manufacturing	32629
3270 Nonmetallic mineral product manufacturing	
327111 Vitreous china plumbing fixture manufacturing	327111
327112 Vitreous china and earthenware articles manufacturing	327112
327113 Porcelain electrical supply manufacturing	327113
327121 Brick and structural clay tile manufacturing	327121
327122 Ceramic wall and floor tile manufacturing	327122
32712A Clay refractory and other structural clay products	327123-4
327125 Nonclay refractory manufacturing	327125
327213 Glass container manufacturing	327213
32721A Glass and glass products, except glass containers	327211-2, 327215
327310 Cement manufacturing	32731
327320 Ready-mix concrete manufacturing	32732
327331 Concrete block and brick manufacturing	327331
327332 Concrete pipe manufacturing	327332
327390 Other concrete product manufacturing	32739
327410 Lime manufacturing	32741
327420 Gypsum product manufacturing	32742
327910 Abrasive product manufacturing	32791
327991 Cut stone and stone product manufacturing	327991
327992 Ground or treated minerals and earths manufacturing	327992
327993 Mineral wool manufacturing	327993
327999 Miscellaneous nonmetallic mineral products	327999
331A Iron and steel mills and manufacturing from purchased steel	
331111 Iron and steel mills	331111
331112 Ferroalloy and related product manufacturing	331112
331210 Iron, steel pipe and tube from purchased steel	33121
331221 Rolled steel shape manufacturing	331221
331222 Steel wire drawing	331222
331B Nonferrous metal production and processing	
331311 Alumina refining	331311
331312 Primary aluminum production	331312
331314 Secondary smelting and alloying of aluminum	331314
331315 Aluminum sheet, plate, and foil manufacturing	331315
331316 Aluminum extruded product manufacturing	331316
331319 Other aluminum rolling and drawing	331319
331411 Primary smelting and refining of copper	331411

Appendix B.—RIMS II Detailed Industries

Detailed industry code and title	Related 1997 NAICS codes
331419 Primary nonferrous metal, except copper and aluminum	331419
331421 Copper rolling, drawing, and extruding	331421
331422 Copper wire, except mechanical, drawing	331422
331423 Secondary processing of copper	331423
331491 Nonferrous metal, except copper and aluminum, shaping	331491
331492 Secondary processing of other nonferrous	331492
3315 Foundries	
331510 Ferrous metal foundries	33151
33152A Aluminum foundries	331521, 331524
33152B Nonferrous foundries, except aluminum	331522, 331525, 331528
3321 Forging and stamping	
332111 Iron and steel forging	332111
332112 Nonferrous forging	332112
332114 Custom roll forming	332114
33211A All other forging and stamping	332115-7
3322 Cutlery and handtool manufacturing	
332211 Cutlery and flatware, except precious, manufacturing	332211
332212 Hand and edge tool manufacturing	332212
332213 Saw blade and handsaw manufacturing	332213
332214 Kitchen utensil, pot, and pan manufacturing	332214
3323 Architectural and structural metals manufacturing	
332311 Prefabricated metal buildings and components	332311
332312 Fabricated structural metal manufacturing	332312
332313 Plate work manufacturing	332313
332321 Metal window and door manufacturing	332321
332322 Sheet metal work manufacturing	332322
332323 Ornamental and architectural metal work manufacturing	332323
Boiler, tank, and shipping container manufacturing	
332410 Power boiler and heat exchanger manufacturing	33241
332420 Metal tank, heavy gauge, manufacturing	33242
332430 Metal can, box, and other container manufacturing	33243
332A Ordnance and accessories manufacturing	
33299A Ammunition manufacturing	332992-3
332994 Small arms manufacturing	332994
332995 Other ordnance and accessories manufacturing	332995
332B Other fabricated metal product manufacturing	
332500 Hardware manufacturing	3325
332600 Spring and wire product manufacturing	3326
332710 Machine shops	33271
332720 Turned product and screw, nut, and bolt manufacturing	33272
332811 Metal heat treating	332811
332812 Metal coating and nonprecious engraving	332812
332813 Electroplating, anodizing, and coloring metal	332813
332910 Metal valve manufacturing	33291
332991 Ball and roller bearing manufacturing	332991
332996 Fabricated pipe and pipe fitting manufacturing	332996
332997 Industrial pattern manufacturing	332997
332998 Enameled iron and metal sanitary ware manufacturing	332998
332999 Miscellaneous fabricated metal product manufacturing	332999
3331 Agriculture, construction, and mining machinery	
333111 Farm machinery and equipment manufacturing	333111
333112 Lawn and garden equipment manufacturing	333112
333120 Construction machinery manufacturing	33312
333131 Mining machinery and equipment manufacturing	333131
333132 Oil and gas field machinery and equipment	333132
3332 Industrial machinery manufacturing	
333210 Sawmill and woodworking machinery	33321
333220 Plastics and rubber industry machinery	33322
333291 Paper industry machinery manufacturing	333291
333292 Textile machinery manufacturing	333292
333293 Printing machinery and equipment manufacturing	333293
333294 Food product machinery manufacturing	333294
333295 Semiconductor machinery manufacturing	333295
333298 All other industrial machinery manufacturing	333298
3333 Commercial and service industry machinery	
33331A Automatic vending, commercial laundry and drycleaning machinery	333311-2
333313 Office machinery manufacturing	333313
333314 Optical instrument and lens manufacturing	333314
333315 Photographic and photocopying equipment manufacturing	333315
333319 Other commercial and service machinery manufacturing	333319
3334 HVAC and commercial refrigeration equipment	
333411 Air purification equipment manufacturing	333411
333412 Industrial and commercial fan and blower manufacturing	333412
333414 Heating equipment, except warm air furnaces	333414
333415 AC, refrigeration, and forced air heating	333415
3335 Metalworking machinery manufacturing	
333511 Industrial mold manufacturing	333511
333512 Metal cutting machine tool manufacturing	333512
333513 Metal forming machine tool manufacturing	333513
333514 Special tool, die, jig, and fixture manufacturing	333514
333515 Cutting tool and machine tool accessory manufacturing	333515
33351A Rolling mill and other metalworking machinery	333516, 333518
3336 Turbine and power transmission equipment manufacturing	
333611 Turbine and turbine generator set units manufacturing	333611
33361A Speed changers and mechanical power transmission equipment	333612-3
333618 Other engine equipment manufacturing	333618
3339 Other general purpose machinery manufacturing	
333911 Pump and pumping equipment manufacturing	333911
333912 Air and gas compressor manufacturing	333912
333913 Measuring and dispensing pump manufacturing	333913
333921 Elevator and moving stairway manufacturing	333921
333922 Conveyor and conveying equipment manufacturing	333922
333923 Overhead cranes, hoists, and monorail systems	333923
333924 Industrial truck, trailer, and stacker manufacturing	333924
333991 Power-driven handtool manufacturing	333991
333992 Welding and soldering equipment manufacturing	333992
333993 Packaging machinery manufacturing	333993
333994 Industrial process furnace and oven manufacturing	333994
333995 Fluid power cylinder and actuator manufacturing	333995
333996 Fluid power pump and motor manufacturing	333996
33399A Scales, balances, and miscellaneous general purpose machinery	333997, 333999
3341 Computer and peripheral equipment manufacturing	
334111 Electronic computer manufacturing	334111
334112 Computer storage device manufacturing	334112
334113 Computer terminal manufacturing	334113
334119 Other computer peripheral equipment manufacturing	334119
334A Audio, video, and communications equipment manufacturing	
334210 Telephone apparatus manufacturing	33421
334220 Broadcast and wireless communications equipment	33422
334290 Other communications equipment manufacturing	33429
334300 Audio and video equipment manufacturing	3343
3344 Semiconductor and electronic component manufacturing	
334411 Electron tube manufacturing	334411
334413 Semiconductors and related device manufacturing	334413
33441A All other electronic component manufacturing	334412, 334414-9
3345 Electronic instrument manufacturing	
334510 Electromedical apparatus manufacturing	334510
334511 Search, detection, and navigation instruments	334511
334512 Automatic environmental control manufacturing	334512
334513 Industrial process variable instruments	334513
334514 Totalizing fluid meters and counting devices	334514
334515 Electricity and signal testing instruments	334515

Appendix B.—RIMS II Detailed Industries

Detailed industry code and title	Related 1997 NAICS codes
334516 Analytical laboratory instrument manufacturing	334516
334517 Irradiation apparatus manufacturing	334517
33451A Watch, clock, and other measuring and controlling device manufacturing	334518-9
3346 Magnetic media manufacturing and reproducing	
334611 Software reproducing	334611
334612 Audio and video media reproduction	334612
334613 Magnetic and optical recording media manufacturing	334613
3351 Electric lighting equipment manufacturing	
335110 Electric lamp bulb and part manufacturing	33511
335120 Lighting fixture manufacturing	33512
3352 Household appliance manufacturing	
335211 Electric housewares and household fan manufacturing	335211
335212 Household vacuum cleaner manufacturing	335212
335221 Household cooking appliance manufacturing	335221
335222 Household refrigerator and home freezer manufacturing	335222
335224 Household laundry equipment manufacturing	335224
335228 Other major household appliance manufacturing	335228
3353 Electrical equipment manufacturing	
335311 Electric power and specialty transformer manufacturing	335311
335312 Motor and generator manufacturing	335312
335313 Switchgear and switchboard apparatus manufacturing	335313
335314 Relay and industrial control manufacturing	335314
3359 Other electrical equipment and component manufacturing	
335911 Storage battery manufacturing	335911
335912 Primary battery manufacturing	335912
335921 Fiber optic cable manufacturing	335921
335929 Other communication and energy wire manufacturing	335929
335930 Wiring device manufacturing	33593
335991 Carbon and graphite product manufacturing	335991
335999 Miscellaneous electrical equipment manufacturing	335999
3361 Motor vehicle manufacturing	
336110 Automobile and light truck manufacturing	33611
336120 Heavy duty truck manufacturing	33612
336A Motor vehicle body, trailer, and parts manufacturing	
336211 Motor vehicle body manufacturing	336211
336212 Truck trailer manufacturing	336212
336213 Motor home manufacturing	336213
336214 Travel trailer and camper manufacturing	336214
336300 Motor vehicle parts manufacturing	3363
3364 Aerospace product and parts manufacturing	
336411 Aircraft manufacturing	336411
336412 Aircraft engine and engine parts manufacturing	336412
336413 Other aircraft parts and equipment	336413
336414 Guided missile and space vehicle manufacturing	336414
33641A Propulsion units and parts for space vehicles and guided missiles	336415, 336419
336B Other transportation equipment manufacturing	
336500 Railroad rolling stock manufacturing	3365
336611 Ship building and repairing	336611
336612 Boat building	336612
336991 Motorcycle, bicycle, and parts manufacturing	336991
336992 Military armored vehicles and tank parts manufacturing	336992
336999 All other transportation equipment manufacturing	336999
3370 Furniture and related product manufacturing	
337110 Wood kitchen cabinet and countertop manufacturing	33711
337121 Upholstered household furniture manufacturing	337121
337122 Nonupholstered wood household furniture manufacturing	337122
337124 Metal household furniture manufacturing	337124
337127 Institutional furniture manufacturing	337127
33712A Other household and institutional furniture	337125, 337129
337211 Wood office furniture manufacturing	337211
337212 Custom architectural woodwork and millwork	337212
337214 Office furniture, except wood, manufacturing	337214
337215 Showcases, partitions, shelving, and lockers	337215
337910 Mattress manufacturing	33791
337920 Blind and shade manufacturing	33792
3391 Medical equipment and supplies manufacturing	
339111 Laboratory apparatus and furniture manufacturing	339111
339112 Surgical and medical instrument manufacturing	339112
339113 Surgical appliance and supplies manufacturing	339113
339114 Dental equipment and supplies manufacturing	339114
339115 Ophthalmic goods manufacturing	339115
339116 Dental laboratories	339116
3399 Other miscellaneous manufacturing	
339910 Jewelry and silverware manufacturing	33991
339920 Sporting and athletic goods manufacturing	33992
339930 Doll, toy, and game manufacturing	33993
339940 Office supplies, except paper, manufacturing	33994
339950 Sign manufacturing	33995
339991 Gasket, packing, and sealing device manufacturing	339991
339992 Musical instrument manufacturing	339992
339994 Broom, brush, and mop manufacturing	339994
339995 Burial casket manufacturing	339995
33999A Buttons, pins, and all other miscellaneous manufacturing	339993, 339999
WHOLESALE TRADE	
4200 Wholesale trade	
420000 Wholesale trade	42
RETAIL TRADE	
4A00 Retail trade	
4A0000 Retail trade	44, 45
TRANSPORTATION AND WAREHOUSING, EXCLUDING POSTAL SERVICE	
4810 Air transportation	
481000 Air transportation	481
4820 Rail transportation	
482000 Rail transportation	482
4830 Water transportation	
483000 Water transportation	483
4840 Truck transportation	
484000 Truck transportation	484
4850 Transit and ground passenger transportation	
485A00 Transit and ground passenger transportation	485 (1)
4860 Pipeline transportation	
486000 Pipeline transportation	486
48A0 Scenic and sightseeing transportation and support activities for transportation	
48A000 Scenic and sightseeing transportation and support activities for transportation	487, 488
4920 Couriers and messengers	
492000 Couriers and messengers	492
4930 Warehousing and storage	
493000 Warehousing and storage	493
INFORMATION	
5111 Newspaper, book, and directory publishers	
511110 Newspaper publishers	51111
511120 Periodical publishers	51112

Appendix B.—RIMS II Detailed Industries

Detailed industry code and title	Related 1997 NAICS codes
511130 Book publishers	51113
5111A0 Database, directory, and other publishers	51114, 51119
5112 Software publishers	
511200 Software publishers	5112
5120 Motion picture and sound recording industries	
512100 Motion picture and video industries	5121
512200 Sound recording industries	5122
5131 Radio and television broadcasting	
513100 Radio and television broadcasting	5131
5132 Cable networks and program distribution	
513200 Cable networks and program distribution	5132
5133 Telecommunications	
513300 Telecommunications	5133
5141 Information services	
514100 Information services	5141
5142 Data processing services	
514200 Data processing services	5142
FINANCE AND INSURANCE	
52A0 Monetary authorities, credit intermediation and related activities	
52A000 Monetary authorities and depository credit intermediation	521, 5221
522A00 Nondepository credit intermediation and related activities	5222, 5223
5230 Securities, commodity contracts, investments	
523000 Securities, commodity contracts, investments	523
5240 Insurance carriers and related activities	
524100 Insurance carriers	5241
524200 Insurance agencies, brokerages, and related	5242
5250 Funds, trusts, and other financial vehicles	
525000 Funds, trusts, and other financial vehicles	525
REAL ESTATE AND RENTAL AND LEASING	
5310 Real estate	
531000 Real estate	531
S008 Owner-occupied dwellings	
S00800 Owner-occupied dwellings	
5321 Automotive equipment rental and leasing	
532100 Automotive equipment rental and leasing	5321
532A Consumer goods and general rental centers	
532A00 General and consumer goods rental except video tapes and discs	53221, 53222, 53229, 5323
532230 Video tape and disc rental	53223
5324 Machinery and equipment rental and leasing	
532400 Machinery and equipment rental and leasing	5324
5330 Lessors of nonfinancial intangible assets	
533000 Lessors of nonfinancial intangible assets	533
PROFESSIONAL, SCIENTIFIC, AND TECHNICAL SERVICES	
5411 Legal services	
541100 Legal services	5411
Accounting and bookkeeping services	
541200 Accounting and bookkeeping services	5412
5413 Architectural and engineering services	
541300 Architectural and engineering services	5413
5414 Specialized design services	
541400 Specialized design services	5414
5415 Computer systems design and related services	
541511 Custom computer programming services	541511
541512 Computer systems design services	541512
54151A Other computer related services, including facilities management	541513, 541519
5416 Management and technical consulting services	
541610 Management consulting services	54161
5416A0 Environmental and other technical consulting services	54162, 54169
5417 Scientific research and development services	
541700 Scientific research and development services	5417
5418 Advertising and related services	
541800 Advertising and related services	5418
5419 Other professional and technical services	
541920 Photographic services	54192
541940 Veterinary services	54194
5419A0 All other miscellaneous professional and technical services	54191, 54193, 54199
MANAGEMENT OF COMPANIES AND ENTERPRISES	
5500 Management of companies and enterprises	
550000 Management of companies and enterprises	55
ADMINISTRATIVE AND WASTE MANGEMENT SERVICES	
5613 Employment services	
561300 Employment services	5613
5615 Travel arrangement and reservation services	
561500 Travel arrangement and reservation services	5615
561A All other administrative and support services	
561100 Office administrative services	5611
561200 Facilities support services	5612
561400 Business support services	5614
561600 Investigation and security services	5616
561700 Services to buildings and dwellings	5617
561900 Other support services	5619
5620 Waste management and remediation services	
562000 Waste management and remediation services	562
EDUCATIONAL SERVICES	
6100 Educational services	
611100 Elementary and secondary schools	6111
611A00 Colleges, universities, and junior colleges	6112, 6113
611B00 Other educational services	6114, 6115, 6116, 6117
HEALTH CARE AND SOCIAL ASSISTANCE	
6210 Ambulatory health care services	
621A00 Offices of physicians, dentists, and other health practitioners	6211, 6212, 6213
621600 Home health care services	6216
621B00 Other ambulatory health care services	6214, 6215, 6219
6220 Hospitals	
622000 Hospitals	622
6230 Nursing and residential care facilities	
623000 Nursing and residential care facilities	623
6240 Social assistance	
624400 Child day care services	6244

Appendix B.—RIMS II Detailed Industries

Detailed industry code and title	Related 1997 NAICS codes
624A00 Social assistance, except child day care services	6241, 6242, 6243
ARTS, ENTERTAINMENT, AND RECREATION	
71A0 Performing arts, spectator sports, museums, zoos, and parks	
711100 Performing arts companies	7111
711200 Spectator sports	7112
711A00 Promoters of performing arts and sports and agents for public figures	7113, 7114
711500 Independent artists, writers, and performers	7115
712000 Museums, historical sites, zoos, and parks	712
7130 Amusements, gambling, and recreation	
713940 Fitness and recreational sports centers	71394
713950 Bowling centers	71395
713A00 Other amusement, gambling, and recreation industries	7131, 7132, 71391, 71392, 71393, 71399
ACCOMMODATION AND FOOD SERVICES	
7210 Accommodation	
7211A0 Hotels and motels, including casino hotels	72111, 72112
721A00 Other accommodations	72119, 7212, 7213
7220 Food services and drinking places	
722000 Food services and drinking places	722
OTHER SERVICES, EXCEPT PUBLIC ADMINISTRATION	
8111 Automotive repair and maintenance	
8111A0 Automotive repair and maintenance, except car washes	81111, 81112, 811191, 811198
811192 Car washes	811192
[illegible]ctronic, commercial, and household goods repair	
811200 Electronic equipment repair and maintenance	8112
811300 Commercial machinery repair and maintenance	8113
811400 Household goods repair and maintenance	8114
8120 Personal and laundry services	
812100 Personal care services	8121
812200 Death care services	8122
812300 Drycleaning and laundry services	8123
812900 Other personal services	8129
813A Religious, grantmaking and giving, and social advocacy organizations	
813100 Religious organizations	8131
813A00 Grantmaking and giving and social advocacy organizations	8132, 8133
813B Civic, social, professional and similar organizations	
813B00 Civic, social, professional and similar organizations	8134, 8139
SPECIAL INDUSTRIES	
[illegible]001 Federal and state and local government enterprises	
491000 Postal service	491
S00A00 Other government enterprises	
[illegible]002 Households	
H00000 Households	

1. Includes Federal Government enterprises.

Appendix C.—RIMS II Industry Aggregations

	Aggregate industry code and title	RIMS II detailed industry codes[1]
	Agriculture, forestry, fishing, and hunting	
1	Crop and animal production	1111A0-112A00
2	Forestry, fishing, and related activities	113A00-115000
	Mining	
3	Oil and gas extraction	211000
4	Mining, except oil and gas	212100-212390
5	Support activities for mining	213111-21311A
	Utilities*	
6	Utilities*	2211A0-221300
	Construction	
7	Construction	230000
	Manufacturing	
8	Wood product manufacturing	321113-321999
9	Nonmetallic mineral product manufacturing	327111-327999
10	Primary metal manufacturing	331111-33152B
11	Fabricated metal product manufacturing	332111-332999
12	Machinery manufacturing	333111-33399A
13	Computer and electronic product manufacturing	334111-334613
14	Electrical equipment and appliance manufacturing	335110-335999
15	Motor vehicle, body, trailer, and parts manufacturing	336110-336300
16	Other transportation equipment manufacturing	336411-336999
17	Furniture and related product manufacturing	337110-337920
18	Miscellaneous manufacturing	339111-33999A
19	Food, beverage, and tobacco product manufacturing	311111-312229
20	Textile and textile product mills	313100-31499A
21	Apparel, leather, and allied product manufacturing	315111-316900
22	Paper manufacturing	322110-322299
23	Printing and related support activities	32311A-323122
24	Petroleum and coal products manufacturing	324110-324199
25	Chemical manufacturing	325110-325998
26	Plastics and rubber products manufacturing	326110-326290
	Wholesale trade	
27	Wholesale trade	420000
	Retail trade	
28	Retail trade	4A0000
	Transportation and warehousing*	
29	Air transportation	481000
30	Rail transportation	482000
31	Water transportation	483000
32	Truck transportation	484000
33	Transit and ground passenger transportation*	485A00
34	Pipeline transportation	486000
35	Other transportation and support activities*	48A000-492000, 491000
36	Warehousing and storage	493000

Appendix C.—RIMS II Industry Aggregations

	Aggregate industry code and title	RIMS II detailed industry codes[1]
	Information	
37	Publishing including software	511110-511200
38	Motion picture and sound recording industries	512100-512200
39	Broadcasting and telecommunications	513100-513300
40	Information and data processing services	514100-514200
	Finance and insurance	
41	Federal Reserve banks, credit intermediation and related services	52A000-522A00
42	Securities, commodity contracts, investments	523000
43	Insurance carriers and related activities	524100-524200
44	Funds, trusts, and other financial vehicles	525000
	Real estate and rental and leasing	
45	Real estate	531000, S00800
46	Rental and leasing services and lessors of intangible assets	532100-533000
	Professional, scientific, and technical services	
47	Professional, scientific, and technical services	541100-5419A0
	Management of companies and enterprises	
48	Management of companies and enterprises	550000
	Administrative and waste management services	
49	Administrative and support services	561300-561900
50	Waste management and remediation services	562000
	Educational services	
51	Educational services	611100-611B00
	Health care and social assistance	
52	Ambulatory health care services	621A00-621B00
53	Hospitals and nursing and residential care facilities	622000-623000
54	Social assistance	624400-624A00
	Arts, entertainment, and recreation	
55	Performing arts, museums, and related activities	711100-712000
56	Amusements, gambling, and recreation	713940-713A00
	Accommodation and food services	
57	Accommodation	7211A0-721A00
58	Food services and drinking places	722000
	Other services*	
59	Other services*	8111A0-813B00, S00A00
	Households	
60	Households	H00000

* Includes Federal Government enterprises.

1. Appendix B identifies the RIMS II detailed industry codes.

Appendix D.—RIMS II Industry Groups

Group industry code and title		RIMS II detailed industry codes[1]	RIMS II aggregate industry codes[2]
1	Agriculture, forestry, fishing, and hunting	1111A0-115000	1-2
2	Mining	211000-21311A	3-5
3	Utilities*	2211A0-221300	6
4	Construction	230000	7
5	Manufacturing	311111-33999A	8-26
6	Wholesale trade	420000	27
7	Retail trade	4A0000	28
8	Transportation and warehousing*	481000-493000	29-36
9	Information	511110-514200	37-40
10	Finance and insurance	52A000-525000	41-44
11	Real estate and rental and leasing	531000-533000	45-46
12	Professional, scientific, and technical services	541100-5419A0	47
13	Management of companies and enterprises	550000	48
14	Administrative and waste management services	561300-562000	49-50
15	Educational services	611100-611B00	51
16	Health care and social assistance	621A00-624A00	52-54
17	Arts, entertainment, and recreation	711100-713A00	55-56
18	Accommodation and food services	7211A0-722000	57-58
19	Other services*	8111A0-813B00, S00A00	59
20	Households	H00000	60

* Includes Federal Government enterprises.
1. Appendix C identifies the RIMS II detailed industry codes.
2. Appendix B identifies the RIMS II aggregate industry codes.

Description of files README.DOC **October 1, 2005**

Source

The Regional Input-Output Modeling System (RIMS II) multipliers on these files were prepared by the Regional Economic Analysis Division, Bureau of Economic Analysis, BE-61, U.S. Department of Commerce. For questions about the multipliers please call (202-606-5343), or FAX (202-606-5321), or e-mail (rimsread@bea.gov).

Ordering information

For your convenience there is an order form on the RIMS II web site for submitting orders for RIMS II multipliers, http://www.bea.gov/bea/regional/rims/orderform.htm. Customized RIMS II multipliers are available for any region comprised of one or more counties at a cost of $275 per region.

Description of RIMS II

The RIMS II multipliers presented here are based on BEA's 1997 national benchmark input-output (I-O) accounts and BEA's 2003 regional economic accounts. RIMS II multipliers based on these sources were first released October 2005.

For more information on the RIMS II model, please consult the RIMS II handbook, "Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System (Third Edition, March 1997)." A PDF version of the handbook can be downloaded from the RIMS II web site, http://www.bea.gov/bea/regional/rims/

Description of files

The CD contains the RIMS II Viewer, a JAVA-based data retrieval program that can be used to read and write RIMS II data to file(s) for further analysis with software packages. It also contains distribution costs data.

The retrieval program must be installed by running the setup program setupwin32.exe (stored on the CD) from within Windows. Running this program opens the Installation Wizard, which acts as a guide in opening and storing all the necessary files for the RIMS II Viewer and the requested region(s). For help using the RIMS II Viewer, enter the program by clicking the icon created on your desktop by the setup program, then press F1 for detailed help

information or F2 for help on getting started.

Files included on CD:

File	Description
README.doc	Description of the data product
COUNTIES.txt	County name and corresponding region number
REGIONS.txt	Region name, region number, and year of regional data used in estimating multipliers
IO473.txt	I-O industries and descriptions
Colrow60.txt	RIMS II aggregate industries and descriptions
Row20.txt	RIMS II aggregate row industries and descriptions
FINALUSE.txt	I-O final use codes and descriptions
FTABC60X.txt	File layout for TABC60X.txt
FTABD60X.txt	File layout for TABD60X.txt
FTABE60X.txt	File layout for TABE60X.txt
FTABF60X.txt	File layout for TABF60X.txt
FTABC473X.txt	File layout for TABC473X.txt
FTABD473X.txt	File layout for TABD473X.txt
FTABE473X.txt	File layout for TABE473X.txt
FTABF473X.txt	File layout for TABF473X.txt

Distribution Cost Files

File	Description
TABC60X.txt	Commodity composition of NIPA final demand for the RIMS II industry aggregations
TABD60X.txt	Commodity composition of Personal Consumption Expenditures by PCE Category for the RIMS II industry aggregations
TABE60X.txt	Commodity composition of Producers' Durable Equipment Expenditures by PDE category for the RIMS II industry aggregations
TABF60X.txt	Commodity composition of intermediate purchases for the RIMS II industry aggregations
TABC473X.txt	Commodity composition of NIPA final demand for the RIMS II detailed industries
TABD473X.txt	Commodity composition of Personal Consumption Expenditures by PCE Category for the RIMS II detailed industries
TABE473X.txt	Commodity composition of Producers' Durable Equipment Expenditures by PDE category for the RIMS II detailed industries
TABF473X.txt	Commodity composition of intermediate purchases for the RIMS II detailed industries

RG##.exe Files

File	Description
TOTLRG##.dat	20-by-473 final-demand output multipliers for region ##
EARNRG##.dat	20-by-473 final-demand earnings multipliers for region ##
EMPLRG##.dat	20-by-473 final-demand employment multipliers for region ##
TLSQRG##.dat	20-by-60 final-demand output multipliers for region ##
ERSQRG##.dat	20-by-60 final-demand earnings multipliers for region ##
JBSQRG##.dat	20-by-60 final-demand employment multipliers for region ##
M473RG##.dat	Summary multipliers for 473 detailed I-O industries for region ##
M_60RG##.dat	Summary multipliers for 60 RIMS II aggregate industries for region ##

File Layout for Data Files: TOTLRG##.dat, EARNRG##.dat, EMPLRG##.dat, TLSQRG##.dat, ERSQRG##.dat, and JBSQRG##.dat

Columns	Description
1 - 2	Row number
3 - 6	Column number
7 - 5	Multiplier

File Layout for Data File: M473RG##.dat

Columns	Description
1 - 8	Detailed industry number
9 - 19	Total final-demand multiplier for output
20 - 30	Total final-demand multiplier for earnings
31 - 41	Total final-demand multiplier for employment
42 - 52	Total direct-effect multiplier for earnings
53 - 63	Total direct-effect multiplier for employment

File Layout for Data File: M_60RG##.dat

Columns	Description
1 - 6	RIMS II aggregate industry number
7 - 17	Total final-demand multiplier for output
18 - 28	Total final-demand multiplier for earnings
29 - 39	Total final-demand multiplier for employment
40 - 50	Total direct-effect multiplier for earnings
51 - 61	Total direct-effect multiplier for employment

File Layout for Data File: IO473.txt

Columns	Description
1 - 3	Column number for 473 detailed industries
5 - 11	I-O industry code
12 - 13	Column number for 60 aggregate industries
15 - 20	Column number for 473 detailed industries
22 - 98	I-O industry description

File Layout for Data File: Colrow60.txt

Columns	Description
1 - 2	Column number for 60 aggregate industries
6 - 98	I-O industry description

File Layout for Data File: Row20.txt

Columns	Description
1 - 2	Column number for 20 aggregate industries
5 - 98	I-O industry description

File Layout for Data File: COUNTIES.txt

Columns	Description
1 - 2	Region number
4 - 51	County name

File Layout for Data File: REGIONS.txt

Columns	Description
1 - 2	Region number
4 - 52	Region name, Regional data year, National input-output data year

RIMS II Multipliers

Each entry in TOTLRG##.dat (the file containing the 20-by-473 total final-demand output multipliers) represents the dollar change in output that occurs in the row industry for each additional dollar of output delivered to final demand by the column industry. For each column, the sum of the entries in rows 1-19 represents the dollar change in output that occurs in all row industries for each additional dollar of output delivered to final demand by the column industry. This value appears in M473RG##.dat as the second entry on the record corresponding to the column industry. Due to rounding these values may not be equal.

Each entry in TLSQRG##.dat (the file containing the 20-by-60 total final-demand output multipliers) represents the dollar change in output that occurs in the row industry for each additional dollar of output delivered to final demand by the column industry. For each column, the sum of the entries in rows 1-19 represents the dollar change in output that occurs in all row industries for each additional dollar of output delivered to final demand by the column industry. This value appears in M_60RG##.dat as the second entry on the record

corresponding to the column industry. Due to rounding these values may not be equal.

Each entry in EARNRG##.dat (the file containing the 20-by-473 total final-demand earnings multipliers) represents the dollar change in earnings that occurs in the row industry for each additional dollar of output delivered to final demand by the column industry. For each column, the sum of the entries in rows 1-20 represents the dollar change in earnings that occurs in all row industries for each additional dollar of output delivered to final demand by the column industry. This value appears in M473RG##.dat as the third entry on the record corresponding to the column industry. Due to rounding these values may not be equal.

Each entry in ERSQRG##.dat (the file containing the 20-by-60 total final-demand earnings multipliers) represents the dollar change in earnings that occurs in the row industry for each additional dollar of output delivered to final demand by the column industry. For each column, the sum of the entries in rows 1-20 represents the dollar change in earnings that occurs in all row industries for each additional dollar of output delivered to final demand by the column industry. This value appears in M_60RG##.dat as the third entry on the record corresponding to the column industry. Due to rounding these values may not be equal.

Each entry in EMPLRG##.dat (the file containing the 20-by-473 total final-demand employment multipliers) represents the change in the number of jobs that occurs in the row industry for each additional 1 million dollars of output delivered to final demand by the column industry. Because the employment multipliers are based on 2003 data, the output delivered to final demand should be in 2003 dollars. For each column, the sum of the entries in rows 1-20 represents the change in the number of jobs that occurs in all row industries for each additional 1 million dollars of output delivered to final demand by the column industry. This value appears in M473RG##.dat as the fourth entry on the record corresponding to the column industry. Due to rounding these values may not be equal.

Each entry in JBSQRG##.dat (the file containing the 20-by-60 total final-demand employment multipliers) represents the change in the number of jobs that occurs in the row industry for each additional 1 million dollars of output delivered to final demand by the column industry. Because the employment multipliers are based on 2003 data, the output delivered to final demand should be in 2003 dollars. For each column, the sum of the entries in rows 1-20 represents the change in the number of jobs that occurs in all row industries for each additional 1 million dollars of output delivered to final demand by the column industry. This value appears in M_60RG##.dat as the fourth entry on the record corresponding to the column industry. Due to rounding these values may not be equal.

The fifth entry on each record in M473RG##.dat or M_60RG##.dat represents the total dollar change in earnings of households employed by all row industries for each additional dollar of earnings paid directly to households employed by the industry corresponding to the industry on the record.

The sixth entry on each record in M473RG##.dat or M_60RG##.dat represents the total change in number of jobs in all row industries for each additional job in the industry corresponding to the industry on the record.

Table 1.4 is a printed version of M473RG##.dat and Table 2.4 is a printed version of M_60RG##.dat. In M473RG### and M_60RG##, zero entries appears for the total direct-effect multipliers for the households industry. Only in these cases, does a zero entry represent a null value.

Distribution Costs Tables

RIMS II provides final-use and intermediate-use distribution costs (wholesale and retail trade margins and transportation costs) tables for both the 473 detailed industries and the 60 industry aggregations. These tables can assist RIMS II users in converting final-demand changes into producers' prices.

The distribution costs tables for final purchases are based on BEA's 1997 national benchmark Input-Output Supplementary Tables. The supplementary tables are bridges between the I-O accounts and the NIPA's. They present the I-O commodity composition of NIPA final demand in producers' and purchasers' prices. Specifically, Table C presents the composition of all NIPA final-demand components; Table D, the composition of personal consumption expenditure categories; Table E, the composition of NIPA producers' durable equipment expenditure categories. Table F, the distribution costs tables for intermediate purchases, is based on data from BEA's 1997 national benchmark Use table.

Section 4.4 Ref 8

U.S. Census Bureau
American FactFinder

DP-1. **Profile of General Demographic Characteristics: 2000** - US Census Bureau (2000
Data Set: Census 2000 Summary File 1 (SF 1) 100-Percent Data
Geographic Area: **Chapin town, South Carolina**

NOTE: For information on confidentiality protection, nonsampling error, definitions, and count corrections see http://factfinder.census.gov/home/en/datanotes/expsf1u.htm.

Subject	Number	Percent
Total population	**628**	**100.0**
SEX AND AGE		
Male	298	47.5
Female	330	52.5
Under 5 years	49	7.8
5 to 9 years	41	6.5
10 to 14 years	48	7.6
15 to 19 years	34	5.4
20 to 24 years	26	4.1
25 to 34 years	110	17.5
35 to 44 years	103	16.4
45 to 54 years	77	12.3
55 to 59 years	26	4.1
60 to 64 years	24	3.8
65 to 74 years	44	7.0
75 to 84 years	35	5.6
85 years and over	11	1.8
Median age (years)	35.6	(X)
18 years and over	466	74.2
Male	219	34.9
Female	247	39.3
21 years and over	453	72.1
62 years and over	103	16.4
65 years and over	90	14.3
Male	37	5.9
Female	53	8.4
RACE		
One race	623	99.2
White	578	92.0
Black or African American	40	6.4
American Indian and Alaska Native	1	0.2
Asian	1	0.2
Asian Indian	0	0.0
Chinese	0	0.0
Filipino	0	0.0
Japanese	0	0.0
Korean	1	0.2
Vietnamese	0	0.0
Other Asian [1]	0	0.0
Native Hawaiian and Other Pacific Islander	0	0.0
Native Hawaiian	0	0.0
Guamanian or Chamorro	0	0.0
Samoan	0	0.0
Other Pacific Islander [2]	0	0.0

SCEG-088

Subject	Number	Percent
Some other race	3	0.5
Two or more races	5	0.8
Race alone or in combination with one or more other races [3]		
White	583	92.8
Black or African American	40	6.4
American Indian and Alaska Native	3	0.5
Asian	1	0.2
Native Hawaiian and Other Pacific Islander	2	0.3
Some other race	4	0.6
HISPANIC OR LATINO AND RACE		
Total population	**628**	**100.0**
Hispanic or Latino (of any race)	4	0.6
Mexican	0	0.0
Puerto Rican	1	0.2
Cuban	0	0.0
Other Hispanic or Latino	3	0.5
Not Hispanic or Latino	624	99.4
White alone	577	91.9
RELATIONSHIP		
Total population	**628**	**100.0**
In households	628	100.0
Householder	249	39.6
Spouse	151	24.0
Child	192	30.6
Own child under 18 years	153	24.4
Other relatives	21	3.3
Under 18 years	6	1.0
Nonrelatives	15	2.4
Unmarried partner	8	1.3
In group quarters	0	0.0
Institutionalized population	0	0.0
Noninstitutionalized population	0	0.0
HOUSEHOLDS BY TYPE		
Total households	**249**	**100.0**
Family households (families)	193	77.5
With own children under 18 years	89	35.7
Married-couple family	151	60.6
With own children under 18 years	68	27.3
Female householder, no husband present	31	12.4
With own children under 18 years	17	6.8
Nonfamily households	56	22.5
Householder living alone	49	19.7
Householder 65 years and over	23	9.2
Households with individuals under 18 years	94	37.8
Households with individuals 65 years and over	67	26.9
Average household size	2.52	(X)
Average family size	2.89	(X)
HOUSING OCCUPANCY		
Total housing units	**261**	**100.0**
Occupied housing units	249	95.4
Vacant housing units	12	4.6
For seasonal, recreational, or occasional use	0	0.0
Homeowner vacancy rate (percent)	2.7	(X)
Rental vacancy rate (percent)	6.5	(X)

Subject	Number	Percent
HOUSING TENURE		
Occupied housing units	**249**	**100.0**
Owner-occupied housing units	220	88.4
Renter-occupied housing units	29	11.6
Average household size of owner-occupied unit	2.49	(X)
Average household size of renter-occupied unit	2.79	(X)

(X) Not applicable
[1] Other Asian alone, or two or more Asian categories.
[2] Other Pacific Islander alone, or two or more Native Hawaiian and Other Pacific Islander categories.
[3] In combination with one or more other races listed. The six numbers may add to more than the total population and the six percentages may add to more than 100 percent because individuals may report more than one race.
Source: U.S. Census Bureau, Census 2000 Summary File 1, Matrices P1, P3, P4, P8, P9, P12, P13, P,17, P18, P19, P20, P23, P27, P28, P33, PCT5, PCT8, PCT11, PCT15, H1, H3, H4, H5, H11, and H12.

DP-1. **Profile of General Demographic Characteristics: 2000**
Data Set: Census 2000 Summary File 1 (SF 1) 100-Percent Data
Geographic Area: **Little Mountain town, South Carolina**

NOTE: For information on confidentiality protection, nonsampling error, definitions, and count corrections see http://factfinder.census.gov/home/en/datanotes/expsf1u.htm.

Subject	Number	Percent
Total population	**255**	**100.0**
SEX AND AGE		
Male	124	48.6
Female	131	51.4
Under 5 years	11	4.3
5 to 9 years	18	7.1
10 to 14 years	10	3.9
15 to 19 years	14	5.5
20 to 24 years	10	3.9
25 to 34 years	34	13.3
35 to 44 years	47	18.4
45 to 54 years	45	17.6
55 to 59 years	17	6.7
60 to 64 years	16	6.3
65 to 74 years	19	7.5
75 to 84 years	11	4.3
85 years and over	3	1.2
Median age (years)	41.6	(X)
18 years and over	207	81.2
Male	102	40.0
Female	105	41.2
21 years and over	200	78.4
62 years and over	46	18.0
65 years and over	33	12.9
Male	13	5.1
Female	20	7.8
RACE		
One race	255	100.0
White	221	86.7
Black or African American	33	12.9
American Indian and Alaska Native	0	0.0

Subject	Number	Percent
Asian	0	0.0
Asian Indian	0	0.0
Chinese	0	0.0
Filipino	0	0.0
Japanese	0	0.0
Korean	0	0.0
Vietnamese	0	0.0
Other Asian [1]	0	0.0
Native Hawaiian and Other Pacific Islander	0	0.0
Native Hawaiian	0	0.0
Guamanian or Chamorro	0	0.0
Samoan	0	0.0
Other Pacific Islander [2]	0	0.0
Some other race	1	0.4
Two or more races	0	0.0
Race alone or in combination with one or more other races [3]		
White	221	86.7
Black or African American	33	12.9
American Indian and Alaska Native	0	0.0
Asian	0	0.0
Native Hawaiian and Other Pacific Islander	0	0.0
Some other race	1	0.4
HISPANIC OR LATINO AND RACE		
Total population	**255**	**100.0**
Hispanic or Latino (of any race)	1	0.4
Mexican	1	0.4
Puerto Rican	0	0.0
Cuban	0	0.0
Other Hispanic or Latino	0	0.0
Not Hispanic or Latino	254	99.6
White alone	221	86.7
RELATIONSHIP		
Total population	**255**	**100.0**
In households	255	100.0
Householder	121	47.5
Spouse	59	23.1
Child	58	22.7
Own child under 18 years	45	17.6
Other relatives	8	3.1
Under 18 years	2	0.8
Nonrelatives	9	3.5
Unmarried partner	5	2.0
In group quarters	0	0.0
Institutionalized population	0	0.0
Noninstitutionalized population	0	0.0
HOUSEHOLDS BY TYPE		
Total households	**121**	**100.0**
Family households (families)	75	62.0
With own children under 18 years	30	24.8
Married-couple family	59	48.8
With own children under 18 years	23	19.0
Female householder, no husband present	12	9.9
With own children under 18 years	4	3.3
Nonfamily households	46	38.0
Householder living alone	42	34.7
Householder 65 years and over	17	14.0
Households with individuals under 18 years	32	26.4
Households with individuals 65 years and over	29	24.0

Subject	Number	Percent
Average household size	2.11	(X)
Average family size	2.67	(X)
HOUSING OCCUPANCY		
Total housing units	**132**	**100.0**
Occupied housing units	121	91.7
Vacant housing units	11	8.3
For seasonal, recreational, or occasional use	2	1.5
Homeowner vacancy rate (percent)	0.0	(X)
Rental vacancy rate (percent)	7.7	(X)
HOUSING TENURE		
Occupied housing units	**121**	**100.0**
Owner-occupied housing units	73	60.3
Renter-occupied housing units	48	39.7
Average household size of owner-occupied unit	2.18	(X)
Average household size of renter-occupied unit	2.00	(X)

(X) Not applicable
[1] Other Asian alone, or two or more Asian categories.
[2] Other Pacific Islander alone, or two or more Native Hawaiian and Other Pacific Islander categories.
[3] In combination with one or more other races listed. The six numbers may add to more than the total population and the six percentages may add to more than 100 percent because individuals may report more than one race.
Source: U.S. Census Bureau, Census 2000 Summary File 1, Matrices P1, P3, P4, P8, P9, P12, P13, P,17, P18, P19, P20, P23, P27, P28, P33, PCT5, PCT8, PCT11, PCT15, H1, H3, H4, H5, H11, and H12.

DP-1. **Profile of General Demographic Characteristics: 2000**
Data Set: Census 2000 Summary File 1 (SF 1) 100-Percent Data
Geographic Area: **Peak town, South Carolina**

NOTE: For information on confidentiality protection, nonsampling error, definitions, and count corrections see http://factfinder.census.gov/home/en/datanotes/expsf1u.htm.

Subject	Number	Percent
Total population	**61**	**100.0**
SEX AND AGE		
Male	23	37.7
Female	38	62.3
Under 5 years	1	1.6
5 to 9 years	4	6.6
10 to 14 years	5	8.2
15 to 19 years	3	4.9
20 to 24 years	1	1.6
25 to 34 years	7	11.5
35 to 44 years	12	19.7
45 to 54 years	6	9.8
55 to 59 years	4	6.6
60 to 64 years	3	4.9
65 to 74 years	9	14.8
75 to 84 years	5	8.2
85 years and over	1	1.6
Median age (years)	43.2	(X)
18 years and over	50	82.0

Subject	Number	Percent
Male	18	29.5
Female	32	52.5
21 years and over	48	78.7
62 years and over	18	29.5
65 years and over	15	24.6
Male	4	6.6
Female	11	18.0
RACE		
One race	61	100.0
White	42	68.9
Black or African American	19	31.1
American Indian and Alaska Native	0	0.0
Asian	0	0.0
Asian Indian	0	0.0
Chinese	0	0.0
Filipino	0	0.0
Japanese	0	0.0
Korean	0	0.0
Vietnamese	0	0.0
Other Asian [1]	0	0.0
Native Hawaiian and Other Pacific Islander	0	0.0
Native Hawaiian	0	0.0
Guamanian or Chamorro	0	0.0
Samoan	0	0.0
Other Pacific Islander [2]	0	0.0
Some other race	0	0.0
Two or more races	0	0.0
Race alone or in combination with one or more other races [3]		
White	42	68.9
Black or African American	19	31.1
American Indian and Alaska Native	0	0.0
Asian	0	0.0
Native Hawaiian and Other Pacific Islander	0	0.0
Some other race	0	0.0
HISPANIC OR LATINO AND RACE		
Total population	**61**	**100.0**
Hispanic or Latino (of any race)	1	1.6
Mexican	0	0.0
Puerto Rican	0	0.0
Cuban	1	1.6
Other Hispanic or Latino	0	0.0
Not Hispanic or Latino	60	98.4
White alone	42	68.9
RELATIONSHIP		
Total population	**61**	**100.0**
In households	61	100.0
Householder	28	45.9
Spouse	12	19.7
Child	17	27.9
Own child under 18 years	11	18.0
Other relatives	2	3.3
Under 18 years	0	0.0
Nonrelatives	2	3.3
Unmarried partner	2	3.3
In group quarters	0	0.0
Institutionalized population	0	0.0
Noninstitutionalized population	0	0.0
HOUSEHOLDS BY TYPE		

Subject	Number	Percent
Total households	**28**	**100.0**
Family households (families)	17	60.7
With own children under 18 years	6	21.4
Married-couple family	12	42.9
With own children under 18 years	4	14.3
Female householder, no husband present	5	17.9
With own children under 18 years	2	7.1
Nonfamily households	11	39.3
Householder living alone	11	39.3
Householder 65 years and over	6	21.4
Households with individuals under 18 years	6	21.4
Households with individuals 65 years and over	12	42.9
Average household size	2.18	(X)
Average family size	2.82	(X)
HOUSING OCCUPANCY		
Total housing units	**36**	**100.0**
Occupied housing units	28	77.8
Vacant housing units	8	22.2
For seasonal, recreational, or occasional use	3	8.3
Homeowner vacancy rate (percent)	0.0	(X)
Rental vacancy rate (percent)	0.0	(X)
HOUSING TENURE		
Occupied housing units	**28**	**100.0**
Owner-occupied housing units	27	96.4
Renter-occupied housing units	1	3.6
Average household size of owner-occupied unit	2.22	(X)
Average household size of renter-occupied unit	1.00	(X)

(X) Not applicable
[1] Other Asian alone, or two or more Asian categories.
[2] Other Pacific Islander alone, or two or more Native Hawaiian and Other Pacific Islander categories.
[3] In combination with one or more other races listed. The six numbers may add to more than the total population and the six percentages may add to more than 100 percent because individuals may report more than one race.
Source: U.S. Census Bureau, Census 2000 Summary File 1, Matrices P1, P3, P4, P8, P9, P12, P13, P,17, P18, P19, P20, P23, P27, P28, P33, PCT5, PCT8, PCT11, PCT15, H1, H3, H4, H5, H11, and H12.

DP-1. **Profile of General Demographic Characteristics: 2000**
Data Set: Census 2000 Summary File 1 (SF 1) 100-Percent Data
Geographic Area: **Pomaria town, South Carolina**

NOTE: For information on confidentiality protection, nonsampling error, definitions, and count corrections see http://factfinder.census.gov/home/en/datanotes/expsf1u.htm.

Subject	Number	Percent
Total population	**177**	**100.0**
SEX AND AGE		
Male	98	55.4
Female	79	44.6
Under 5 years	18	10.2
5 to 9 years	8	4.5
10 to 14 years	6	3.4
15 to 19 years	13	7.3

Subject	Number	Percent
20 to 24 years	13	7.3
25 to 34 years	25	14.1
35 to 44 years	28	15.8
45 to 54 years	21	11.9
55 to 59 years	8	4.5
60 to 64 years	6	3.4
65 to 74 years	17	9.6
75 to 84 years	7	4.0
85 years and over	7	4.0
Median age (years)	37.5	(X)
18 years and over	136	76.8
Male	70	39.5
Female	66	37.3
21 years and over	129	72.9
62 years and over	34	19.2
65 years and over	31	17.5
Male	13	7.3
Female	18	10.2
RACE		
One race	173	97.7
White	97	54.8
Black or African American	73	41.2
American Indian and Alaska Native	0	0.0
Asian	0	0.0
Asian Indian	0	0.0
Chinese	0	0.0
Filipino	0	0.0
Japanese	0	0.0
Korean	0	0.0
Vietnamese	0	0.0
Other Asian [1]	0	0.0
Native Hawaiian and Other Pacific Islander	0	0.0
Native Hawaiian	0	0.0
Guamanian or Chamorro	0	0.0
Samoan	0	0.0
Other Pacific Islander [2]	0	0.0
Some other race	3	1.7
Two or more races	4	2.3
Race alone or in combination with one or more other races [3]		
White	98	55.4
Black or African American	77	43.5
American Indian and Alaska Native	0	0.0
Asian	0	0.0
Native Hawaiian and Other Pacific Islander	0	0.0
Some other race	6	3.4
HISPANIC OR LATINO AND RACE		
Total population	**177**	**100.0**
Hispanic or Latino (of any race)	4	2.3
Mexican	3	1.7
Puerto Rican	0	0.0
Cuban	0	0.0
Other Hispanic or Latino	1	0.6
Not Hispanic or Latino	173	97.7
White alone	96	54.2
RELATIONSHIP		
Total population	**177**	**100.0**
In households	177	100.0

Subject	Number	Percent
Householder	70	39.5
Spouse	32	18.1
Child	48	27.1
Own child under 18 years	37	20.9
Other relatives	10	5.6
Under 18 years	3	1.7
Nonrelatives	17	9.6
Unmarried partner	8	4.5
In group quarters	0	0.0
Institutionalized population	0	0.0
Noninstitutionalized population	0	0.0
HOUSEHOLDS BY TYPE		
Total households	**70**	**100.0**
Family households (families)	47	67.1
With own children under 18 years	21	30.0
Married-couple family	32	45.7
With own children under 18 years	12	17.1
Female householder, no husband present	11	15.7
With own children under 18 years	7	10.0
Nonfamily households	23	32.9
Householder living alone	17	24.3
Householder 65 years and over	7	10.0
Households with individuals under 18 years	23	32.9
Households with individuals 65 years and over	23	32.9
Average household size	2.53	(X)
Average family size	2.91	(X)
HOUSING OCCUPANCY		
Total housing units	**84**	**100.0**
Occupied housing units	70	83.3
Vacant housing units	14	16.7
For seasonal, recreational, or occasional use	1	1.2
Homeowner vacancy rate (percent)	0.0	(X)
Rental vacancy rate (percent)	21.1	(X)
HOUSING TENURE		
Occupied housing units	**70**	**100.0**
Owner-occupied housing units	55	78.6
Renter-occupied housing units	15	21.4
Average household size of owner-occupied unit	2.44	(X)
Average household size of renter-occupied unit	2.87	(X)

(X) Not applicable
[1] Other Asian alone, or two or more Asian categories.
[2] Other Pacific Islander alone, or two or more Native Hawaiian and Other Pacific Islander categories.
[3] In combination with one or more other races listed. The six numbers may add to more than the total population and the six percentages may add to more than 100 percent because individuals may report more than one race.
Source: U.S. Census Bureau, Census 2000 Summary File 1, Matrices P1, P3, P4, P8, P9, P12, P13, P,17, P18, P19, P20, P23, P27, P28, P33, PCT5, PCT8, PCT11, PCT15, H1, H3, H4, H5, H11, and H12.

Section 4.4 Ref 9

U.S. Census Bureau
American FactFinder

DP-1. Profile of General Demographic Characteristics: 2000
Data Set: Census 2000 Summary File 1 (SF 1) 100-Percent Data
Geographic Area: **Columbia city, South Carolina**

NOTE: Corrected counts are available for one or more geographies displayed in this table.

NOTE: For information on confidentiality protection, nonsampling error, definitions, and count corrections see http://factfinder.census.gov/home/en/datanotes/expsf1u.htm.

Subject	Number	Percent
Total population	**116,278**	**100.0**
SEX AND AGE		
Male	56,999	49.0
Female	59,279	51.0
Under 5 years	6,478	5.6
5 to 9 years	6,495	5.6
10 to 14 years	6,195	5.3
15 to 19 years	13,248	11.4
20 to 24 years	17,556	15.1
25 to 34 years	19,541	16.8
35 to 44 years	15,466	13.3
45 to 54 years	12,381	10.6
55 to 59 years	3,948	3.4
60 to 64 years	2,988	2.6
65 to 74 years	5,846	5.0
75 to 84 years	4,595	4.0
85 years and over	1,541	1.3
Median age (years)	28.6	(X)
18 years and over	92,908	79.9
Male	44,864	38.6
Female	48,044	41.3
21 years and over	79,204	68.1
62 years and over	13,735	11.8
65 years and over	11,982	10.3
Male	4,377	3.8
Female	7,605	6.5
RACE		
One race	114,691	98.6
White	57,236	49.2
Black or African American	53,465	46.0
American Indian and Alaska Native	296	0.3
Asian	2,008	1.7
Asian Indian	570	0.5
Chinese	453	0.4
Filipino	216	0.2
Japanese	109	0.1
Korean	353	0.3
Vietnamese	118	0.1
Other Asian [1]	189	0.2
Native Hawaiian and Other Pacific Islander	104	0.1
Native Hawaiian	29	0.0
Guamanian or Chamorro	30	0.0
Samoan	21	0.0

Subject	Number	Percent
Other Pacific Islander [2]	24	0.0
Some other race	1,582	1.4
Two or more races	1,587	1.4
Race alone or in combination with one or more other races [3]		
White	58,295	50.1
Black or African American	54,256	46.7
American Indian and Alaska Native	717	0.6
Asian	2,469	2.1
Native Hawaiian and Other Pacific Islander	217	0.2
Some other race	2,121	1.8
HISPANIC OR LATINO AND RACE		
Total population	**116,278**	**100.0**
Hispanic or Latino (of any race)	3,520	3.0
Mexican	1,387	1.2
Puerto Rican	886	0.8
Cuban	125	0.1
Other Hispanic or Latino	1,122	1.0
Not Hispanic or Latino	112,758	97.0
White alone	55,993	48.2
RELATIONSHIP		
Total population	**116,278**	**100.0**
In households	93,288	80.2
Householder	42,245	36.3
Spouse	13,304	11.4
Child	24,597	21.2
Own child under 18 years	19,161	16.5
Other relatives	5,711	4.9
Under 18 years	2,586	2.2
Nonrelatives	7,431	6.4
Unmarried partner	2,093	1.8
In group quarters	22,990	19.8
Institutionalized population	6,053	5.2
Noninstitutionalized population	16,937	14.6
HOUSEHOLDS BY TYPE		
Total households	**42,245**	**100.0**
Family households (families)	22,136	52.4
With own children under 18 years	10,732	25.4
Married-couple family	13,304	31.5
With own children under 18 years	5,633	13.3
Female householder, no husband present	7,456	17.6
With own children under 18 years	4,548	10.8
Nonfamily households	20,109	47.6
Householder living alone	15,633	37.0
Householder 65 years and over	4,140	9.8
Households with individuals under 18 years	12,130	28.7
Households with individuals 65 years and over	8,580	20.3
Average household size	2.21	(X)
Average family size	2.97	(X)
HOUSING OCCUPANCY		
Total housing units	**46,142**	**100.0**
Occupied housing units	42,245	91.6
Vacant housing units	3,897	8.4
For seasonal, recreational, or occasional use	213	0.5
Homeowner vacancy rate (percent)	2.2	(X)
Rental vacancy rate (percent)	7.7	(X)

Subject	Number	Percent
HOUSING TENURE		
Occupied housing units	**42,245**	**100.0**
Owner-occupied housing units	19,282	45.6
Renter-occupied housing units	22,963	54.4
Average household size of owner-occupied unit	2.29	(X)
Average household size of renter-occupied unit	2.14	(X)

(X) Not applicable
[1] Other Asian alone, or two or more Asian categories.
[2] Other Pacific Islander alone, or two or more Native Hawaiian and Other Pacific Islander categories.
[3] In combination with one or more other races listed. The six numbers may add to more than the total population and the six percentages may add to more than 100 percent because individuals may report more than one race.
Source: U.S. Census Bureau, Census 2000 Summary File 1, Matrices P1, P3, P4, P8, P9, P12, P13, P,17, P18, P19, P20, P23, P27, P28, P33, PCT5, PCT8, PCT11, PCT15, H1, H3, H4, H5, H11, and H12.

GEO_ID	GEO_ID2	SUMLEVEL	GEO_NAME	P003001	P003003	P003004	P003005	P003006	P003007	P003008	P003009	P004002	
Geography Identifier	Geography Identifier	Geographic Summary Level	Geography	Total population: Total	Total population: Population of one race; White alone	Total population: Population of one race; Black or African American alone	Total population: Population of one race; American Indian and Alaska Native alone	Total population: Population of one race; Asian alone	Total population: Population of one race; Native Hawaiian and Other Pacific Islander alone	Total population: Population of one race; Some other race alone	Total population: Population of two or more races	Total population: Hispanic or Latino	Aggregate
04000US45	45	040	South Carolina	4012012	2695560	1185216	13718	36014	1628	39926	30950	95076	1316452
						29.54168632	0.341923205	0.897654344	0.040578144	0.99516153	0.995759734	2.36978354	32.81276

USCB 000016

GEO_ID	GEO_ID2	SUMLEVEL	GEO_NAME	P003001	P003003	P003004	P003005	P003006	P003007	P003008	P003009	P004002	
Geography Identifier	Geography Identifier	Geographic Summary Level	Geography	Total population: Total	Total population: Population of one race; White alone	Total population: Population of one race; Black or African American alone	Total population: Population of one race; American Indian and Alaska Native alone	Total population: Population of one race; Asian alone	Total population: Population of one race; Native Hawaiian and Other Pacific Islander alone	Total population: Population of one race; Some other race alone	Total population: Population of two or more races	Total population: Hispanic or Latino	Aggregate
04000US37	37	040	North Carolina	8049313	5804856	1737545	99551	113689	3983	186629	103260	378983	2244857
						21.58625214	1.236783933	1.412406251	0.049482484	2.318570541	1.282842399	4.708018697	27.88831775

Section 4.4 Ref 10

US EPA 1991

WATER ON TAP
what you need to know

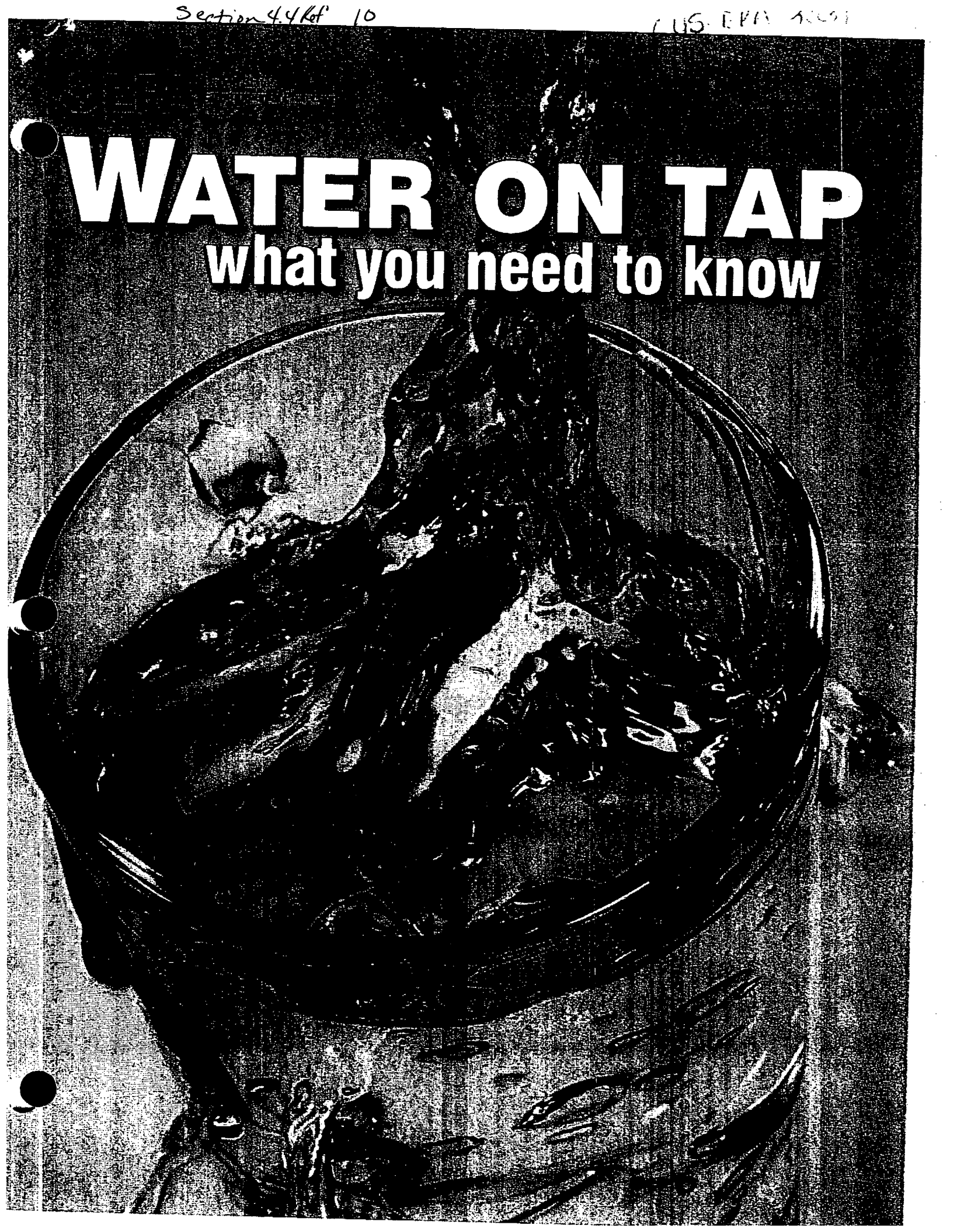


Table of Contents

Chapter *Page No.*

1. A Consumer's Guide To The Nation's Drinking Water 1
2. How Safe Is My Drinking Water? 2
3. Where Does My Drinking Water Come From And How Is It Treated? 7
4. How Do We Use Drinking Water In Our Homes? 10
5. What's Being Done To Improve Water Security? 13
6. What Can I Do If There Is A Problem With My Drinking Water? 15
7. How Safe Is The Drinking Water In My Household Well? 18
8. What You Can Do To Protect Your Drinking Water 21

Appendix A: National Primary Drinking Water Standards as of 10/03 23

Appendix B: References 28

Appendix C: Sources of Additional Information 29

Appendix D: Glossary 31

Office of Water (4601)
EPA 816-K-03-007
www.epa.gov/safewater
October 2003

Printed on Recycled Paper

1. A Consumer's Guide To The Nation's Drinking Water

The United States enjoys one of the best supplies of drinking water in the world. Nevertheless, many of us who once gave little or no thought to the water that comes from our taps are now asking the question: "Is my water safe to drink?" While tap water that meets federal and state standards is generally safe to drink, threats to drinking water are increasing. Short-term disease outbreaks and water restrictions during droughts have demonstrated that we can no longer take our drinking water for granted.

Consumers have many questions about their drinking water. How safe is my drinking water? What is being done to improve security of public water systems? Where does my drinking water come from, and how is it treated? Do private **wells** receive the same protection as public water systems? What can I do to help protect my drinking water?

This booklet provides the answers to these and other frequently asked questions.

This booklet also directs you to more detailed sources of information. Often, you will be directed to a page on the EPA website. Additionally, the Safe Drinking Water Hotline is available to answer your questions. Please also see Appendix C for more resources. Refer to the Glossary (Appendix D) for definitions of words in bold font.

What you need to know to protect your family

Sensitive Subpopulations

Some people may be more vulnerable to **contaminants** in drinking water than the general population. People undergoing chemotherapy or living with HIV/AIDS, transplant patients, children and infants, the frail elderly, and pregnant women and their fetuses can be particularly at risk for infections.

If you have special health care needs, consider taking additional precautions with your drinking water, and seek advice from your health care provider. For more information, see *www.epa.gov/safewater/healthcare/special.html*.

You will find information on bottled water and home water treatment units on page 16 of this booklet. You may also contact NSF International, Underwriter's Laboratory, or the Water Quality Association. Contact information is located in Appendix C.

2. How Safe Is My Drinking Water?

What Law Keeps My Drinking Water Safe?

Congress passed the Safe Drinking Water Act (SDWA) in 1974 to protect public health by regulating the nation's public drinking water supply and protecting sources of drinking water. SDWA is administered by the U.S. Environmental Protection Agency (EPA) and its state partners.

Highlights of the Safe Drinking Water Act

- Authorizes EPA to set enforceable health standards for contaminants in drinking water
- Requires public notification of water systems violations and annual reports (Consumer Confidence Reports) to customers on contaminants found in their drinking water - *www.epa.gov/safewater/ccr*
- Establishes a federal-state partnership for regulation enforcement
- Includes provisions specifically designed to protect underground sources of drinking water - www.epa.gov/safewater/uic
- Requires disinfection of surface water supplies, except those with pristine, protected sources
- Establishes a multi-billion-dollar state revolving loan fund for water system upgrades - www.epa.gov/safewater/dwsrf
- Requires an assessment of the vulnerability of all drinking water sources to contamination - *www.epa.gov/safewater/protect*

— *Drinking Water: Past, Present, and Future EPA-816-F-00-002*

What Is A Public Water System?

The Safe Drinking Water Act (SDWA) defines a **public water system (PWS)** as one that serves piped water to at least 25 persons or 15 service connections for at least 60 days each year. There are approximately 161,000 public water systems in the United States.[1] Such systems may be publicly or privately owned. **Community water systems (CWSs)** are public water systems that serve people year-round in their homes. Most people in the U.S. (268 million) get their water from a community water system. EPA also regulates other kinds of public water systems,

Public Water Systems

Community Water System (54,000 systems)—A public water system that serves the same people year-round. Most residences are served by Community Water Systems.

Non-Community Water System (approximately 108,000 systems)—A public water system that does not serve the same people year-round. There are two types of non-community systems:

- *Non-Transient Non-Community Water System (almost 19,000 systems)*—A non-community water system that serves the same people more than six months of the year, but not year-round. For example, a school with its own water supply is considered a non-transient system.
- *Transient Non-Community Water System (more than 89,000 systems)*—A non-community water system that serves the public but not the same individuals for more than six months. For example, a rest area or a campground may be considered a transient system.

such as those at schools, campgrounds, factories, and restaurants. Private water supplies, such as household wells that serve one or a few homes, are not regulated by EPA. For information on household wells, see "How Safe Is The Drinking Water In My Household Well?" on page 18 of this booklet.

Cost of Making Water Safe Continues to Rise

Much of the existing water infrastructure (underground pipes, treatment plants, and other facilities) was built many years ago. In 1999, EPA conducted the second Drinking Water Infrastructure Needs Survey, and found that drinking water systems will need to invest $150 billion over a 20-year period to ensure clean and safe drinking water.

Will Water Systems Have Adequate Funding In The Future?

Nationwide, drinking water systems have spent hundreds of billions of dollars to build drinking water treatment and **distribution systems**. From 1995 to 2000, more than $50 billion was spent on capital investments to fund water quality improvements.[2]

With the aging of the nation's infrastructure, the clean water and drinking water industries face a significant challenge to sustain and advance their achievements in protecting public health. EPA's *Clean Water & Drinking Water Infrastructure Gap Analysis*[3] has found that if present levels of spending do not increase, there will be a significant funding gap by the year 2019.

Where Can I Find Information About My Local Water System?

Since 1999, water suppliers have been required to provide annual Consumer Confidence Reports to their customers. These reports are due by July 1 each year, and contain information on contaminants found in the drinking water, possible health effects, and the water's source. Some Consumer Confidence Reports are available at *www.epa.gov/safewater/dwinfo.htm.*

Water suppliers must promptly inform you if your water has become contaminated by something that can cause immediate illness. Water suppliers have 24 hours to inform their customers of **violations** of EPA standards "that have the potential to have serious adverse effects on human health as a result of short-term exposure." If such a violation occurs, the water system will announce it through the media, and must provide information about the potential adverse effects on human health, steps the system is taking to correct the violation, and the need to use alternative water supplies (such as boiled or bottled water) until the problem is corrected.

Systems will inform customers about violations of less immediate concern in the first water bill sent after the violation, in a Consumer Confidence Report, or by mail within a year. In 1998, states began compiling information on individual systems, so you can evaluate the overall quality of drinking water in your state. Additionally, EPA must compile and summarize the state reports into an annual report on the condition of the nation's drinking water. To view the most recent annual report, see *www.epa.gov/safewater/annual.*

How Often Is My Water Supply Tested?

EPA has established pollutant-specific minimum testing schedules for public water systems. To find out how frequently your drinking water is tested, contact your water system or the agency in your state in charge of drinking water.

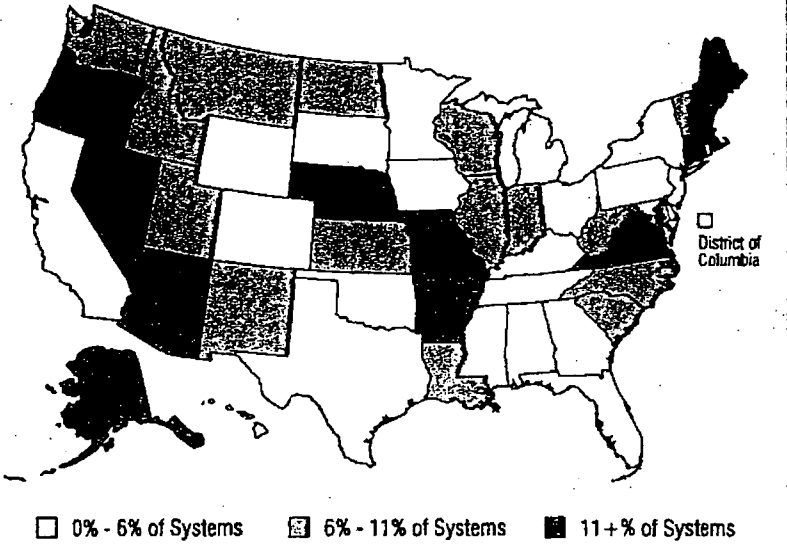
If a problem is detected, immediate retesting requirements go into effect along with strict instructions about how the system informs the public. Until the system can reliably demonstrate that it is free of problems, the retesting is continued.

In 2001, one out of every four community water systems did not conduct testing or report the results for all of the monitoring required to verify the safety

of their drinking water.[4] Although failure to monitor does not necessarily suggest safety problems, conducting the required reporting is crucial to ensure that problems will be detected. Consumers can help make sure certain monitoring and reporting requirements are met by first contacting their state drinking water agency to determine if their water supplier is in compliance. If the water system is not meeting the requirements, consumers can work with local and state officials and the water supplier to make sure the required monitoring and reporting occurs.

A network of government agencies monitor tap water suppliers and enforce drinking water standards to ensure the safety of public water supplies. These agencies include EPA, state departments of health and environment, and local public health departments.

Reported Community Water Systems Violating Maximum Contaminant Levels or Treatment Standards in FY 2002



Common Sources of Pollution

Naturally Occurring: microorganisms (wildlife and soils), radionuclides (underlying rock), nitrates and nitrites (nitrogen compounds in the soil), heavy metals (underground rocks containing arsenic, cadmium, chromium, lead, and selenium), fluoride.

Human Activities: bacteria and nitrates (human and animal wastes—septic tanks and large farms), heavy metals (mining construction, older fruit orchards), fertilizers and pesticides (used by you and others (anywhere crops or lawns are maintained)), industrial products and wastes (local factories, industrial plants, gas stations, dry cleaners, leaking underground storage tanks, landfills, and waste dumps), household wastes (cleaning solvents, used motor oil, paint, paint thinner), lead and copper (household plumbing materials), water treatment chemicals (wastewater treatment plants).

Nevertheless, problems with local drinking water can, and do, occur.

What Problems Can Occur?

Actual events of drinking water contamination are rare, and typically do not occur at levels likely to pose health concerns. However, as development in our modern society increases, there are growing numbers of activities that can contaminate our drinking water. Improperly disposed-of chemicals, animal and human wastes, wastes injected underground, and naturally occurring substances have the potential to contaminate drinking water. Likewise, drinking water that is not properly treated or disinfected, or that travels through an improperly maintained distribution system, may also pose a health risk. Greater vigilance by you, your water supplier, and your government can help prevent such events in your water supply.

Contaminants can enter water supplies either as a result of human and animal activities, or because they occur naturally in the environment. Threats to your drinking water may exist in your neighborhood, or may occur many miles away. For more information on drinking water threats, see *www.epa.gov/safewater/*

publicoutreach/landscapeposter.html. Some typical examples are microbial contamination, chemical contamination from fertilizers, and lead contamination.

Boil Water Notices for Microbial Contaminants

When microorganisms such as those that indicate fecal contamination are found in drinking water, water suppliers are required to issue "Boil Water Notices." Boiling water for one minute kills the microorganisms that cause disease. Therefore, these notices serve as a precaution to the public. *www.epa.gov/safewater/faq/emerg.html*

Microbial Contamination:

The potential for health problems from microbial-contaminated drinking water is demonstrated by localized outbreaks of waterborne disease. Many of these outbreaks have been linked to contamination by bacteria or viruses, probably from human or animal wastes. For example, in 1999 and 2000, there were 39 reported disease outbreaks associated with drinking water, some of which were linked to public drinking water supplies.[5]

Certain **pathogens** (disease-causing **microorganisms**), such as ***Cryptosporidium***, may occasionally pass through water filtration and disinfection processes in numbers high enough to cause health problems, particularly in vulnerable members of the population. *Cryptosporidium* causes the gastrointestinal disease, cryptosporidiosis, and can cause serious, sometimes fatal, symptoms, especially among sensitive members of the population. (See box on Sensitive Subpopulations on page 1.) A serious outbreak of cryptosporidiosis occurred in 1993 in Milwaukee, Wisconsin, causing more than 400,000 persons to be infected with the disease, and resulting in at least 50 deaths. This was the largest recorded outbreak of waterborne disease in United States history.[6]

Excessive levels of nitrates can cause "blue baby syndrome," which can be fatal without immediate medical attention.

Chemical Contamination From Fertilizers:

Nitrate, a chemical most commonly used as a fertilizer, poses an immediate threat to infants when it is found in drinking water at levels above the national standard. Nitrates are converted to nitrites in the intestines. Once absorbed into the bloodstream, nitrites prevent hemoglobin from transporting oxygen. (Older children have an enzyme that restores hemoglobin.) Excessive levels can cause "blue baby syndrome," which can be fatal without immediate medical attention. Infants most at risk for blue baby syndrome are those who are already sick, and while they are sick, consume food that is high in nitrates or drink water or formula mixed with water that is high in nitrates. Avoid using water with high nitrate levels for drinking. This is especially important for infants and young children, nursing mothers, pregnant women and certain elderly people.

Nitrates: Do NOT Boil

Do NOT boil water to attempt to reduce nitrates. Boiling water contaminated with nitrates increases its concentration and potential risk. If you are concerned about nitrates, talk to your health care provider about alternatives to boiling water for baby formula.

Lead Contamination:

Lead, a metal found in natural deposits, is commonly used in household plumbing materials and water service lines. The greatest exposure to lead is swallowing lead paint chips or breathing in lead dust. But lead in drinking water can also cause a variety of adverse health effects. In babies and children, exposure to lead in drinking water above the **action level** of lead (0.015 milligram per liter) can result in delays in physical and mental development, along with slight deficits in attention span and learning abilities. Adults who drink this water over many years could develop kidney problems or high blood pressure. Lead is rarely found in source water, but enters tap water through corrosion of plumbing materials. Very old and poorly maintained homes may be more likely to have lead pipes, joints, and solder. However, new homes are also at risk: pipes legally considered to be "lead-free" may contain up to eight percent lead. These pipes can leach significant amounts of lead in the water for the first several months after their installation. For more information on lead contamination, see *www.epa.gov/safewater/contaminants/dw_contamfs/lead.html.*

Lead: Do NOT Boil

Do NOT boil water to attempt to reduce lead. Boiling water increases lead concentration. Always use water from the cold tap for preparing baby formula, cooking, and drinking. Flush pipes first by running the water before using it. Allow the water to run until it's cold. If you have high lead levels in your tap water, talk to your health care provider about alternatives to using boiled water in baby formula.

For more information on drinking water contaminants that are regulated by EPA, see Appendix A, or visit *www.epa.gov/safewater/mcl.html.*

Where Can I Find More Information About My Drinking Water?

Drinking water varies from place to place, depending on the water's source and the treatment it receives. If your drinking water comes from a community water system, the system will deliver to its customers annual drinking water quality reports (or Consumer Confidence Reports). These reports will tell consumers what contaminants have been detected in their drinking water, how these detection levels compare to drinking water standards, and where their water comes from. The reports must be provided annually before July 1, and, in most cases, are mailed directly to customers' homes. Contact your water supplier to get a copy of your report, or see if your report is posted online at *www.epa.gov/safewater/dwinfo.htm.* Your state's department of health or environment can also be a valuable source of information. For help in locating these agencies, call the Safe Drinking Water Hotline. Further resources can be found in Appendix C. Information on testing household wells is on page 19.

---

1 *Factoids: Drinking Water & Ground Water Statistics for 2002, 2003.*

2 *Community Water Systems Survey 2000, Volume I, 2001.*

3 *The Clean Water and Drinking Water Infrastructure Gap Analysis,* EPA 816-R-02-020.

4 *Factoids: Drinking Water and Ground Water Statistics for 2001,* EPA 816-K-02-004.

5 *Morbidity and Mortality Weekly Report: Surveillance for Waterborne Disease Outbreaks, United States 1999-2000, 2002.*

6 *25 Years of the Safe Drinking Water Act, 1999.*

3. Where Does My Drinking Water Come From And How Is It Treated?

Your drinking water comes from **surface water** or **ground water**. The water that systems pump and treat from sources open to the atmosphere, such as rivers, lakes, and reservoirs is known as surface water. Water pumped from wells drilled into underground **aquifers**, geologic formations containing water, is called ground water. The quantity of water produced by a well depends on the nature of the rock, sand, or soil in the aquifer from which the water is drawn. Drinking water wells may be shallow (50 feet or less) or deep (more than 1,000 feet). More water systems have ground water than surface water as a source (approx. 147,000 v. 14,500), but more people drink from a surface water system (195 million v. 101,400). Large-scale water supply systems tend to rely on surface water resources, while smaller water systems tend to use ground water. Your water utility or public works department can tell you the source of your public water supply.

How Does Water Get To My Faucet?

An underground network of pipes typically delivers drinking water to the homes and businesses served by the water system. Small systems serving just a handful of households may be relatively simple, while large metropolitan systems can be extremely complex—sometimes consisting of thousands of miles of pipes serving millions of people. Drinking water must meet required health standards when it leaves the treatment plant. After treated water leaves the plant, it is monitored within the distribution system to identify and remedy any problems such as water main breaks, pressure variations, or growth of microorganisms.

How Is My Water Treated To Make It Safe?

Water utilities treat nearly 34 billion gallons of water every day.[1] The amount and type of treatment applied varies with the source and quality of the water. Generally, surface water systems require more treatment than ground water systems because they are directly exposed to the atmosphere and runoff from rain and melting snow.

Water suppliers use a variety of treatment processes to remove contaminants from drinking water. These individual processes can be arranged in a "treatment train" (a series of processes applied in a sequence). The most commonly used processes include coagulation (flocculation and sedimentation), filtration, and disinfection. Some water systems also use ion exchange and adsorption. Water utilities select the treatment combination most appropriate to treat the contaminants found in the **source water** of that particular system.

Coagulation (Flocculation & Sedimentation):

Flocculation: This step removes dirt and other particles suspended in the water. Alum and iron salts or synthetic organic polymers are added to the water to form tiny sticky particles called "floc," which attract the dirt particles.

> All sources of drinking water contain some naturally occurring contaminants. At low levels, these contaminants generally are not harmful in our drinking water. Removing all contaminants would be extremely expensive, and in most cases, would not provide increased protection of public health. A few naturally occurring minerals may actually improve the taste of drinking water and may even have nutritional value at low levels.

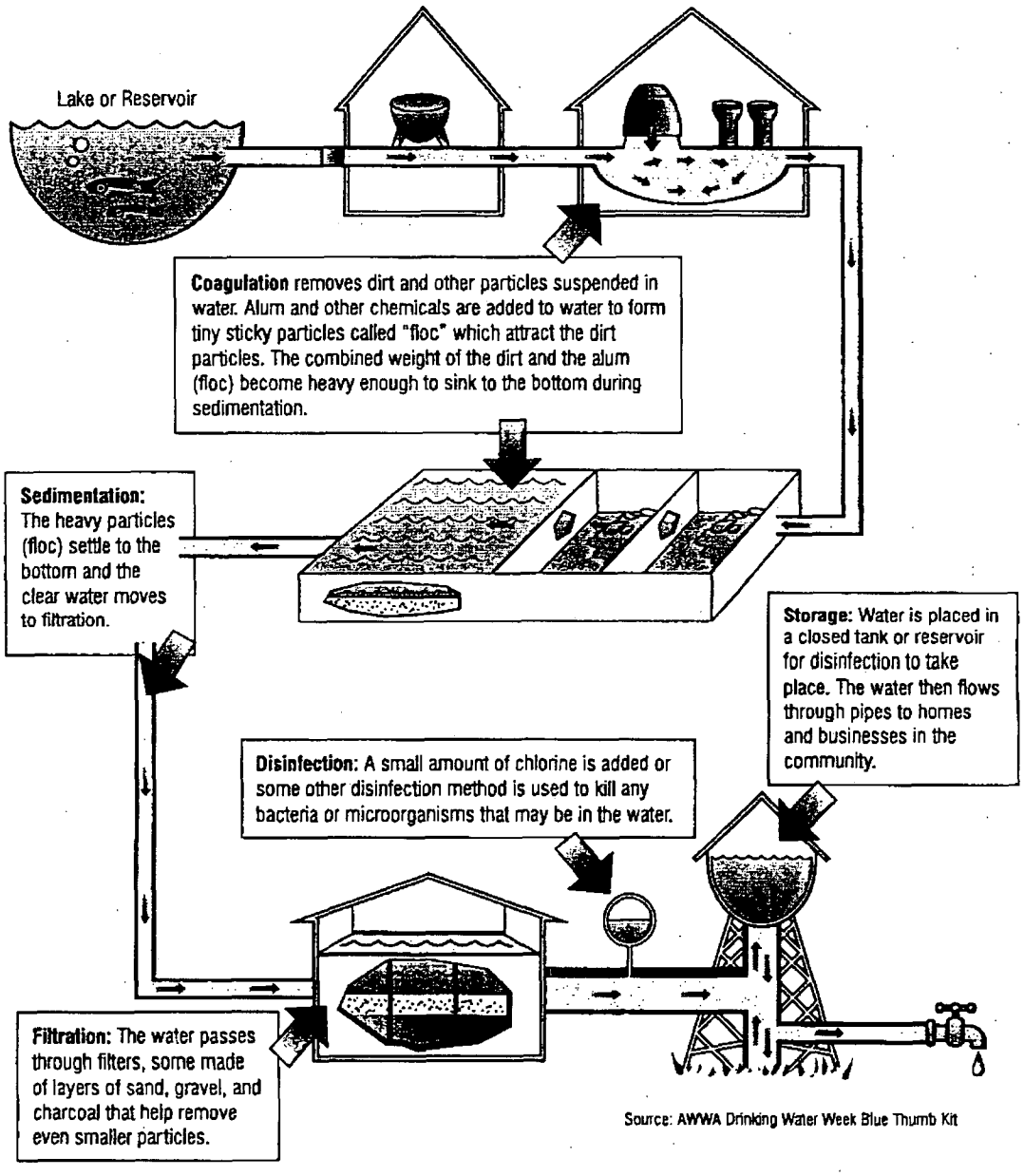
Sedimentation: The flocculated particles then settle naturally out of the water.

Filtration:

Many water treatment facilities use filtration to remove all particles from the water. Those particles include clays and silts, natural organic matter, precipitates from other treatment processes in the facility, iron and manganese, and microorganisms. Filtration clarifies the water and enhances the effectiveness of disinfection.

Water Treatment Plant

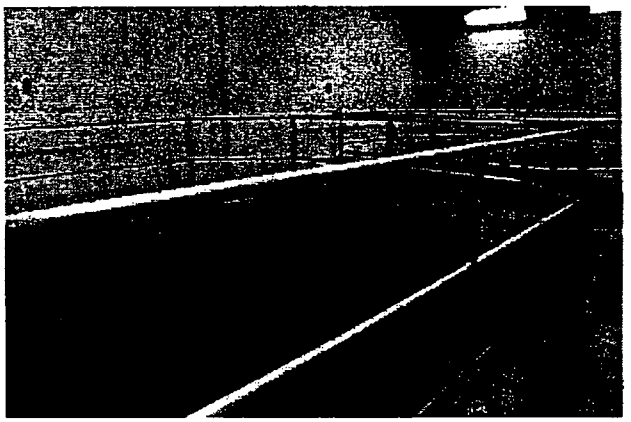
Follow a drop of water from the source through the treatment process. Water may be treated differently in different communities depending on the quality of the water which enters the plant. Groundwater is located underground and typically requires less treatment than water from lakes, rivers, and streams.



Source: AWWA Drinking Water Week Blue Thumb Kit

Disinfection:

Disinfection of drinking water is considered to be one of the major public health advances of the 20th century. Water is often disinfected before it enters the distribution system to ensure that dangerous microbial contaminants are killed. Chlorine, chlorinates, or chlorine dioxides are most often used because they are very effective **disinfectants**, and residual concentrations can be maintained in the water system.



Water System Filtration Tank

Why Is My Water Bill Rising?

The cost of drinking water is rising as suppliers meet the needs of aging infrastructure, comply with public health standards, and expand service areas. In most cases, these increasing costs have caused water suppliers to raise their rates. However, despite rate increases, water is generally still a bargain compared to other utilities, such as electricity and phone service. In fact, in the United States, combined water and sewer bills average only about 0.5 percent of household income.[2]

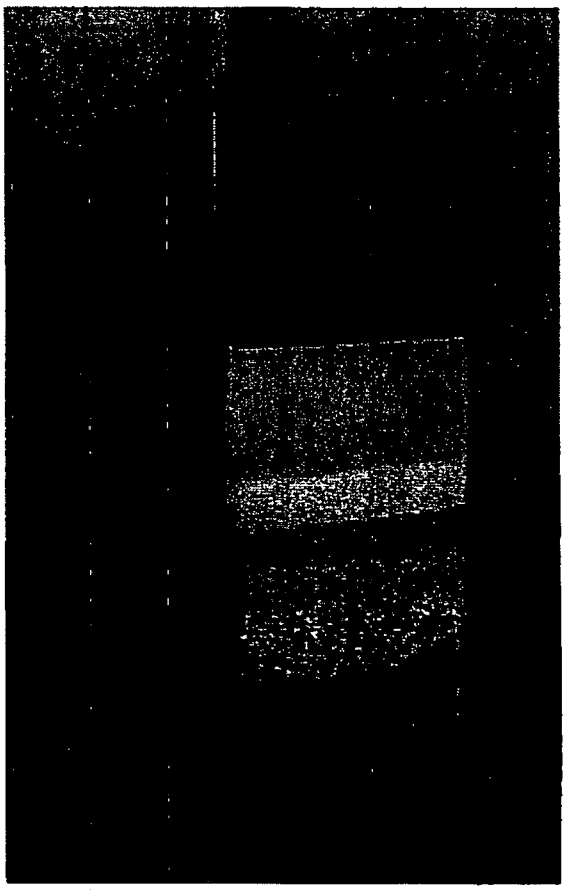
---

1 *Protect Your Drinking Water*, 2002.

2 *Congressional Budget Office Study: Future Investment in Drinking Water & Wastewater Infrastructure, 2002.*

Disinfection Byproducts

Disinfection of drinking water is one of the major public health advances of the 20th century. However, sometimes the disinfectants themselves can react with naturally occurring materials in the water to form unintended byproducts, which may pose health risks. EPA recognizes the importance of removing microbial contaminants while simultaneously protecting the public from disinfection byproducts, and has developed regulations to limit the presence of these byproducts. For more information, see *www.epa.gov/safewater/mdbp.html.*



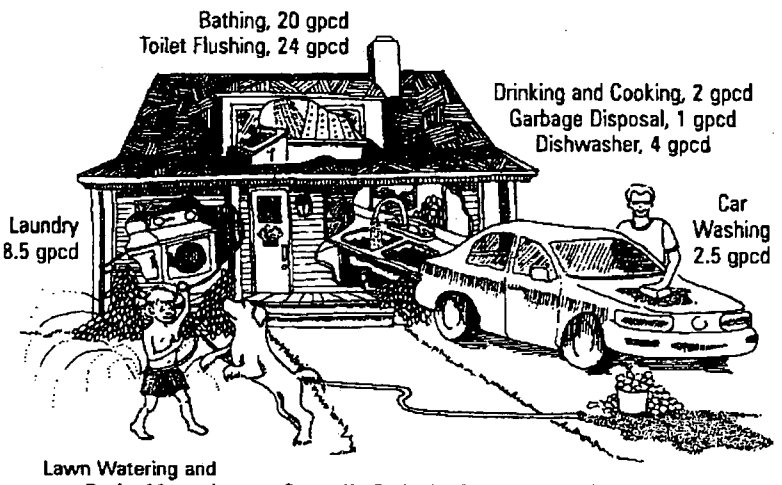
Water passes through charcoal, sand, and gravel layers in a water system's filtration tank.

4. How Do We Use Drinking Water In Our Homes?

We take our water supplies for granted, yet they are limited. Only one percent of all the world's water can be used for drinking. Nearly 97 percent of the world's water is salty or otherwise undrinkable, and the other two percent is locked away in ice caps and glaciers. There is no "new" water: whether our source water is a stream, river, lake, spring, or well, we are using the same water the dinosaurs used millions of years ago.

Common Household Uses of Drinking Water*

*(*Gallons per Capita per Day)*



Source: Van Der Leeden, F., F. L. Troise, and D. K. Todd. The Water Encyclopedia. Lewis Publishers, Inc. Second Edition, 1990.

The average American uses about 90 gallons of water each day in the home, and each American household uses approximately 107,000 gallons of water each year.[1] For the most part, we use water treated to meet drinking water standards to flush toilets, water lawns, and wash dishes, clothes, and cars. In fact, 50-70 percent of home water is used for watering lawns and gardens.[2] Nearly 14 percent of the water a typical homeowner pays for is never even used—it leaks down the drain.[3]

How Much Water Do Homes In The U.S. Use Compared To Other Countries?

Americans use much more water each day than individuals in both developed and undeveloped countries: For example, the average European uses 53 gallons; the average Sub-Saharan citizen, 3-5 gallons.[4]

Water efficiency plays an important role in protecting water sources and improving water quality. By using water wisely, we can save money and help the environment. Water efficiency means using less water to provide the same benefit. Using water-saving techniques could save you hundreds of dollars each year, while also reducing the amount of pollutants entering our waterways.

How Do Drinking Water Utilities Conserve Water?

Water utilities forecast water source availability, growth in population, and water demand to ensure adequate future water supplies during normal conditions, as well as periods of drought. When water shortages are predicted or experienced, water utilities have many options for conserving water. Temporary cutbacks or permanent operating adjustments can help conserve water.

Temporary cutbacks may include:

- Reduction of system-wide operating pressure, and
- Water use bans, restrictions, and rationing.

Permanent conservation measures may include:

- Subsidizing use of water-efficient faucets, toilets, and showerheads,
- Public education and voluntary use reduction,
- Billing practices that impose higher rates for higher amounts of water use,
- Building codes that require water-efficient fixtures and appliances,
- Leak detection surveys and meter testing, repair, and replacement, and
- Reduction in use and increase in recycling of industrial water.

How Can Businesses Conserve Water?

The industrial and commercial sectors can conserve water through recycling and waste reduction. Industry has implemented conservation measures to comply with state and federal water pollution controls. Evaluation of industrial plant data may show that a particular process or manufacturing step uses the most water or causes the greatest contamination. Such areas can be targeted for water conservation. Also, water that is contaminated by one process may be usable in other plant processes that do not require high-quality water.

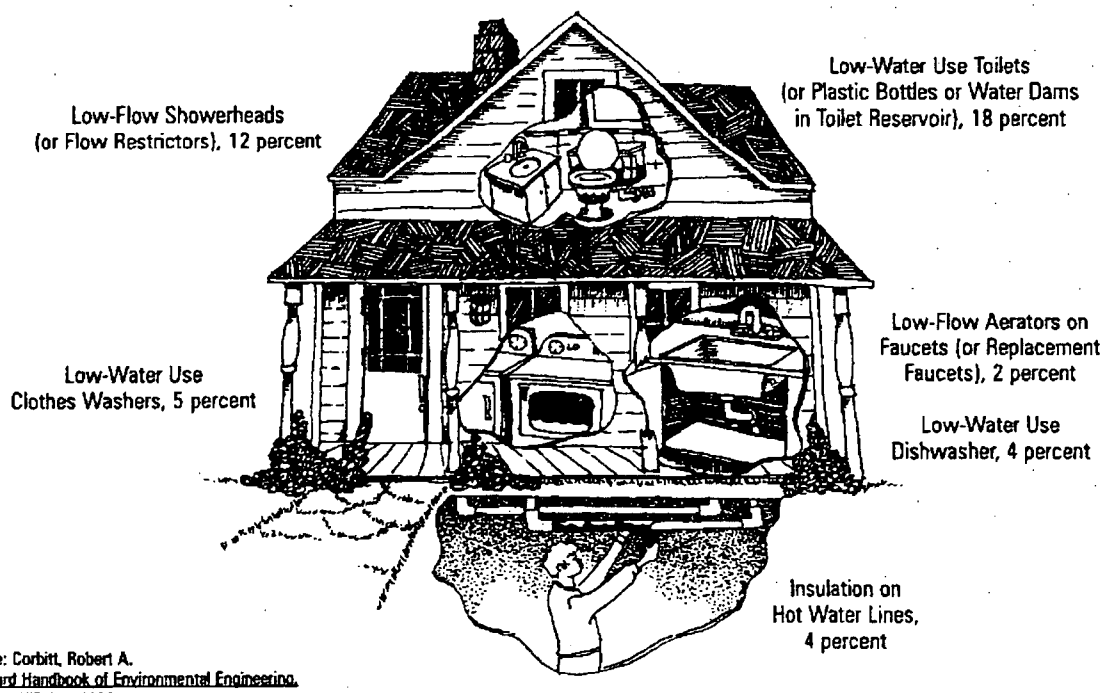
How Can I Conserve Water?

The national average cost of water is $2.00 per 1,000 gallons. The average American family spends about $474 each year on water and sewage charges.[5] American households spend an additional $230 per year on water heating costs.[6] By replacing appliances such as the dishwasher and inefficient fixtures such as toilets and showerheads, you can save a substantial amount each year in water, sewage, and energy costs.

There are many ways to save water in and around your home. Here are the five that might get the best results:

Ways To Save Water At Home*

*(*Water Savings as Percent of Total Interior Water Use)*



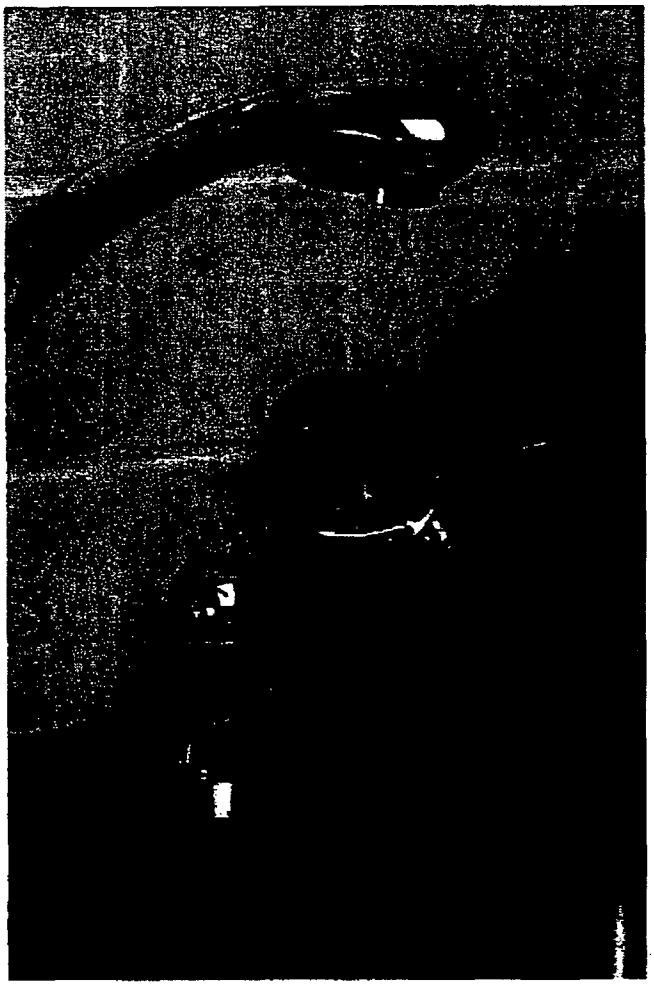
Source: Corbitt, Robert A.
Standard Handbook of Environmental Engineering.
McGraw-Hill, Inc. 1989.

- *Stop Leaks.*
- *Replace Old Toilets* with models that use 1.6 gallons or less per flush.
- *Replace Old Clothes Washers* with EPA Energy Star certified models.
- *Plant the Right Kind of Garden* that requires less water.
- *Provide Only the Water Plants Need.*

For more information on ways to conserve water in the home, see *www.epa.gov/water/waterefficiency.html* or *www.h2ouse.org.*

---

[1] *Water Trivia Facts*, EPA 80-F-95-001.
[2] AWWA *Stats on Tap.*
[3] *Using Water Wisely in the Home*, 2002.
[4] *The Use of Water Today*, World Water Council.
[5] *Investing in America's Water Infrastructure*, 2002.
[6] *Using Water Wisely in the Home*, 2002.



Nearly 14 percent of the water a typical homeowner pays for is never even used—it leaks down the drain.

Using Water Wisely in the Home, 2002

5. What's Being Done To Improve Water Security?

What Security Measures Are In Place To Protect Water Systems?

Drinking water utilities today find themselves facing new responsibilities due to concerns over water system security and counter-terrorism. EPA is committed to the safety of public drinking water supplies and has taken numerous steps to work with utilities, other government agencies, and law enforcement to minimize threats.

The Public Health Security and Bioterrorism Preparedness and Response Act of 2002 requires that all community water systems serving more than 3,300 people evaluate their susceptibility to potential threats and identify corrective actions. EPA has provided assistance to help utilities with these **Vulnerability Assessments** by giving direct grants to large systems, supporting self-assessment tools, and providing technical help and training to small and medium utilities. For more information on water system security, see *www.epa.gov/safewater/security.*

How Can I Help Protect My Drinking Water?

Local drinking water and wastewater systems may be targets for terrorists and other would-be criminals

wishing to disrupt and cause harm to your community water supplies or wastewater facilities.

Because utilities are often located in isolated areas, drinking water sources and wastewater collection systems may cover large areas that are difficult to secure and patrol. Residents can be educated to notice and report any suspicious activity in and around local water utilities. Any residents interested in protecting their water resources and community as a whole can join together with law enforcement, neighborhood watch groups, water suppliers, wastewater operators, and other local public health officials. If you witness suspicious activities, report them to your local law enforcement authorities.

Examples of suspicious activity might include:

- People climbing or cutting a utility fence
- People dumping or discharging material to a water reservoir

- Unidentified truck or car parked or loitering near waterway or facilities for no apparent reason
- Suspicious opening or tampering with manhole covers, fire hydrants, buildings, or equipment

- People climbing or on top of water tanks
- People photographing or videotaping utility facilities, structures or equipment
- Strangers hanging around locks or gates

Report suspicious activity to local authorities

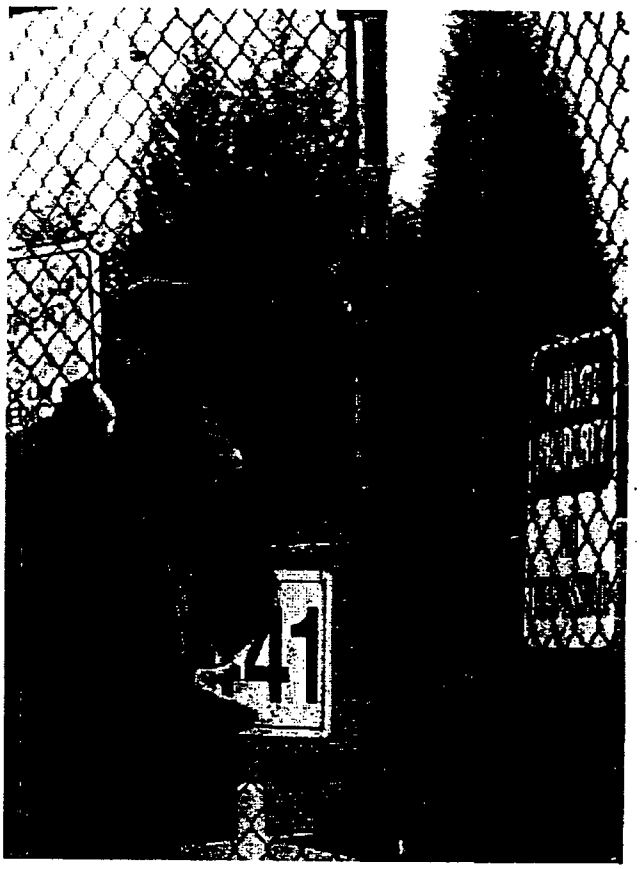
Do not confront strangers. Instead report suspicious activities to local authorities.

When reporting an incident:

- State the nature of the incident
- Identify yourself and your location
- Identify location of activity
- Describe any vehicle involved (color, make, model, plate number)
- Describe the participants (how many, sex, race, color of hair, height, weight, clothing)

For emergencies, dial 9-1-1 or other local emergency response numbers.

For more information on water security, visit: *www.epa.gov/safewater/security*



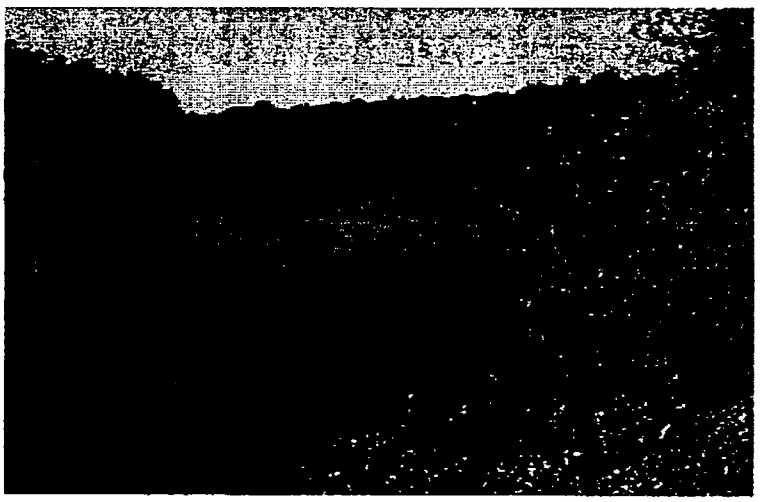
6. What Can I Do If There Is A Problem With My Drinking Water?

Local incidents, such as spills and treatment problems, can lead to short-term needs for alternative water supplies or in-home water treatment. In isolated cases, individuals may need to rely on alternative sources for the long term, due to their individual health needs or problems with obtaining new drinking water supplies.

What Alternative Sources Of Water Are Available?

Bottled water is sold in supermarkets and convenience stores. Some companies lease or sell water dispensers or bubblers and regularly deliver large bottles of water to homes and businesses. It is expensive compared to water from a public water system. The bottled water quality varies among brands, because of the variations in the source water used, costs, and company practices.

The U.S. Food and Drug Administration (FDA) regulates bottled water used for drinking. While most consumers assume that bottled water is at least as safe as tap water, there are still potential risks. Although required to meet the same safety standards as public water supplies, bottled water does not undergo the same testing and reporting as water from a treatment facility. Water that is bottled and sold in the same state may not be subject to any federal standards at all. Those with compromised immune systems may want to read bottled water labels to make sure more stringent treatments have been used, such as reverse osmosis, distillation, UV radiation, or filtration by an absolute 1 micron filter.



Check with NSF International to see if your bottled water adheres to FDA and international drinking water standards. The International Bottled Water Association can also provide information on which brands adhere to even more stringent requirements. Contact information is listed in Appendix C.

Can I Do Anything In My House To Improve The Safety Of My Drinking Water?

Most people do not need to treat drinking water in their home to make it safe. However, a home water treatment unit can improve water's taste, or provide a factor of safety for those people more vulnerable to waterborne disease. There are different options for home treatment systems. Point-of-use (POU) systems treat water at a single tap. Point-of-entry (POE) systems treat water used throughout the house. POU systems can be installed in various places in the home, including the counter top, the faucet itself, or under the sink. POE systems are installed where the water line enters the house.

POU and POE devices are based on various contaminant removal technologies. Filtration, ion exchange, reverse osmosis, and distillation are some of the treatment methods used. All types of units are generally available from retailers, or by mail order. Prices can reach well into the hundreds and sometimes thousands of dollars, and depending on the method and location of installation, plumbing can also add to the cost.

TREATMENT DEVICE	WHAT IT DOES TO WATER	TREATMENT LIMITATIONS
Activated Carbon Filter (includes mixed media that remove heavy metals)	✓ Adsorbs organic contaminants that cause taste and odor problems. ✓ Somedesigns remove chlorination byproducts; ✓ Some types remove cleaning solvents and pesticides	Is efficient in removing metals such as lead and copper Does not remove nitrate, bacteria or dissolved minerals
Ion Exchange Unit (with activated alumina)	✓ Removes minerals, particularly calcium and magnesium that make water "hard" ✓ Some designs remove radium and barium ✓ Removes fluoride	If water has oxidized iron or iron bacteria, the ion-exchange resin will become coated or clogged and lose its softening ability
Reverse Osmosis Unit (with carbon)	✓ Removes nitrates, sodium, other dissolved inorganics and organic compounds ✓ Removes foul tastes, smells or colors ✓ May also reduce the level of some pesticides, dioxins and chloroform and petrochemicals	Does not remove all inorganic and organic contaminants
Distillation Unit	✓ Removes nitrates, bacteria, sodium, hardness, dissolved solids, most organic compounds, heavy metals, and radionucleides ✓ Kills bacteria	Does not remove some volatile organic contaminants, certain pesticides and volatile solvents Bacteria may recolonize on the cooling coils during inactive periods

Activated carbon filters adsorb **organic contaminants** that cause taste and odor problems. Depending on their design, some units can remove chlorination byproducts, some cleaning solvents, and pesticides. To maintain the effectiveness of these units, the carbon canisters must be replaced periodically. Activated carbon filters are efficient in removing metals such as lead and copper if they are designed to absorb or remove lead.

Because ion exchange units can be used to remove minerals from your water, particularly calcium and magnesium, they are sold for water softening. Some ion exchange softening units remove radium and barium from water. Ion exchange systems that employ activated alumina are used to remove fluoride and arsenate from water. These units must be regenerated periodically with salt.

Reverse osmosis treatment units generally remove a more diverse list of contaminants than other systems. They can remove nitrates, sodium, other dissolved inorganics, and organic compounds.

Distillation units boil water and condense the resulting steam to create distilled water. Depending on their design, some of these units may allow vaporized organic contaminants to condense back into the product water, thus minimizing the removal of organics.

You may choose to boil your water to remove microbial contaminants. Keep in mind that boiling reduces

the volume of water by about 20 percent, thus concentrating those contaminants not affected by the temperature of boiling water, such as nitrates and pesticides. For more information on boiling water, see page 5 of this booklet.

No one unit can remove everything. Have your water tested by a certified laboratory prior to purchasing any device. Do not rely on the tests conducted by salespeople that want to sell you their product.

Maintaining Treatment Devices

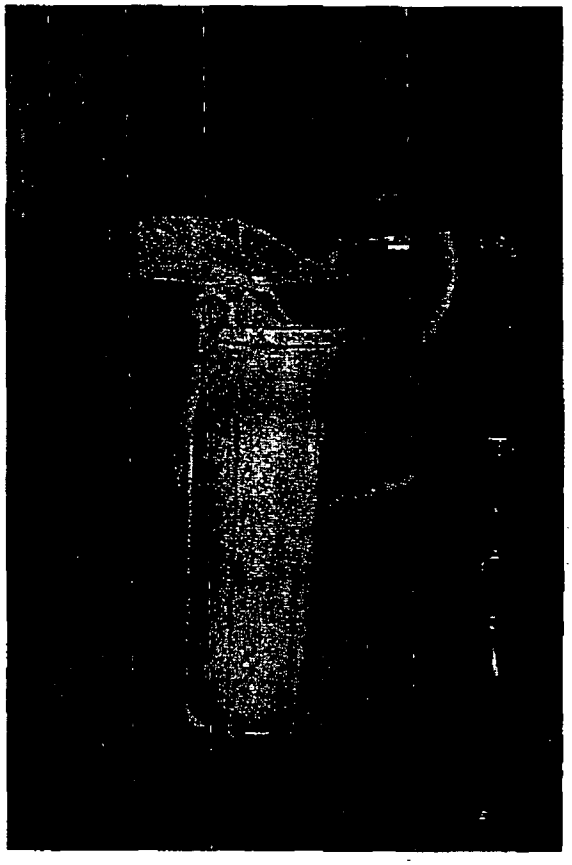
All POU and POE treatment units need maintenance to operate effectively. If they are not maintained properly, contaminants may accumulate in the units and actually make your water worse. In addition, some vendors may make claims about their effectiveness that have no merit. Units are tested for their safety and effectiveness by two organizations, NSF International and Underwriters Laboratory. In addition, the Water Quality Association represents the household, commercial, industrial and small community treatment industry and can help you locate a professional that meets their code of ethics. EPA does not test or certify these treatment units.

Where Can I Learn More About Home Treatment Systems?

Your local library has articles, such as those found in consumer magazines, on the effectiveness of these devices.

The U.S. General Accounting Office published a booklet called *Drinking Water: Inadequate Regulation of Home Treatment Units Leaves Consumers At Risk* (December 1991). To read this booklet, visit *www.gao.gov* and search for **document number RCED-92-34**, or call (202) 512-6000.

This treatment device is for point of use (POU). For more information on different types of devices contact NSF International, Underwriters Laboratory, or the Water Quality Association See Appendix C for contact information.



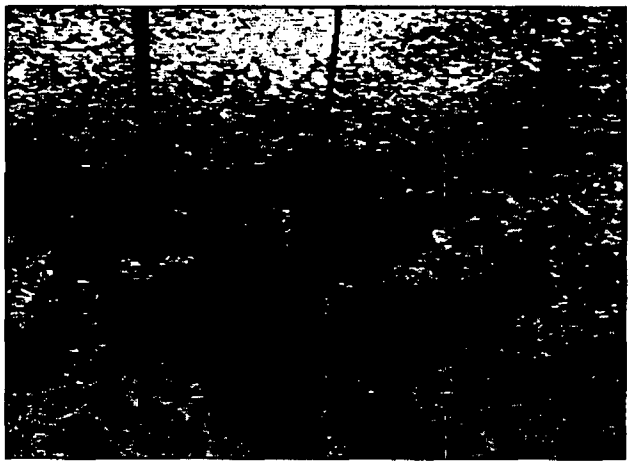
7. How Safe Is The Drinking Water In My Household Well?

EPA regulates public water systems; it does not have the authority to regulate private wells. Approximately 15 percent of Americans rely on their own private drinking water supplies (*Drinking Water from Household Wells*, 2002), and these supplies are not subject to EPA standards. Unlike public drinking water systems serving many people, they do not have experts regularly checking the water's source and its quality before it is sent to the tap. These households must take special precautions to ensure the protection and maintenance of their drinking water supplies.

Drinking Water from Household Wells is an EPA publication available to specifically address special concerns of a private drinking water supply. To learn more, or to obtain a copy, visit *www.epa.gov/safewater/privatewells*, or call the Safe Drinking Water Hotline.

How Much Risk Can I Expect?

The risk of having problems depends on how good your well is—how well it was built and located, and how well you maintain it. It also depends on your local environment. That includes the quality of the aquifer from which your water is drawn and the human activities going on in your area that can affect your well.



Several sources of pollution are easy to spot by sight, taste, or smell. However, many serious problems can be found only by testing your water. Knowing the possible threats in your area will help you decide the kind of tests you may need.

What Should I Do?

There are six basic steps you can take to help protect your private drinking water supply:

1. Identify potential problem sources.
2. Talk with local experts.
3. Have your water tested periodically.
4. Have the test results interpreted and explained clearly.
5. Set and follow a regular maintenance schedule for your well, and keep up-to-date records.
6. Immediately remedy any problems.

Identify Potential Problem Sources

Understanding and spotting possible pollution sources is the first step to safeguarding your drinking water. If your drinking water comes from a well, you may also have a **septic system**. Septic systems and other on-site wastewater disposal systems are major potential sources of contamination of private water supplies if they are poorly maintained or located improperly, or if they are used for disposal of toxic chemicals. Information on septic systems is available from local health departments, state agencies, and the National Small Flows Clearinghouse (*www.epa.gov/owm/mab/smcomm/nsfc.htm*) at (800) 624-8301. A septic system design manual and guidance on system maintenance are available from EPA (*www.epa.gov/OW-OWM.html/mtb/decent/homeowner.htm*).

Talk With Local Experts

Ground water conditions vary greatly from place to place, and local experts can give you the best information about your drinking water supply. Some examples are your health department's "sanitarian," local water-well contractors, public water system officials, county extension agents of the Natural Resources Conservation Service (NRCS), local or county planning commissions, and your local library.

Have Your Water Tested Periodically

Test your water every year for total **coliform** bacteria, nitrates, total dissolved solids, and pH levels. If you suspect other contaminants, test for these as well. As the tests can be expensive, limit them to possible problems specific to your situation. Local experts can help you identify these contaminants. You should also test your water after replacing or repairing any part of the system, or if you notice any change in your water's look, taste, or smell.

Often, county health departments perform tests for bacteria and nitrates. For other substances, health departments, environmental offices, or county governments should have a list of state-certified laboratories. Your State Laboratory Certification Officer can also provide you with this list. Call the Safe Drinking Water Hotline for the name and number of your state's certification officer. Any laboratory you use should be certified to do drinking water testing.

Have Your Test Results Interpreted And Explained Clearly

Compare your well's test results to federal and state drinking water standards (see Appendix A, or visit *www.epa.gov/safewater/mcl.html* or call the Safe Drinking Water Hotline). You may need to consult experts to aid you in understanding your results, such as the state agency that licenses water well contractors, your local health department, or your state's drinking water program.

Protecting Your Ground Water Supply

- Periodically inspect exposed parts of the well for problems such as:
  - Cracked, corroded, or damaged well casing
  - Broken or missing well cap
  - Settling and cracking of surface seals.
- Slope the area around the well to drain surface runoff away from the well.
- Install a well cap or sanitary seal to prevent unauthorized use of, or entry into, the well.
- Disinfect drinking water wells at least once per year with bleach or hypochlorite granules, according to the manufacturer's directions.
- Have the well tested once a year for coliform bacteria, nitrates, and other constituents of concern.
- Keep accurate records of any well maintenance, such as disinfection or sediment removal, that may require the use of chemicals in the well.
- Hire a certified well driller for any new well construction, modification, or abandonment and closure.
- Avoid mixing or using pesticides, fertilizers, herbicides, degreasers, fuels, and other pollutants near the well.
- Do not dispose of wastes in dry wells or in abandoned wells.
- Do not cut off the well casing below the land surface.
- Pump and inspect septic systems as often as recommended by your local health department.
- Never dispose of hazardous materials in a septic system.

Set A Regular Maintenance Schedule For Your Well And Your Septic System

Proper well and septic system construction and continued maintenance are keys to the safety of your water supply. Your state water well and septic system contractor licensing agency, local health department, or local public water system professional can provide information on well construction. Make certain your contractors are licensed by the state, if required, or certified by the National Ground Water Association.

Maintain your well, fixing problems before they reach crisis levels, and keep up-to-date records of well installation and repairs, as well as plumbing and water costs. Protect your own well area from contamination.

Immediately Remedy Any Problems

If you find that your well water is contaminated, fix the problem as soon as possible. Consider connecting into a nearby community water system, if one is available. You may want to install a water treatment device to remove impurities. Information on these devices is provided on page 16. If you connect to a public water system, remember to close your well properly.

After A Flood-Concerns And Advisories

- Stay away from well pump to avoid electric shock.
- Do not drink or wash from a flooded well.
- Pump the well until water runs clear.
- If water does not run clear, contact the county or state health department or extension service for advice.

Animal waste can contaminate your water supply

8. What You Can Do To Protect Your Drinking Water

Drinking water protection is a shared responsibility. Many actions are underway to protect our nation's drinking water, and there are many opportunities for citizens to become involved.

Be Involved!

EPA activities to protect drinking water include setting drinking water standards and overseeing the work of states that enforce federal standards—or stricter ones set by the individual state. EPA holds many public meetings on issues ranging from proposed drinking water standards to the development of databases. You can also comment on proposed drafts of other upcoming EPA documents. A list of public meetings and regulations open for comment can be found at *www.epa.gov/safewater/pubinput.html.*

Be Informed!

- Read the annual Consumer Confidence Report provided by your water supplier. Some Consumer Confidence Reports are available at *www.epa.gov/safewater/dwinfo.htm.*
- Use information from your state's Source Water Assessment to learn about potential threats to your water source.
- If you are one of the 15 percent of Americans who uses a private source of drinking water—such as a well, cistern, or spring—find out what activities are taking place in your **watershed** that may impact your drinking water; talk to local experts/test your water periodically; and maintain your well properly.
- Find out if the Clean Water Act standards for your drinking water source are intended to protect water for drinking, in addition to fishing and swimming.

Be Observant!

- Look around your watershed and look for announcements in the local media about activities that may pollute your drinking water.
- **Form and operate** a citizens watch network within your community to communicate regularly with law enforcement, your public water supplier and wastewater operator. **Communication** is key to a safer community!
- **Be alert.** Get to know your water/wastewater utilities, their vehicles, routines and their personnel.
- **Become aware of your surroundings.** This will help you to recognize suspicious activity as opposed to normal daily activities.

Other Ways To Get Involved

- Attend public hearings on new construction, storm water permitting, and town planning.
- Keep your public officials accountable by asking to see their environmental impact statements.
- Ask questions about any issue that may affect your water source.
- Participate with your government and your water system as they make funding decisions.
- Volunteer or help recruit volunteers to participate in your community's contaminant monitoring activities.
- Help ensure that local utilities that protect your water have adequate resources to do their job.

- If you see any suspicious activities in or around your water supply, please notify local authorities or call 9-1-1 immediately to report the incident.

Stormwater runoff threatens our sources of drinking water. As this water washes over roofs, pavement, farms and grassy areas, it picks up fertilizers, pesticides and litter, and deposits them in surface water and ground water. Here are some other threats to our drinking water:

Every year:

- We apply 67 million pounds of pesticides that contain toxic and harmful chemicals to our lawns.
- We produce more than 230 million tons of municipal solid water—approximately five pounds of trash or garbage per person per day—that contain bacteria, nitrates, viruses, synthetic detergents, and household chemicals.
- Our more than 12 million recreational and houseboats and 10,000 boat marinas release solvents, gasoline, detergents, and raw sewage directly into our rivers, lakes and streams.

Don't Contaminate!

- Reduce paved areas: use permeable surfaces that allow rain to soak through, not run off.
- Reduce or eliminate pesticide application: test your soil before applying chemicals, and use plants that require little or no water, pesticides, or fertilizers.
- Reduce the amount of trash you create: reuse and recycle.
- Recycle used oil: 1 quart of oil can contaminate 2 million gallons of drinking water—take your used oil and anti-freeze to a service station or recycling center.
- Take the bus instead of your car one day a week: you could prevent 33 pounds of carbon dioxide emissions each day.
- Keep pollutants away from boat marinas and waterways: keep boat motors well-tuned to prevent leaks, select nontoxic cleaning products and use a drop cloth, and clean and maintain boats away from the water.

For more information on how you can help protect your local drinking water source, call the Safe Drinking Water Hotline, or check *www.epa.gov/safewater/publicoutreach*. Additional resources are listed in Appendix C.

Appendix A: National Primary Drinking Water Standards as of 10/03

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Acrylamide	TT[8]	Nervous system or blood problems; increased risk of cancer	Added to water during sewage/ wastewater treatment	zero
OC	Alachlor	0.002	Eye, liver, kidney or spleen problems; anemia; increased risk of cancer	Runoff from herbicide used on row crops	zero
R	Alpha particles	15 picocuries per Liter (pCi/L)	Increased risk of cancer	Erosion of natural deposits of certain minerals that are radioactive and may emit a form of radiation known as alpha radiation	zero
IOC	Antimony	0.006	Increase in blood cholesterol; decrease in blood sugar	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder	0.006
IOC	Arsenic	0.010 as of 1/23/06	Skin damage or problems with circulatory systems, and may have increased risk of getting cancer	Erosion of natural deposits; runoff from orchards; runoff from glass & electronics production wastes	0
IOC	Asbestos (fibers >10 micrometers)	7 million fibers per Liter (MFL)	Increased risk of developing benign intestinal polyps	Decay of asbestos cement in water mains; erosion of natural deposits	7 MFL
OC	Atrazine	0.003	Cardiovascular system or reproductive problems	Runoff from herbicide used on row crops	0.003
IOC	Barium	2	Increase in blood pressure	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits	2
OC	Benzene	0.005	Anemia; decrease in blood platelets; increased risk of cancer	Discharge from factories; leaching from gas storage tanks and landfills	zero
OC	Benzo(a)pyrene (PAHs)	0.0002	Reproductive difficulties; increased risk of cancer	Leaching from linings of water storage tanks and distribution lines	zero
IOC	Beryllium	0.004	Intestinal lesions	Discharge from metal refineries and coal-burning factories; discharge from electrical, aerospace, and defense industries	0.004
R	Beta particles and photon emitters	4 millirems per year	Increased risk of cancer	Decay of natural and man-made deposits of certain minerals that are radioactive and may emit forms of radiation known as photons and beta radiation	zero
DBP	Bromate	0.010	Increased risk of cancer	Byproduct of drinking water disinfection	zero
IOC	Cadmium	0.005	Kidney damage	Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries and paints	0.005
OC	Carbofuran	0.04	Problems with blood, nervous system, or reproductive system	Leaching of soil fumigant used on rice and alfalfa	0.04
OC	Carbon tetrachloride	0.005	Liver problems; increased risk of cancer	Discharge from chemical plants and other industrial activities	zero
D	Chloramines (as Cl_2)	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort; anemia	Water additive used to control microbes	MRDLG=4[1]

LEGEND

D	Disinfectant	IOC	Inorganic Chemical	OC	Organic Chemical	DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

	Contaminant	MCL[1] or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Chlordane	0.002	Liver or nervous system problems; increased risk of cancer	Residue of banned termiticide	zero
D	Chlorine (as Cl_2)	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort	Water additive used to control microbes	MRDLG=4[1]
D	Chlorine dioxide (as ClO_2)	MRDL=0.8[1]	Anemia; infants & young children: nervous system effects	Water additive used to control microbes	MRDLG=0.8[1]
DBP	Chlorite	1.0	Anemia; infants & young children: nervous system effects	Byproduct of drinking water disinfection	0.8
OC	Chlorobenzene	0.1	Liver or kidney problems	Discharge from chemical and agricultural chemical factories	0.1
IOC	Chromium (total)	0.1	Allergic dermatitis	Discharge from steel and pulp mills; erosion of natural deposits	0.1
IOC	Copper	TT[7]; Action Level = 1.3	Short-term exposure: Gastrointestinal distress. Long-term exposure: Liver or kidney damage. People with Wilson's Disease should consult their personal doctor if the amount of copper in their water exceeds the action level	Corrosion of household plumbing systems; erosion of natural deposits	1.3
M	*Cryptosporidium*	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
IOC	Cyanide (as free cyanide)	0.2	Nerve damage or thyroid problems	Discharge from steel/metal factories; discharge from plastic and fertilizer factories	0.2
OC	2,4-D	0.07	Kidney, liver, or adrenal gland problems	Runoff from herbicide used on row crops	0.07
OC	Dalapon	0.2	Minor kidney changes	Runoff from herbicide used on rights of way	0.2
OC	1,2-Dibromo-3-chloropropane (DBCP)	0.0002	Reproductive difficulties; increased risk of cancer	Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards	zero
OC	o-Dichlorobenzene	0.6	Liver, kidney, or circulatory system problems	Discharge from industrial chemical factories	0.6
OC	p-Dichlorobenzene	0.075	Anemia; liver, kidney or spleen damage; changes in blood	Discharge from industrial chemical factories	0.075
OC	1,2-Dichloroethane	0.005	Increased risk of cancer	Discharge from industrial chemical factories	zero
OC	1,1-Dichloroethylene	0.007	Liver problems	Discharge from industrial chemical factories	0.007
OC	cis-1,2-Dichloroethylene	0.07	Liver problems	Discharge from industrial chemical factories	0.07
OC	trans-1,2-Dichloroethylene	0.1	Liver problems	Discharge from industrial chemical factories	0.1
OC	Dichloromethane	0.005	Liver problems; increased risk of cancer	Discharge from drug and chemical factories	zero
OC	1,2-Dichloropropane	0.005	Increased risk of cancer	Discharge from industrial chemical factories	zero
OC	Di(2-ethylhexyl) adipate	0.4	Weight loss, liver problems, or possible reproductive difficulties	Discharge from chemical factories	0.4
OC	Di(2-ethylhexyl) phthalate	0.006	Reproductive difficulties; liver problems; increased risk of cancer	Discharge from rubber and chemical factories	zero
OC	Dinoseb	0.007	Reproductive difficulties	Runoff from herbicide used on soybeans and vegetables	0.007

LEGEND

D	Disinfectant	IOC	Inorganic Chemical	OC	Organic Chemical	DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Dioxin (2,3,7,8-TCDD)	0.00000003	Reproductive difficulties; increased risk of cancer	Emissions from waste incineration and other combustion; discharge from chemical factories	zero
OC	Diquat	0.02	Cataracts	Runoff from herbicide use	0.02
OC	Endothall	0.1	Stomach and intestinal problems	Runoff from herbicide use	0.1
OC	Endrin	0.002	Liver problems	Residue of banned insecticide	0.002
OC	Epichlorohydrin	TT[8]	Increased cancer risk, and over a long period of time, stomach problems	Discharge from industrial chemical factories; an impurity of some water treatment chemicals	zero
OC	Ethylbenzene	0.7	Liver or kidney problems	Discharge from petroleum refineries	0.7
OC	Ethylene dibromide	0.00005	Problems with liver, stomach, reproductive system, or kidneys; increased risk of cancer	Discharge from petroleum refineries	zero
IOC	Fluoride	4.0	Bone disease (pain and tenderness of the bones); children may get mottled teeth	Water additive which promotes strong teeth; erosion of natural deposits; discharge from fertilizer and aluminum factories	4.0
M	*Giardia lamblia*	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
OC	Glyphosate	0.7	Kidney problems; reproductive difficulties	Runoff from herbicide use	0.7
DBP	Haloacetic acids (HAA5)	0.060	Increased risk of cancer	Byproduct of drinking water disinfection	n/a[6]
OC	Heptachlor	0.0004	Liver damage; increased risk of cancer	Residue of banned termiticide	zero
OC	Heptachlor epoxide	0.0002	Liver damage; increased risk of cancer	Breakdown of heptachlor	zero
M	Heterotrophic plate count (HPC)	TT[3]	HPC has no health effects; it is an analytic method used to measure the variety of bacteria that are common in water. The lower the concentration of bacteria in drinking water, the better maintained the water system is.	HPC measures a range of bacteria that are naturally present in the environment	n/a
OC	Hexachlorobenzene	0.001	Liver or kidney problems; reproductive difficulties; increased risk of cancer	Discharge from metal refineries and agricultural chemical factories	zero
OC	Hexachlorocyclopentadiene	0.05	Kidney or stomach problems	Discharge from chemical factories	0.05
IOC	Lead	TT[7]; Action Level = 0.015	Infants and children: Delays in physical or mental development; children could show slight deficits in attention span and learning abilities; Adults: Kidney problems; high blood pressure	Corrosion of household plumbing systems; erosion of natural deposits	zero
M	*Legionella*	TT[3]	Legionnaire's Disease, a type of pneumonia	Found naturally in water; multiplies in heating systems	zero
OC	Lindane	0.0002	Liver or kidney problems	Runoff/leaching from insecticide used on cattle, lumber, gardens	0.0002
IOC	Mercury (inorganic)	0.002	Kidney damage	Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and croplands	0.002
OC	Methoxychlor	0.04	Reproductive difficulties	Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, livestock	0.04

LEGEND

D	Disinfectant	IOC	Inorganic Chemical	OC	Organic Chemical	DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
IOC	Nitrate (measured as Nitrogen)	10	Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	10
IOC	Nitrite (measured as Nitrogen)	1	Infants below the age of six months who drink water containing nitrite in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	1
OC	Oxamyl (Vydate)	0.2	Slight nervous system effects	Runoff/leaching from insecticide used on apples, potatoes, and tomatoes	0.2
OC	Pentachlorophenol	0.001	Liver or kidney problems; increased cancer risk	Discharge from wood-preserving factories	zero
OC	Picloram	0.5	Liver problems	Herbicide runoff	0.5
OC	Polychlorinated biphenyls (PCBs)	0.0005	Skin changes; thymus gland problems; immune deficiencies; reproductive or nervous system difficulties; increased risk of cancer	Runoff from landfills; discharge of waste chemicals	zero
R	Radium 226 and Radium 228 (combined)	5 pCi/L	Increased risk of cancer	Erosion of natural deposits	zero
IOC	Selenium	0.05	Hair or fingernail loss; numbness in fingers or toes; circulatory problems	Discharge from petroleum refineries; erosion of natural deposits; discharge from mines	0.05
OC	Simazine	0.004	Problems with blood	Herbicide runoff	0.004
OC	Styrene	0.1	Liver, kidney, or circulatory system problems	Discharge from rubber and plastic factories; leaching from landfills	0.1
OC	Tetrachloroethylene	0.005	Liver problems; increased risk of cancer	Discharge from factories and dry cleaners	zero
IOC	Thallium	0.002	Hair loss; changes in blood; kidney, intestine, or liver problems	Leaching from ore-processing sites; discharge from electronics, glass, and drug factories	0.0005
OC	Toluene	1	Nervous system, kidney, or liver problems	Discharge from petroleum factories	1
M	Total Coliforms (including fecal coliform and *E. coli*)	5.0 percent[4]	Not a health threat in itself; it is used to indicate whether other potentially harmful bacteria may be present[5]	Coliforms are naturally present in the environment as well as feces; fecal coliforms and *E. coli* only come from human and animal fecal waste	zero
DBP	Total Trihalomethanes (TTHMs)	0.10 0.080 after 12/31/03	Liver, kidney or central nervous system problems; increased risk of cancer	Byproduct of drinking water disinfection	n/a[6]
OC	Toxaphene	0.003	Kidney, liver, or thyroid problems; increased risk of cancer	Runoff/leaching from insecticide used on cotton and cattle	zero
OC	2,4,5-TP (Silvex)	0.05	Liver problems	Residue of banned herbicide	0.05
OC	1,2,4-Trichlorobenzene	0.07	Changes in adrenal glands	Discharge from textile finishing factories	0.07
OC	1,1,1-Trichloroethane	0.2	Liver, nervous system, or circulatory problems	Discharge from metal degreasing sites and other factories	0.20

LEGEND

D	Disinfectant	IOC	Inorganic Chemical	OC	Organic Chemical	DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	1,1,2-Trichloroethane	0.005	Liver, kidney, or immune system problems	Discharge from industrial chemical factories	0.003
OC	Trichloroethylene	0.005	Liver problems; increased risk of cancer	Discharge from metal degreasing sites and other factories	zero
M	Turbidity	TT[3]	Turbidity is a measure of the cloudiness of water. It is used to indicate water quality and filtration effectiveness (e.g., whether disease-causing organisms are present). Higher turbidity levels are often associated with higher levels of disease-causing microorganisms such as viruses, parasites and some bacteria. These organisms can cause symptoms such as nausea, cramps, diarrhea, and associated headaches.	Soil runoff	n/a
R	Uranium	30 ug/L as of 12/08/03	Increased risk of cancer, kidney toxicity	Erosion of natural deposits	zero
OC	Vinyl chloride	0.002	Increased risk of cancer	Leaching from PVC pipes; discharge from plastic factories	zero
M	Viruses (enteric)	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
OC	Xylenes (total)	10	Nervous system damage	Discharge from petroleum factories; discharge from chemical factories	10

LEGEND

D	Disinfectant	IOC	Inorganic Chemical	OC	Organic Chemical	DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

NOTES

1 Definitions

- Maximum Contaminant Level Goal (MCLG)—The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.
- Maximum Contaminant Level (MCL)—The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards.
- Maximum Residual Disinfectant Level Goal (MRDLG)—The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.
- Maximum Residual Disinfectant Level (MRDL)—The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.
- Treatment Technique (TT)—A required process intended to reduce the level of a contaminant in drinking water.

2 Units are in milligrams per liter (mg/L) unless otherwise noted. Milligrams per liter are equivalent to parts per million (ppm).

3 EPA's surface water treatment rules require systems using surface water or ground water under the direct influence of surface water to (1) disinfect their water, and (2) filter their water or meet criteria for avoiding filtration so that the following contaminants are controlled at the following levels:

- *Cryptosporidium* (as of 1/1/02 for systems serving >10,000 and 1/14/05 for systems serving <10,000) 99 percent removal.
- *Giardia lamblia*: 99.9 percent removal/inactivation
- Viruses: 99.99 percent removal/inactivation
- *Legionella*: No limit, but EPA believes that if *Giardia* and viruses are removed/inactivated, *Legionella* will also be controlled.
- Turbidity: At no time can turbidity (cloudiness of water) go above 5 nephelolometric turbidity units (NTU): systems that filter must ensure that the turbidity go no higher than 1 NTU (0.5 NTU for conventional or direct filtration) in at least 95 percent of the daily samples in any month. As of January 1, 2002, for systems servicing >10,000, and January 14, 2005, for systems servicing <10,000, turbidity may never exceed 1 NTU, and must not exceed 0.3 NTU in 95 percent of daily samples in any month.
- HPC: No more than 500 bacterial colonies per milliliter
- Long Term 1 Enhanced Surface Water Treatment (Effective Date: January 14, 2005): Surface water systems or (GWUDI) systems serving fewer than 10,000 people must comply with the applicable Long Term 1 Enhanced Surface Water Treatment Rule provisions (e.g. turbidity standards, individual filter monitoring, *Cryptosporidium* removal requirements, updated watershed control requirements for unfiltered systems).
- Filter Backwash Recycling: The Filter Backwash Recycling Rule requires systems that recycle to return specific recycle flows through all processes of the system's existing conventional or direct filtration system or at an alternate location approved by the state.

4 No more than 5.0 percent samples total coliform-positive in a month. (For water systems that collect fewer than 40 routine samples per month, no more than one sample can be total coliform-positive per month.) Every sample that has total coliform must be analyzed for either fecal coliforms or *E. coli*. If two consecutive TC-positive samples, and one is also positive for *E. coli* fecal coliforms, system has an acute MCL violation.

5 Fecal coliform and *E. coli* are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Disease-causing microbes (pathogens) in these wastes can cause diarrhea, cramps, nausea, headaches, or other symptoms. These pathogens may pose a special health risk for infants, young children, and people with severely compromised immune systems.

6 Although there is no collective MCLG for this contaminant group, there are individual MCLGs for some of the individual contaminants:

- Haloacetic acids: dichloroacetic acid (zero); trichloroacetic acid (0.3 mg/L)
- Trihalomethanes: bromodichloromethane (zero); bromoform (zero); dibromochloromethane (0.06 mg/L)

7 Lead and copper are regulated by a Treatment Technique that requires systems to control the corrosiveness of their water. If more than 10 percent of tap water samples exceed the action level, water systems must take additional steps. For copper, the action level is 1.3 mg/L, and for lead is 0.015 mg/L.

8 Each water system must certify, in writing, to the state (using third-party or manufacturers certification) that when it uses acrylamide and/or epichlorohydrin to treat water, the combination (or product) of dose and monomer level does not exceed the levels specified, as follows: Acrylamide = 0.05 percent dosed at 1 mg/L (or equivalent); Epichlorohydrin = 0.01 percent dosed at 20 mg/L (or equivalent).

Appendix B: References

US EPA Publications

25 Years of the Safe Drinking Water Act: History & Trends
EPA 816-R-99-007
December 1999

Community Water Systems Survey 2000, Volume I
EPA 815-R-02-0054
December 2002

Drinking Water Costs and Federal Funding
EPA 810-F-99-014
December 1999

Drinking Water from Household Wells
EPA 816-K-02-003
January 2002

Drinking Water Priority Rulemaking: Microbial and Disinfection Byproduct Rules
EPA 816-F-01-012
June 2001

Drinking Water Treatment
EPA 810-F-99-013
December 1999

Factoids: Drinking Water and Ground Water Statistics for 2001
EPA 815-K-02-004
May 2002

Factoids: Drinking Water and Ground Water Statistics for 2002
EPA 816-K-03-001
January 2003

Fact Sheet: 1999 Drinking Water Infrastructure Needs Survey
EPA 816-F-01-001
February 2001

"Investing in America's Water Infrastructure" Keynote Address by G. Tracy Mehan III to the Schwab Capital Markets' Global Water Conference
April 2003

Protect Your Drinking Water
EPA 816-F-02-012
September 2002

Public Access to Information & Public Involvement
EPA 810-F-99-021
December 1999

Report to Congress: EPA Studies on Sensitive Subpopulations and Drinking Water Contaminants
EPA 815-R-00-015
December 2000

Safe Drinking Water Act-Protecting America's Public Health
EPA 816-H-02-003
January 2002

Safe Drinking Water Act: Underground Injection Control Program: Protecting Public Health and Drinking Water Resources
EPA 816-H-01-003
August 2001

The Clean Water and Drinking Water Infrastructure Gap Analysis
EPA 816-F-02-017
September 2002

The Drinking Water State Revolving Fund: Protecting the Public Through Drinking Water Infrastructure Improvements
EPA 819-F-00-028
November 2001

Understanding the Safe Drinking Water Act
EPA 810-F-99-008
December 1999

Using Water Wisely in the Home
EPA 800-F-02-001
June 2001

Publications From Outside Sources

Centers for Disease Control and Prevention. *Morbidity and Mortality Weekly Report: Surveillance for Waterborne-Disease Outbreaks-United States-1999-2000.*
November 22, 2002

Congressional Budget Office. *Future Investment in Drinking Water & Wastewater Infrastructure*
November 2002

Appendix C: Sources of Additional Information

American Water Works Association
Public Affairs Department
6666 West Quincy Avenue
Denver, CO 80235
Phone (303) 794-7711
www.awwa.org

Association of Metropolitan Water Agencies
1620 I Street NW
Suite 500
Washington, DC 20006
Phone (202) 331-2820
Fax (202) 785-1845
www.amwa.net

Association of State Drinking Water Administrators
1025 Connecticut Avenue NW
Suite 903
Washington, DC 20036
Phone (202) 293-7655
www.asdwa.org

Clean Water Action
4455 Connecticut Avenue NW Suite A300
Washington, DC 20008
Phone (202) 895-0420
www.cleanwater.org

Consumer Federation of America
1424 16th Street NW
Suite 604
Washington, DC 20036
Phone (202) 387-6121
www.consumerfed.org

The Groundwater Foundation
P.O. Box 22558
Lincoln, NE 68542
Phone (800) 858-4844
www.groundwater.org

The Ground Water Protection Council
13308 N. Mac Arthur
OKC, OK 73142
Phone (405) 516-4972
www.gwpc.org

International Bottled Water Association
1700 Diagonal Road
Suite 650
Alexandria, VA 22314
Phone (703) 683-5213
Information Hotline 1-800-WATER-11
ibwainfo@bottledwater.org

National Association of Regulatory Utility Commissioners
Phone (202) 898-2200
www.naruc.org

National Association of Water Companies
1725 K Street NW
Suite 1212
Washington, DC 20006
Phone (202) 833-8383
www.nawc.org

National Drinking Water Clearinghouse
West Virginia University
P.O. Box 6064
Morgantown, WV 26506
Phone (800) 624-8301
www.ndwc.wvu.edu

National Ground Water Association
601 Dempsey Rd
Westerville, OH 43081-8978
Phone: (800) 551-7379
www.ngwa.org

National Rural Water Association
2915 South 13th Street
Duncan, OK 73533
Phone (580) 252-0629
www.nrwa.org

Natural Resources Defense Council
40 West 20th Street
New York, NY 10011
Phone (212) 727-2700
www.nrdc.org

NSF International
P.O. Box 130140
789 North Dixboro Road
Ann Arbor, MI 48113
Phone (800) NSF-MARK
www.nsf.org

Rural Community Assistance Program
1522 K Street NW
Suite 400
Washington, DC 20005
Phone (202) 408-1273
www.rcap.org

Underwriters Laboratories
Corporate Headquarters
333 Pfingsten Road
Northbrook, IL 60062-2096
Phone (877) 272-8800
www.ul.com

Water Quality Association
4151 Naperville Road
Lisle, IL 60532
Phone (630) 505-0160
www.wqa.org

U.S. Environmental Protection Agency Water Resource Center
1200 Pennsylvania Avenue NW
RC-4100
Washington, DC 20460
SDWA Hotline (800) 426-4791
www.epa.gov/safewater

Water Systems Council
National Programs Office
101 30th Street NW
Suite 500
Washington, D.C. 20007
Phone: (202) 625-4387
Wellcare Hotline 888-395-1033
www.watersystems council.org

EPA Region 1
(CT, ME, MA, NH, RI, VT)
Phone (617) 918-1111
Phone (617) 918-1614
(UIC issues)

EPA Region 2
(NJ, NY, PR, VI)
Phone (212) 637-5000
Phone (212) 637-4232
(UIC issues)

EPA Region 3
(DE, DC, MD, PA, VA, WV)
Phone (215) 814-5700
Phone (215) 814-5445
(UIC issues)

EPA Region 4
(AL, FL, GA, KY, MS, NC, SC, TN)
Phone (404) 562-9900
Phone (404) 562-9452
(UIC issues)

EPA Region 5
(IL, IN, MI, MN, OH, WI)
Phone (312) 886-2000
Phone (312) 886-1492
(UIC issues)

EPA Region 6
(AR, LA, NM, OK, TX)
Phone (214) 665-6444
Phone (214) 665-7183
(UIC issues)

EPA Region 7
(IA, KS, MO, NE)
Phone (913) 551-7003
Phone (913) 551-7030
(UIC issues)

EPA Region 8
(CO, MT, ND, SD, UT, WY)
Phone (303) 312-6312
Phone (303) 312-6242
(UIC issues)

EPA Region 9
(AZ, CA, HI, NW, AS GU)
Phone (415) 947-8000
Phone (415) 947-1834
(UIC issues)

EPA Region 10
(AK, ID, OR, WA)
Phone (206) 553-1200
Phone (206) 553-1901
(UIC issues)

Appendix D: Glossary

Action Level

The level of lead and copper which, if exceeded, triggers treatment or other requirements that a water system must follow.

Aquifer

A natural underground layer, often of sand or gravel, that contains water

Coliform

A group of related bacteria whose presence in drinking water may indicate contamination by disease-causing microorganisms

Community Water System (CWS)

A water system that supplies drinking water to 25 people or more year-round in their residences

Contaminant

Anything found in water (including microorganisms, radionuclides, chemicals, minerals, etc.) which may be harmful to human health

Cryptosporidium

Microorganism found commonly in lakes and rivers which is highly resistant to disinfection.

Disinfectant

A chemical (commonly chlorine, chloramines, or ozone) or physical process (e.g., ultraviolet light) that kills microorganisms such as viruses, bacteria, and protozoa

Distribution System

A network of pipes leading from a treatment plant to customers' plumbing systems

Ground Water

Water that is pumped and treated from an aquifer

Inorganic Contaminants

Mineral-based compounds such as metals, nitrates, and asbestos; naturally occurring in some water, but can also enter water through human activities

Maximum Contaminant Level

The highest level of a contaminant that EPA allows in drinking water (legally enforceable standard)

Maximum Contaminant Level Goal

The level of a contaminant at which there would be no risk to human health (not a legally enforceable standard)

Microorganisms

Tiny living organisms that can be seen only under a microscope; some can cause acute health problems when consumed in drinking water

Non-Transient Non-Community Water System

A non-community water system that serves the same people more than six months of the year, but not year-round

Organic Contaminants

Carbon-based chemicals, such as solvents and pesticides, which enter water through cropland runoff or discharge from factories

Pathogen

Disease-causing organism

Public Water System (PWS)

A water system which supplies drinking water to at least 25 people, at least 60 days each year

Sensitive Subpopulation

People who may be more vulnerable to drinking water contamination, such as infants, children, some elderly, and people with severely compromised immune systems

Septic System

Used to treat sanitary waste; can be a significant threat to water quality due to leaks or runoff

Source Water

Water in its natural state, prior to any treatment for drinking (i.e., lakes, streams, ground water)

Surface Water

Water that is pumped and treated from sources open to the atmosphere, such as rivers, lakes, and reservoirs

Transient Non-Community Water System

A non-community water system that serves the public but not the same individuals for more than six months

Violation

Failure to meet any state or federal drinking water regulation

Vulnerability Assessment

An evaluation of drinking water source quality and its vulnerability to contamination by pathogens and toxic chemicals

Watershed

The land area from which water drains into a stream, river, or reservoir

Well

A bored, drilled or driven shaft whose depth is greater than the largest surface dimension, a dug hole whose depth is greater than the largest surface dimension, an improved sinkhole, or a subsurface fluid distribution system

Section 4.5 References

1. SCE&G (South Carolina Electric & Gas) 2006a. *Radiological Environmental Monitoring Report - Virgil C. Summer Nuclear Station for the Operating Period January 1, 2005 to December 31, 2005,* April 2006.

2. SCE&G 2006b. *Virgil C. Summer Nuclear Station - Annual Effluent and Waste Disposal Report for the operating period January 1, 2005 to December 31, 2005.* April 2006.

3. SCE&G 2006c. *Survey Report of Steam Generator Recycle Facility,* number Q-8015, 8016. V.C. Summer Nuclear Station, August 14, 2006.

4. SCE&G 2007. *Offsite Dose Calculation Manual for South Carolina Electric & Gas Company Virgil C. Summer Nuclear Station*, Revision 25. January 2007.

Section 4.5
Ref 1

SCE&G
A SCANA COMPANY

RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT

VIRGIL C. SUMMER NUCLEAR STATION

FOR THE OPERATING PERIOD

JANUARY 1, 2005 - DECEMBER 31, 2005

April 2005

Prepared by: L. Brett Williams
Brett Williams
Health Physics Specialist

Reviewed by: Mike B Roberts
Mike Roberts
Health Physicist

Approved by: Paul A Mothena
Paul Mothena
Manager Health Physics Services

EXECUTIVE SUMMARY

This Annual Radiological Environmental Operating Report describes the V.C. Summer Environmental Monitoring Program and the program results for the calendar year 2005.

Included are the identification of sample locations, descriptions of environmental sampling and type of analysis, comparisons of present environmental radioactivity levels and pre-operational environmental data, land use census comparisons of doses calculated from environmental measurements, and a summary of environmental radiological sampling results. Quality assurance practices, sampling deviations and unavailable samples are also discussed.

Sampling activities were conducted as prescribed by the Offsite Dose Calculation Manual (ODCM) for V.C. Summer Nuclear Station (VCSNS) and applicable Health Physics Procedures. Required analyses were performed and detection limits met for required samples with exceptions noted. Samples were collected comprising one thousand two hundred nineteen analyses (1,219) performed to compile the data for the 2005 Environmental Report. Supplemental samples comprising one hundred forty five (145) analyses were performed on some media for additional information. Based on the results from the annual land use census, the current number of sampling sites for V.C. Summer Nuclear Station is sufficient.

Concentrations observed in the environment in 2005 from V.C. Summer related radionuclide concentrations were within the range of concentrations observed in the past. Review of the data indicates that a very low radioactive concentration in shoreline sediment was the only indicator with VCSNS produced radioactivity, well below the reporting level requirements of the ODCM. It is therefore concluded that VCSNS operations have no significant radiological impact on the health and safety of the public or the environment.

TABLE OF CONTENTS

	PAGE
INTRODUCTION	1
DESCRIPTION OF THE RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM	2
LAND USE CENSUS	3
MONITORING RESULTS AND DISCUSSION	4
CONCLUSION	6

LIST OF TABLES

TABLE		PAGE
1	Monitoring Methods for Critical Radiation Exposure Pathways	2
2	2005 Fission and Activated Corrosion Product Activity in Sediment	6
3	Required Sampling Site Locations	7
4	Results of the 2005 Land Use Census Verification	9
5	Critical Receptor Evaluation for 2005	10
6	Radiological Environmental Monitoring Program Specifications	11
7	Supplemental Radiological Environmental Monitoring	16
8	Radiological Environmental Monitoring Program Summary for 2005	19
9	Radiological Environmental Monitoring Program Preoperational (Baseline) Summary	25
10	Results of 2005 Environmental Intercomparison Program with Independent Lab, Analytics, Inc.	30
11	2005 Environmental Sampling Program Exceptions	32

LIST OF FIGURES

FIGURE		PAGE
1-1	Control Site Locations (50 mile radius around the Virgil C. Summer Nuclear Station)	33
1-2	Radiological Monitoring Program Local Indicator Sample Sites (5 mile radius around Virgil C. Summer Nuclear Station)	34
1-3	Radiological Monitoring Program Local Indicator Sample Sites (1-mile radius around Virgil C. Summer Nuclear Station)	35

INTRODUCTION

Virgil C. Summer Nuclear Station (VCSNS) utilizes a pressurized water reactor rated at 2900 MWt (990 MWe gross). The station is located adjacent to the Monticello Reservoir near Jenkinsville, South Carolina and approximately 26 miles northwest of Columbia. VCSNS achieved initial criticality on October 22, 1982, reached 50% power December 12, 1982 and 100% power June 10, 1983 following steam generator feedwater modifications. Steam generators were replaced in the fall of 1994. During the ninth refuel the plant was uprated to 2900 MWt (990 MWe gross). VCSNS is currently operating in the 15th fuel cycle.

VCSNS is operating in conjunction with the adjacent Fairfield Pump Storage Facility (FPSF) which consists of eight reversible pump-turbine units of 60 MWe capacity each. During periods of off-peak power demand, base load generating capacity is used to pump water from Parr Reservoir to Monticello Reservoir. Monticello Reservoir has a surface area of approximately 6800 acres and lies about 150 feet above Parr Reservoir whose full pool area is approximately 4400 acres. The pump-turbine units operate in the generating mode to meet peak system loads while Monticello Reservoir also provides condenser cooling water for VCSNS. Cooling water intake and discharge structures are separated by a jetty to ensure adequate circulation within the reservoir.

VCSNS is located in Fairfield County which, along with Newberry County, makes up the principle area within a 10 mile radius of the plant. This area is mainly forest with only about 30% devoted to small farming activities principally producing small grains, feed crops and beef cattle. Significant portions of Lexington and Richland Counties are encompassed within the 20-mile radius of the plant and exhibit similar agricultural activities. Columbia, the state capital, is the only large city within the 50-mile radius of the plant. Small agricultural concerns are predominant, but make up less than 50% of the land area. The main industrial activity is concentrated around Columbia and is generally greater than 20 miles from the VCSNS.

Liquid effluents from VCSNS are released into the Monticello/Parr Reservoirs at two discharge points: the Circulating Water Discharge Canal (CWDC) and the FPSF Penstocks. Non-nuclear drains are released to the CWDC. Effluent from the liquid waste processing system and processed steam generator blowdown are released through the penstocks. Radioactive gaseous effluents from VCSNS are released from three points: the Main Plant Vent, the Reactor Building Purge Exhaust and the Oil Incineration Facility, all considered to be ground level releases.

Radioactive liquid and gaseous releases from the facility and their potential influence on the surrounding biota and man are the primary concern of the Radiological Environmental Monitoring Program at VCSNS. This report summarizes the results of the Radiological Environmental Monitoring Program conducted during 2005. Data trends, control/indicator and preoperational/operational data intercomparisons and other data interpretations are presented.

DESCRIPTION OF THE RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

The Radiological Environmental Monitoring Program is carried out in its entirety by South Carolina Electric and Gas Company. The program has been designed to meet the following general commitments:

1. To analyze selected samples in important anticipated pathways for the qualification and quantification of radionuclides released to the environment surrounding VCSNS.

2. To establish correlations between levels of environmental radioactivity and radioactive effluents from VCSNS operation.

The program utilizes the concepts of control/indicator and preoperational /operational intercomparisons in order to establish the adequacy of radioactivity source control and to realistically verify the assessment of environmental radioactivity levels and subsequent radiation dose to man.

Sample media and analysis sensitivity requirements have been established to ensure that the maximum dose pathways are monitored and sensitivities represent a small fraction of annual release limits. Effluent dispersion characteristics, demography, hydrology and land use have been considered in selection of environmental sampling locations. These criteria were used to establish both the preoperational and operational phases of the Radiological Environmental Monitoring Program. Elements of the program monitor the impact of gaseous and liquid effluents released from VCSNS.

Specific methods used in monitoring the pathways of these effluents which may lead to radiation exposure of the public, based on existing demography, are summarized below in Table 1. Requirements of the Radiological Environmental Monitoring Program are specified in the VCSNS Offsite Dose Calculation Manual (ODCM). Elements of the program monitor the impact of gaseous and liquid effluents released from VCSNS.

Table 1 - Monitoring Methods for Critical Radiation Exposure Pathways

Effluent Release Type	Exposure Pathway	Monitoring Media
Gaseous	Immersion Dose and other External Dose	Thermoluminescent Dosimetry (TLD), Area Monitoring, Air Sampling
	Vegetation (Ingestion)	Vegetation and Food Crop Sampling,
	Milk (Ingestion)	Milk Sampling, Grass (Forage) Sampling
Liquid	Fish (Ingestion)	Fish Sampling
	Water & Shoreline Exposure (Ingestion and Immersion)	Surface Water Sampling, Ground Water Sampling, Shoreline and Bottom Sediment Sampling
	Drinking Water (Ingestion)	Drinking Water Sampling

Monitoring sites indicative of plant operating conditions are generally located within a 5-mile radius of the plant. Table 6 provides a list of ODCM required sampling locations. Table 7 provides a list of supplemental sampling locations. Maps showing radiological environmental sampling locations within a radius of approximately 5 miles from VCSNS are presented as Figures 1-2 and 1-3. Figure 1-1 shows monitoring sites at distances greater than 10 miles from the plant. These locations indicate regional fluctuations in background radiation levels.

In addition to preoperational/operational data intercomparisons, control/indicator data intercomparisons are utilized. This is done to assess the probability that any observed abnormal measurement of radioactivity concentration is due to random or regional fluctuations rather than to a true increase in local environmental radioactivity concentration.

Environmental data is gathered through multiple types of sampling and measurements at specific locations. Several multiple sampling combinations are in use around the VCSNS. For example, all air sampling locations serve as environmental dosimetry monitoring locations. At these locations, airborne plant effluents are monitored for gamma immersion dose (noble gases), in addition to air contaminants. Monitoring locations Site 6 (1.0 mi. ESE) and Site 7 (1.0 mi. E) have broadleaf vegetation gardens for monitoring gaseous effluent deposition (ingestion pathway) in the two sectors having the highest deposition coefficients (D/Q) with real potential for exposure. Monitoring location Site 18 (16.5 mi. S) serves as a control location for direct radiation and garden monitoring.

Liquid effluents are monitored using three different monitoring media (fish, bottom sediment and surface water) at the two most probable affected bodies of water around the plant: Site 21, Parr Reservoir (2.7 mi. SSW) and Site 23, Monticello Reservoir (0.5 mi. ESE). The control location for liquid effluent comparisons is at Site 22, Neal Shoals (26.0 mi. NNW) on the Broad River.

Quality of analytical measurements is demonstrated by participation in a laboratory intercomparison program. Results of the intercomparison program with an outside vendor and VCSNS Count Room were satisfactory in 2005. The results of each of these quality control checks of the Radiological Environmental Monitoring program verify the technical credibility of analytical data generated and reported by the program.

LAND USE CENSUS

Annually a land use census is performed within a 5-mile radius of VCSNS to verify the adequacy of sample locations. In addition, the location of the maximum exposed individual (MEI) is identified. The results of the land use census performed in 2005 are included in Table 4. A verification of the maximum exposed individual location is presented in Table 5. Identification of the highest offsite dose locations was performed by calculating a hypothetical dose based on predicted VCSNS source term from the Operating License Environmental Report which is higher than actual source terms and 5 year average meteorological data. Exposure pathways used in the analysis were those identified during the land use census.

The location and pathway presently used in the ODCM for offsite organ dose calculations (E 1.1 miles - residence/garden) was found to have a calculated dose of 2.9E+0 mrem/yr. In addition, the ODCM required environmental gardens (ESE 1.0 and E 1.0 mile) were found to have a calculated dose of 2.34 and 3.71 mrem/year which are higher calculated doses than garden locations of all real individuals. There were no milking animals or dairy activity found within 5 miles of VCSNS. Therefore, changes to the ODCM gaseous effluent calculations or garden sample locations are not indicated.

MONITORING RESULTS AND DISCUSSION

The results of the Radiological Environmental Monitoring Program for 2005 are summarized in Table 8. For comparison, preoperational data are summarized in Table 9. The Radiological Environmental Program attained a program compliance rate of approximately 98.6 %. A listing of program exceptions and their respective causes are included in Table 11. Analysis of the impact of these omissions verified that program quality has not been affected.

Corbicula harvest for possible commercial use was observed in Lake Monticello in 2005. Samples were collected and analyzed for gamma emitting isotopes. No measurable gamma emitting nuclides were detected above background.

Gross beta activities measured in air particulate samples collected at indicator locations around VCSNS were consistent with preoperational levels and not statistically different from control locations. The highest site-specific mean activity (2.09E-2 pCi/m^3) was measured at indicator location Site 2 (Transmission Line 1.1 mi. SW). The results indicate that the operation of VCSNS has not contributed to detectable increases of airborne gross beta activity in the environment.

Gamma spectroscopy measurements of composited air particulate samples and activated charcoal cartridges support the gross beta activity trend. Only natural background activities were detected.

The highest minimum detectable activity (MDA) levels for ^{134}Cs, ^{137}Cs and ^{131}I were 7.51E-3, 2.04E-3 and 1.66E-2 pCi/m^3, respectively. The average maximum results support the gaseous effluent release data reported in the 2005 Annual Effluent and Waste Disposal Reports for VCSNS. No measurable iodine or particulate were released. 98.1 % of the required indicator/control air samples were collected.

Environmental dosimetry measurements did not differ significantly from preoperational measurements. Indicator and control dosimetry measurements also showed no appreciable differences. Comparison with other operational years shows no statistically significant difference. Monitoring location 4 (Fairfield Hydro 1.2 mi. WNW), was the indicator location showing the highest mean exposure rate of 1.19E+1 μR/hr. This is equal to the 2004 value of 1.19E+01 μR/hr and consistent with the highest mean exposure rate of 1.4E+1 μR/hr measured during the preoperational period. 98.8% of the required TLDs were collected.

Gamma spectroscopy measurements of surface water samples did not indicate the presence of activated corrosion or fission products above the respective MDA's for indicator sites. Tritium analysis did not indicate the presence of tritium above MDA. The highest MDA for surface water tritium at all indicator and control sites was 5.66E+2 pCi/l. 97.2 % of the required indicator/control surface water samples were collected.

Gamma spectroscopy measurements of the ODCM required ground water samples did not indicate the presence of activated corrosion or fission products above the respective MDAs. Tritium analysis did not indicate the presence of tritium above MDA. The highest MDA for tritium at all indicator and control sites was 4.97E+2 pCi/l. All required indicator/control ground water samples were collected.

Tritium analysis of a single supplemental ground water sample collected at GW-9 (NPDES well 0.35 mi. SSE) indicated the presence of tritium at a concentration of 1.83E+3 pCi/l.

Gamma spectroscopy measurements of drinking water samples collected from the Jenkinsville and Columbia water supplies did not indicate the presence of activated corrosion or fission product activity above the respective MDAs. Tritium analysis did not indicate the presence of tritium above MDA. The highest MDA for tritium at all indicator and control sites was 5.66E+2 pCi/l. The highest indicator and control site-specific gross beta activity was measured at Site 39 (Nuclear LMWTF 14.0 mi. SSE) at a level of 2.93 pCi/l. All required indicator/control drinking water samples were collected.

There were no milk samples collected in 2005. Milk sampling is required to be performed at the three highest dose locations (> 1 mrem/year) within 5 miles of the plant. Presently there are no locations meeting the criteria for indicator dairies. The closest dairy is approximately 5 miles from the plant (see Table 4). Milk samples will be obtained from this dairy if gaseous releases from the plant exceed 5% of quarterly organ dose limits or radionuclides (attributed to the operation of VCSNS) are detected in broadleaf vegetation, grass or air samples at concentrations greater than required LLDs.

Gamma spectroscopy measurement of the grass samples collected indicated ^{137}Cs in 12 of 12 samples at Site 2 (transmission line 1.1 mi. SW) at concentrations ranging from 1.35E+1 to 7.84E+1 pCi/kg. The maximum preoperational control activity was 3.4E+2 pCi/kg. A review of Site 2 air sample results indicated that no ^{137}Cs was detected. All required indicator/control grass samples were collected.

Gamma spectroscopy measurements of the broadleaf samples collected did not indicate the presence of activated corrosion or fission products above the respective MDAs. 100% of the required indicator/control broadleaf samples were collected.

Gamma spectroscopy measurements of all non-leafy (other vegetation) samples collected did not indicate the presence of activated corrosion or fission products above the respective MDA. All required indicator/control non-leafy (other vegetation) samples were collected.

Gamma spectroscopy measurements of the fish samples collected at indicator sites did not indicate the presence of activated corrosion or fission products above the respective MDA. All required indicator/control fish samples were collected.

Gamma spectroscopy measurements of sediment samples resulted in detection of ^{60}Co that is attributed to VCSNS operation. ^{60}Co was detected in 1 of 2 indicator samples taken at Site 21 (Parr Res. 2.7 mi. SSW) at a concentration of 1.25E+1 pCi/kg. ^{137}Cs was detected in 4 0f 4 indicator samples taken at Site 21 (Parr Res. 2.7 mi. SSW) and Site 23 (Monticello Res. 0.5 mi. ESE) at concentrations ranging from 1.17E+1 to 1.32E+2 pCi/kg and 1.57E+1 to 6.67E+1 pCi/kg respectively. ^{137}Cs was detected in 2 of 2 control samples taken at Site 22 (Neal Shoals 26 mi. NNW) at concentrations ranging from 1.31E+2 to 1.90E+2 pCi/kg.

Radiation doses to man, corresponding to the concentrations of activity in sediment, were calculated using Regulatory Guide 1.109 methodology. A 500-hour/year exposure to shoreline sediment containing maximum and mean concentrations of ^{60}Co, with a shoreline width factor of 1, and a sediment mass of 40 kg/m^2 was assumed. The results are included in Table 2 and show a maximum dose to the public from contaminated sediment to be 4.25E-3 mrem/yr for 2005 based on sediment samples from Parr Reservoir

Table 2 - 2005 Fission and Activated Corrosion Product Activity in Sediment

Location	Radionuclide	Activity (pCi/kg)		Corresponding Calculated Annual Dose Equivalent (mrem/yr) Total Body	
		Maximum	Mean	Maximum	Mean
Parr Reservoir	^{60}Co	1.25E+1	1.25E+1	4.25E-3	4.25E-3
		–	—		

CONCLUSION

As in previous years of VCSNS operation, the presence of fission product activity attributed to residual fallout from atmospheric weapons testing and the Chernobyl accident were detected in environmental media including sediment and grass.

No detectable fission or activation product activity attributed to VCSNS operation was observed in environmental media except for sediment samples from Parr Reservoir. The dose from sediment represents a small fraction of the observed variation in natural background and a small fraction of VCSNS effluent dose limits. The absence of an impact was expected since, historically, releases from VCSNS have been a small fraction of ODCM Specification limits. The dose calculated for the maximally exposed individual will not result in observable effect on the ecosystem or general public. The results of the Radiological Environmental Monitoring Program, therefore, substantiate the continuing adequacy of source control at VCSNS and conformance of station operation to 10 CFR 50, Appendix I design objectives.

Table 3 - Required Sampling Site Locations

Site No.	Description	Distance[1] (Miles)	Direction[2]	Sample Type(s)[3]
1	Borrow Pit	1.2	1.79.8 S	DQ
2	Transmission Line	1.1	225.0 SW	AP, RI, DQ
3	Firing Range	1.2	270.0 W	DQ
4	Fairfield Hydro	1.2	289.5 WNW	DQ
5	Transmission Line Entrance	0.9	144.0 SE	DQ
6	Env. Lab Garden	1.0	111.0 ESE	AP,RI, ,GA, DQ
7	Environmental Lab Garden	1.0	97.8 E	AP,RI,DQ, GA
8	Monticello Res. S of Rd 224	1.5	62.0 ENE	DQ
9	Ball Park	2.3	41.6 NE	DQ
10	Meteorological Tower #2	2.5	25.5 NNE	DQ
12	Old Hwy 99	4.2	349.4N	DQ
13	North Dam	2.9	333.0 NNW	DQ
14	Dairy (Shealy)[4]	6.5	277.0 W	MK,GR
16	Dairy (Parr)[4]	20.0	275.5 W	MK,GR
16a	TLD Location	28.0	278.6W	DQ
17	Columbia Water Works	25.0	144.0 SE	AP,RI,DQ,DW
18	Residence/Pine Island Club[5]	16.5	165.0 S	DQ,GA
19	Residence/Little Saluda	21.0	224.0 SSW	DQ
20	Residence/Whitmire	22.0	309.5 NW	DQ
21	Parr Reservoir	2.7	199.5 SSW	SW,FH,BS
22	Neal Shoals	26.0	343.1 NNW	SW,FH,BS
23	Discharge Canal (Mont, Res.)	0.5	104.5 ESE	SW,FH,BS
26	On Site Well (P2)	460 Ft	270.0 W	GW
27	On Site Well (P5)	510 Ft	180.0 S	GW
28	Nuclear Training Center (EOF)[6]	2.6	170.2 SSE	DW
29	Trans. Line WSW of VCSNS	1.0	260.6 WSW	DQ
30	Oak Tree North of Borrow Pit[7]	1.0	196.2 SSW	DQ, AP, RI
31	McCrorey-Liston School	6.6	11.5 NNE	DQ
32	Clark Bridge Road and Brooks Drive	4.6	24.0 NNE	DQ
33	Rd 48 near Hwy 213	4.2	68.0 ENE	DQ
34	Rd 419 North of Hwy 60	4.9	111.0 ESE	DQ
35	Glenn's Bridge Road	4.6	132.0 SE	DQ
36	Woods Behind Jenk. Post Office	3.1	151.0 SSE	DQ
37	Residence	4.9	304.8 NW	DQ
39	LMWTF	14.0	168.0 SSE	DW
41	Below Catwalk at Trestle	3.8	182.0 S	DQ
42	Broad River Rd (Residence Peak)	3.8	198.0 SSW	DQ
43	Hwy 176 and Rd 435	5.2	236.0 SW	DQ
44	Rd 28 at Cannon's Creek	2.8	256.6 WSW	DQ
45	Rd 33 at Pomaria	5.8	253.2 WSW	DQ
46	Rd 28 at Heller's Creek	3.7	291.5 WNW	DQ
47	Fairfield Tailrace	1.0	316.0 NW	DQ
52	Monticello (Rd 11)	3.8	13.0 NNE	DQ
53	Rd 359	3.0	46.5 NE	DQ
54	Jenkinsville School	1.7	72.5 ENE	DQ
55	St. Barnabas Church	2.8	91.5 E	DQ
56	Old Jenkinsville Dinner	2.0	144.0 SE	DQ

Site No.	Description	Distance[1] (Miles)	Direction[2]	Sample Type(s)[3]
58	Residence	2.5	157.0 SSE	DQ
59	Nuclear Training Center (EOF)[6]	2.6	170.2 SSE	DQ, GW
60	Rd 98 near Rd 28	3.5	274.6 W	DQ

Footnotes

1. Distance given is the distance between the site location and the VCSNS reactor containment building.

2. Direction given in degrees from true north-south line through center of reactor containment building.

3. Sample Types:

AP = Air Particulate	GW = Ground Water	GA = Garden
RI = Air Radioiodine	DW = Drinking Water	FH = Fish
DQ = Quarterly TLD	MK = Milk	BS = Bottom Sediment
SW = Surface Water	GR = Grass (Forage)	

4. Site 14 and 16 are not presently in use. If conditions change, requiring a renewal of dairy sampling these sites will be reactivated.

5. Site 18 consists of 2 locations in close proximity to Lake Murray. Garden product samples are taken at the Wyse residence. The TLD is located on Pine Island.

6. Site 28 for drinking water and site 59 for quarterly TLD measurements are co-located at the location of the SCE&G Nuclear Training Center which also serves as the Virgil C. Summer Station Emergency Offsite Facility.

7. Site 30 air sampler and TLD though not in line of sight are located in the same sector.

Table 4 – Results of the 2005 Land Use Census Verification

Sector	Nearest Residence	Miles	Nearest Garden	Miles	Nearest Cattle	No. Milked	Miles	Nearest Goat	No. Milked	Miles
N	P. Oliver	3.73			John Robinson	0	3.4			
NNE	Bessie Crumblin	2.9	Virgil Harrison	3.21	WI/Charles Coleman	0	4.97			
NE	Eartha Guinyard	1.5	David Stone	2.1	David Stone	0	2.1			
ENE	Robert Martin	1.53	Essie Mae Glenn	1.68		0	0	Robert Martin	0	1.53
E	Lynn Mincy	1.2	Lynn Mincy	1.2						
ESE	Carrie Lee Martin	1.1	Glover / Kennedy	5	Glover/Kennedy	0	5			
SE	John White	1.44	John White	1.44	Sim Robertson	0	4.7			
SSE	Ronnie Mann (A)	2.39	Ronnie Mann (B)	2.39						
S	Kelly Boulware	3.56	Kelly Boulware	3.56	Shirley Counts	0	5			
SSW	Nick Bates	3.11	Nora Wicker	3.77	G.A. Mayers	0	4.7			
SW	Marvin Miller	3.3	Marvin Miller	3.3				Shakkori	0	4.7
WSW	Ron Hope	2.9	Mary Davis	3	Ken/Virg Graham		4.98	Steve All		4.83
W	Jerry Cassado	2.55	Marion Livingston	2.8	Marion Livingston	0	2			
W					Ken/Virg Graham	90	5			
WNW	Lorraine Wicker	4.24	Claude Ringer	4.8	Claude Ringer	0	4.8		0	0
NW	Louise Workman	3.9								
NNW	Frank March	2.9	Frank March	2.9	Frank March	0	2.9			

(A) CHANGE IN CLOSEST RESIDENCE
(B) CHANGE IN CLOSEST GARDEN

Table 5 Critical Receptor Evaluation for 2005

NAME	SECTOR	MILES	PATHWAY	X/Q	D/Q	Dose* mRem/y
Kelly Boulware	S	3.56	Res,Gar	9.17E-08	4.28E-10	1.12E-01
Shirley Counts	S	5	Res,Gar,B	4.64E-08	2.06E-10	7.48E-02
Nick Bates	SSW	3.11	Res	1.46E-07	8.62E-10	5.66E-03
Nora Wicker	SSW	3.77	Res,Gar	9.78E-08	5.63E-10	1.45E-01
G.A. Mayers	SSW	4.7	Res,Gar,B	6.27E-08	3.51E-10	1.25E-01
Marvin Miller	SW	3.3	Res,Gar	1.31E-07	9.60E-10	3.39E-01
Shakkori	SW	4.7	Res,G	6.32E-08	4.47E-10	7.82E-03
Ron Hope	WSW	2.9	Res	1.43E-07	9.27E-10	5.60E-03
Mary Davis	WSW	3	Res,Gar	1.33E-07	8.58E-10	2.20E-01
Steve All	WSW	4.83	Res,G	5.04E-08	3.04E-10	5.59E-03
Ken/Virg Graham	WSW	4.98	B	4.75E-08	2.85E-10	2.84E-02
Jerry Cassado	W	2.55	Res	2.02E-07	8.65E-10	7.68E-03
Marion Livingston	W	2	B	3.42E-07	1.53E-09	1.53E-01
Marion Livingston	W	2.8	Res,Gar	1.66E-07	6.98E-10	1.85E-01
Marion Livingston	W	2 & 2.8	Res,Gar,B	BOTH	BOTH	3.38E-01
Ken/Virg Graham	W	5	Res,Gar,B,C/M	5.21E-08	1.97E-10	1.06E-01
Lorraine Wicker	WNW	4.24	Res	4.94E-08	1.67E-10	1.85E-03
C. Ringer	WNW	4.8	Res,Gar,B	3.90E-08	1.27E-10	4.70E-02
Louise Workman	NW	3.9	Res	1.11E-07	3.21E-10	4.13E-03
Frank March	NNW	2.9	Res,Gar,B	3.51E-07	9.68E-10	3.65E-01
John Robinson	N	3.4	B	2.83E-07	8.13E-10	8.15E-02
P. Oliver	N	3.73	Res	2.36E-07	6.63E-10	8.80E-03
Bessie Crumblin	NNE	2.9	Res	3.76E-07	1.13E-09	1.41E-02
Virgil Harrison	NNE	3.21	Res,Gar	3.07E-07	9.01E-10	2.48E-01
Will/Charles Coleman	NNE	4.97	B	1.34E-07	3.50E-10	3.51E-02
Eartha Guinyard	NE	1.5	Res	2.01E-06	6.73E-09	7.55E-02
David Stone	NE	2.1	Res,Gar,B	9.68E-07	2.98E-09	1.11E+00
Robert Martin	ENE	1.53	Res,G	2.00E-06	5.81E-09	1.45E-01
Essie Mae Glenn	ENE	1.68	Res,Gar	1.63E-06	4.61E-09	1.27E+00
**VCS Garden #7	E	1	Res,Gar	4.42E-06	1.36E-08	3.71E+00
ODCM Assumed MEI	E	1.1	Res,Gar	3.54E-06	1.06E-08	2.90E+00
[1] Lynn Mincy	E	1.2	Res,Gar	2.89E-06	8.46E-09	2.33E+00
**VCS Garden #6	ESE	1	Res,Gar	2.64E-06	8.62E-09	2.34E+00
Carrie Lee Martin	ESE	1.1	Res	2.10E-06	6.72E-09	7.88E-02
Glover / Kennedy	ESE	5	Res,Gar,B	8.90E-08	1.94E-10	7.53E-02
John White	SE	1.44	Res,Gar	7.17E-07	2.69E-09	7.19E-01
Sim Robertson	SE	4.7	Res,B	6.18E-08	1.70E-10	6.41E-02
Ronnie Mann	SSE	2.39	Res,Gar	1.59E-07	6.98E-10	1.84E-01

Pathways:
Res = Residence
Gar = Garden
B = Beef
C/M = Cow/Milk (Infant)
G= Goat

Footnotes:

[1] Maximum exposed individual.

* Hypothetical dose based on Operating License Environmental Report Source Term. X/Q and D/Q were derived from ODCM 5-year average meteorological data

** ODCM required environmental gardens.

Table 6 – Radiological Environmental Monitoring Program Specifications

Exposure Pathway and/or Sample	Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample Location	Type & Frequency of Analysis
AIRBORNE: I. Particulate	A) 3 Indicator samples to be taken at locations (in different sectors) beyond but as close to the exclusion boundary as practicable where the highest offsite sector ground level concentrations are anticipated.[2]	Continuous sampler operation with weekly collection.	2 7 30	Gross beta following filter change; Quarterly composite (by location) for gamma isotopic.
	B) 1 Indicator sample to be taken in the sector beyond but as close to the exclusion boundary as practicable corresponding to the residence having the highest anticipated offsite ground level concentration or dose.[2]	Continuous sampler operation with weekly collection.	6	Gross beta following filter change; Quarterly composite (by location) for gamma isotopic.
	C) 1 Indicator sample to be taken at the location of one of the dairies being sampled meeting the criteria of VII(A).[2,4]	Continuous sampler operation with weekly collection.	N/A	Gross beta following filter change; Quarterly composite (by location) for gamma isotopic.
	D) 1 Control sample to be taken at a location at least 10 air miles from the site and not in the most prevalent wind directions.[2]	Continuous sampler operation with weekly collection.	17	Gross beta following filter change; Quarterly composite (by location) for gamma isotopic.
II. Radioiodine	A) 3 Indicator samples to be taken at two locations as given in I(A) above	Continuous sampler operation with weekly canister collection.	2 7 30	Gamma Isotopic for Iodine 131 weekly.
	B) 1 Indicator sample to be taken at the location as given in 1(B) above.	Continuous sampler operation with weekly canister collection.	6	Gamma Isotopic for Iodine 131 weekly.
	C) 1 Indicator sample to be taken at the location as given in I(C) above.	Continuous sampler operation with weekly canister collection.	N/A	Gamma Isotopic for Iodine 131 weekly.
	D) 1 Control sample to be taken at a location similar in nature to I(D) above.	Continuous sampler operation with weekly canister collection.	17	Gamma Isotopic for Iodine 131 weekly.

Exposure Pathway and/or Sample	Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample Location	Type & Frequency of Analysis
III. Direct	A) 13 Indicator stations to form and inner ring of stations in the 13 accessible sectors within 1 to 2 miles of the plant.	Monthly or quarterly exchange[5,7] two or more dosimeters at each location.	1,2,3,4,5,6, 7,8,9,10,29, 30,47	Gamma dose monthly or quarterly
	B) 16 indicator stations to form an outer ring of stations in the 16 accessible sectors within 3 to 5 miles of the plant.	Monthly or quarterly exchange[5,7] two or more dosimeters at each location.	12,13,32,33, 34,35,36,37, 41,42,43,44, 46,53,55,60	Gamma dose monthly or quarterly
	C) 11 Stations to be placed in special interest areas such as population centers, nearby residences, schools and in 4 or 5 areas to serve as controls.	Quarterly exchange[7]; two or more dosimeters at each location	16,17,18,19, 20,31,45,52, 54,56,58	Gamma dose quarterly.
WATERBORNE IV. Surface Water	A) 1 Indicator sample downstream to be taken at a location which allows for mixing a dilution in the ultimate receiving river.	Time composite samples with collection every month[5]	21[3,6]	Gamma isotopic monthly with quarterly composite (by location) to be analyzed for tritium[7]
	B) 1 Control sample to be taken at a location on the receiving river sufficiently far upstream such that no effects of pumped storage operation are anticipated.	Time composite samples with collection every month[5]	22[3]	Gamma isotopic monthly with quarterly composite (by location) to be analyzed for tritium[7].
	C) 1 Indicator sample to be taken in the upper reservoir of the pumped storage facility at the plant discharge canal.	Time composite samples with collection every month[5]	23[3]	Gamma isotopic monthly with quarterly composite (by location) to be analyzed for tritium[7].
V. Ground Water	A) 2 Indicator samples to be taken within the exclusion boundary and in the direction of potentially affected ground water supplies.	Quarterly grab sampling[7]	26 27	Gamma isotopic and tritium analyses quarterly[7].
	B) 1 Control sample from unaffected location	Quarterly grab sampling[7]	59	Gamma isotopic and tritium analyses quarterly[7].

Exposure Pathway and/or Sample	Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample Location	Type & Frequency of Analysis
VI. Drinking Water	A) 1 Indicator sample from a nearby public ground water supply source.	Monthly grab sampling[5].	28	Monthly[5] gamma isotopic, gross beta and quarterly[7] composite for tritium analyses.
	B) 1 Indicator (finished water) sample from the nearest downstream water supply.	Monthly composite sampling.	17	Monthly[5] gamma isotopic, and gross beta and quarterly[7] composite for tritium analyses.
	C) 1 Control (finished water) sample from an unaffected water supply.	Monthly composite sampling.	39	Monthly[5] gamma isotopic, and gross beta and quarterly[7] composite for tritium analyses
INGESTION: VII. Milk[4]	A) Samples from milking animals in 3 locations within 5 km having the highest dose potential. If there are none then 1 sample from milking animals in each of 3 areas between 5 to 8 km distance where doses are calculated to be greater than 1 mrem per year.[10]	Semimonthly when animals are on pasture[8]; monthly other times[5]	To be supplied when milk animals are found in accordance with criteria VII.A.	Gamma isotopic and I-131 analysis semimonthly[8] when animals are on pasture, monthly other times[5]
	B) 1 Control sample to be taken at the location of a dairy > 20 miles distance and not in the most prevalent wind direction[2].	Semimonthly when animals are on pasture[8]; monthly other times[5,11].	16	Gamma isotopic and I-131 analysis semimonthly[8] when animals are on pasture, monthly other times[5]
	C) 1 Indicator grass (forage) sample to be taken at the location of one of the dairies being sampled meeting the criteria of VII(A),above, when animals are on pasture	Monthly when available[5]	To be supplied when milk animals are found in accordance with criteria VII.A.	Gamma isotopic.
	D) 1 Control grass (forage) sample to be taken at the location of VII(B) above.	Monthly when available[5,11]	16	Gamma isotopic.

Exposure Pathway and/or Sample	Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample Location	Type & Frequency of Analysis
VIII. Food Products	A) 2 Samples of broadleaf vegetation grown in the 2 nearest offsite location of highest calculated annual average ground level D/Q if milk sampling is not performed within 3 km or if milk sampling is not performed at a location within 5-8 km where the doses are calculated to be greater than 1 mrem/yr[10].	Monthly when available[5].	6 7	Gamma isotopic on edible portion.
	B) 1 Control sample for the same foods taken at least 10 miles distance and not in the most prevalent wind direction if milk sampling is not performed within 3 km or if milk sampling is not performed at a location within 5 to 8 km where the doses are calculated to be greater than 1 mrem/yr[10]	Monthly when available[5].	18	Gamma isotopic on edible portion.
IX. Fish	A) 1 Indicator sample to be taken at a location in the upper reservoir.	Semiannual[9] collection of the following specie types if available: bass; bream, crappie; catfish, carp.	23[3]	Gamma isotopic on edible portions semiannually[9].
	B) 1 Indicator sample to be taken at a location in the lower reservoir.	Semiannual[9] collection of the following specie types if available: bass; bream, crappie; catfish, carp.	21[3]	Gamma isotopic on edible portions semiannually[9].
	C) 1 Control sample to be taken at a location on the receiving river sufficiently far upstream such that no effects of pumped storage operation are anticipated	Semiannual[9] collection of the following specie types if available: bass; bream, crappie; catfish, carp.	22[3]	Gamma isotopic on edible portions semiannually[9].
AQUATIC: X. Sediment	A) 1 Indicator sample to be taken at a location in the upper reservoir.	Semiannual grab sample.[9]	23[3]	Gamma isotopic.
	B) 1 Indicator sample to be taken on or near the shoreline of the lower reservoir.	Semiannual grab sample.[9]	21[3]	Gamma isotopic.
	C) 1 Control sample to be taken at a location on the receiving river sufficiently far upstream such that no effects of pumped storage operation are anticipated.	Semiannual grab sample.[9]	22[3]	Gamma isotopic.

FOOTNOTES

1. Reserved for future use.
2. Sample site locations are based on 5-year average meteorological analysis.
3. Though generalized areas are noted for simplicity of sample site enumeration, airborne, water and sediment sampling is done at the same location whereas biological sampling sites are generalized areas in order to reasonably assure availability of samples.
4. Milking animal and garden survey results will be analyzed annually. If the survey should indicate new dairying activity the owners shall be contacted with regard to a contract for supplying sufficient samples. If contractual arrangements can be made, site(s) will be added for additional milk sampling up to a total of 3 Indicator Locations.
5. Not to exceed 35 days.
6. Time composite samples are samples which are collected with equipment capable of collecting an aliquot at time intervals which are short (e.g. hourly) relative to the compositing period.
7. At least once per 100 days.
8. At least once per 18 days.
9. At least once per 200 days.
10. The dose shall be calculated for the maximum organ and age group, using the guidance/methodology contained in Regulatory Guide 1.109, Rev. 1 and the parameters particular to the site.
11. Milk and forage sampling at the control location is only required when locations meeting the criteria of VII(A)are being sampled.

Table 7 – Supplemental Radiological Environmental Monitoring

Exposure Pathway and/or Sample	Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample Location	Type & Frequency of Analysis
AIRBORNE: S-I. Particulate	A) 1 Indicator sample monitoring the nearest community with the highest anticipated dose or ground level concentration.	Continuous sampler operation with weekly collection.	8	Gross beta following filter change; Monthly Composite (by location) for gamma isotopic.
S-II. Radioiodine	A) 1 Indicator sample to be taken from the location of S-1(A) above.	Continuous sampler operation with weekly collection.	8	Gamma isotopic for I-131 weekly.
S-III. Direct	A) 5 stations to be placed within the exclusion boundary.	Quarterly exchange[7]; two or more dosimeters at each location.	61,62,63, 68 & 99	Gamma dose quarterly.
	B) 2 stations to be placed around VCSNS sludge lagoons.	Quarterly exchange[7]; two or more dosimeters at each location.	94,97	Gamma dose quarterly.
WATERBORNE: S-IV. Surface Water	A) 1 indicator sample to be taken of the combined wastewater discharge.	Composite samples with monthly collection.[13,5]	77	Gamma isotopic and tritium.
	B) 1 Indicator sample taken at each storm drain outfall.	Daily sample with monthly composite.	72,73	Gamma isotopic and tritium.
S-V. Groundwater	A) 4 Indicator samples to be taken at NPDES monitoring wells.	Semiannual[9]	GW-9, GW-12, GW-13A, GW15	Gamma isotopic, tritium and other as directed.
	B) 1 Control sample to be taken at NPDES monitoring wells.	Semiannual[9]	GW-8	Gamma isotopic, tritium and other as directed.

Exposure Pathway and/or Sample	Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample Location	Type & Frequency of Analysis
INGESTION: S-VII. Milk[4]	A) 1 Sample from one of the nearest affected dairies at or beyond 5 miles.	Biweekly grab sample.[8,14,5]	14	Gamma isotopic and I-131 analysis biweekly.
	B) 1 Control sample to be taken at the location of a dairy greater than 20 miles distance and not in the most prevalent wind direction.	Biweekly grab sample.[8,14,5]	16	Gamma isotopic and I-131 analysis biweekly.
	C) 1 Indicator grass (forage) sample to be taken at the location of S-VII(A) above.	Monthly when available.[14]	14	Gamma isotopic.
S-VII. Milk[4]	D) 1 Control grass (forage) sample to be taken at the location of S-VII(B) above.	Monthly when available.[14]	16	Gamma isotopic.
	E) 2 Indicator grass (forage) samples to be taken at 2 of the locations beyond but as close to the exclusion boundary as practical where the highest offsite sectorial ground level concentrations are anticipated.	Monthly when available.	2,7	Gamma isotopic.
	F) 1 Control grass (forage) sample to be used for routine monitoring along with S-IV(E) above.	Monthly when available.	18	Gamma isotopic.
S-VIII. Food Products	A) 1 Indicator sample of various types of foods grown in the area surrounding the plant (root, fruit, grain).	Annually during growing season.[11]	6,7	Gamma isotopic on edible portion.

FOOTNOTES

1. Reserved for future use.

2. Reserved for future use.

3. Reserved for future use.

4. Milking animal and garden survey results will be analyzed annually. If the survey should indicate new activity the owners shall be contacted with regard to a contract for supplying sufficient samples. If contractual arrangements can be made, site(s) will be added for additional milk sampling up to a total of 3 Indicator Locations.

5. Not to exceed 35 days.

6. Reserved for future use.

7. At least once per 100 days.

8. At least once per 18 days.

9. At least once per 200 days.

10. Reserved for future use.

11. At least once per 400 days.

12. Reserved for future use.

13. Weekly, when circulating water is not operational.

14. Milk and grass (forage) sampling is not required unless VCSNS gaseous releases exceed 5% of quarterly organ dose limits or radionuclides (attributed to VCSNS operation) are detected in broadleaf vegetation, grass or air samples at concentrations greater than required LLD. Sampling should continue for 2 months after plant releases are reduced to less than trigger levels and milk contamination levels have returned to background levels.

- The ODCM requires semimonthly sampling when animals are on pasture, monthly at other times.

Table 8 – Radiological Environmental Monitoring Program Summary for 2005

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed[1]	Lower Limit of Detection[2] Actual (Max.)	All Indicator Locations Mean[3] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[3] (#/total #) (Range)	Number of Nonroutine Reported[4] Measurements
				Name (Distance & Direction)	Mean[3] (#/total #) (Range)		
Air Particulate (pCi/m^3)	Gross Beta (305)	6.58E-3 (1.0E-2)	2.08E-2 (250/254) (6.72E-3 to 3.62E-2)	Site 2 Environmental Lab Garden (1.1 mi SW)	2.12E-2 (48/49) (8.99E-3 to 3.62E-2)	1.97E-2 (51/51) (5.02E-3 to 3.13E-2)	0
	Gamma Spec (72)						
	^{134}Cs	7.510E-3 (5.0E-2)	All < LLD			All < LLD	0
	^{137}Cs	2.04E-3 (6.0E-2)	All < LLD			All < LLD	0
Air Radioiodine (pCi/m^3)	^{131}I (306)	1.66E-2 (7.0E-2)	All < LLD			All < LLD	0
Direct (TLD)[5] (μR/hr)	Gamma(134) Quarterly	N/A	8.39E+0 (114/114) (5.46E+0 to 1.24E+1)	Site 4, Fairfield Hydro (1.2 mi., WNW)	1.19E+1 (4/4) (1.15E+1 to 1.24E+1)	8.26E+0 (20/20) (5.60+0 to 1.09E+1)	0
	Gamma(24) Special Interest	N/A	8.84E+0 (24/24) (5.28E+0 to 1.16E+1)	Site 52 Monticello Rt. 11 (3.8 mi., NNE)	1.11E+1 (4/4) (1.08E+1 to 1.16E+1)	N/A	0
Surface Water (pCi/l)	^{3}H (35)	5.66E+2 (2.0E+3)	All < LLD			All < LLD	0
	Gamma Spec(35)						
	^{54}Mn	1.91E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{58}Co	2.15E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{59}Fe	4.39E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{60}Co	2.02E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{65}Zn	3.92E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{95}Zr	4.19E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{95}Nb	2.72E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{134}Cs	1.72E+0 (1.5E+1)	All < LLD			All < LLD	0

Table 8 (cont.) - Radiological Environmental Monitoring Program Summary for 2005

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed[1]	Lower Limit of Detection[2] Actual (Max.)	All Indicator Locations Mean[3] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[3] (#/total #) (Range)	Number of Nonroutine Reported[4] Measurements
				Name (Distance & Direction)	Mean[3] (#/total #) (Range)		
Surface Water (Continued)	^{137}Cs	2.10E+0 (1.8E+1)	All < LLD			All < LLD	0
	^{140}Ba	1.38E+1 (6.0E+1)	All < LLD			All < LLD	0
	^{140}La	4.89E+0 (1.5E+1)	All < LLD			All < LLD	0
Ground Water (pCi/l)	^{3}H (12)	4.97E+2 N/A	All < LLD			All < LLD	0
	Gamma Spec (12)						
	^{54}Mn	2.07E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{58}Co	1.84E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{59}Fe	4.18E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{60}Co	2.25E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{65}Zn	3.36E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{95}Zr	3.64E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{95}Nb	2.32E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{134}Cs	1.60E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{137}Cs	2.04E+0 (1.8E+1)	All < LLD			All < LLD	0
	^{140}Ba	8.74E+0 (6.0E+1)	All < LLD			All < LLD	0
	^{140}La	3.61E+0 (1.5E+1)	All < LLD			All < LLD	0

Table 8 (Cont.) - Radiological Environmental Monitoring Program Summary for 2005

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed[1]	Lower Limit of Detection[2] Actual (Max.)	All Indicator Locations Mean[3] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[3] (#/total #) (Range)	Number of Nonroutine Reported[4] Measurements
				Name (Distance & Direction)	Mean[3] (#/total #) (Range)		
Drinking Water[5] (pCi/l)	Gross Beta (36)	1.32E+0 (4.00E+0)	1.97E+0 (19/24) (1.42E+0 to 2.44E+0)	Site 28, Nuclear Training Center (2.6mi, SSE)	1.99E+0 (10/12) (1.42E+0 to 2.44E+0)	2.04E+0 (11/12) (1.48E+0 to 2.93E+0)	0
	^{3}H (36)	5.66E+2 (2.0E+3)	All < LLD			All < LLD	0
	Gamma Spec (72)[10]						
	^{54}Mn	2.13E+ 0 (1.5E+ 1)	All < LLD			All < LLD	0
	^{58}Co	2.08E+ 0 (1.5E+ 1)	All < LLD			All < LLD	0
	^{59}Fe	4.79E+ 0 (3.0E+ 1)	All < LLD			All < LLD	0
	^{60}Co	2.26E+ 0 (1.5E+ 1)	All < LLD			All < LLD	0
	^{65}Zn	4.33E+0 (3.0E+ 1)	All < LLD			All < LLD	0
	^{95}Zr	3.52E+ 0 (3.0E+ 1)	All < LLD			All < LLD	0
	^{95}Nb	2.41E+ 0 (1.5E + 1)	All < LLD			All < LLD	0
	^{131}I	5.43E-1 (1.0E+ 0)	All < LLD			All < LLD	0
	^{134}Cs	1.79E+ 0 (1.5E + 1)	All < LLD			All < LLD	0
	^{137}Cs	2.27E+ 0 (1.8E + 1)	All < LLD			All < LLD	0
	^{140}Ba	1.19E+ 1 (6.0E+ 1)	All < LLD			All < LLD	0
	^{140}La	5.68E+ 0 (1.5E+ 1)	All < LLD			All < LLD	0

Table 8 (Cont.)- Radiological Environmental Monitoring Program Summary for 2005

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed[1]	Lower Limit of Detection[2] Actual (Max.)	All Indicator Locations Mean[3] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[3] (#/total #) (Range)	Number of Nonroutine Reported[4] Measurements
				Name (Distance & Direction)	Mean[3] (#/total #) (Range)		
Grass (pCi/kg wet)	Gamma Spec (36)						
	^{131}I	3.74E+1 (6.0E+1)	All < LLD			All < LLD	0
	^{134}Cs	2.13E+1 (6.0E+1)	All < LLD			All < LLD	0
	^{137}Cs	2.43E+1 (8.0E+1)	3.64E+1 (12/24) (1.35E+1 to 7.84E+1)	Site 2 Transmission Line (1.1 mi SW)	3.64E+1(12/12) (1.35E+1 to 7.84E+1)	All < LLD	0
Broadleaf Vegetation (pCi/kg wet)	Gamma Spec (36)						
	^{131}I	2.45E+ 1 (6.0E+ 1)	All < LLD			All < LLD	0
	^{134}Cs	1.76E+ 1 (6.0E+ 1)	All < LLD			All < LLD	0
	^{137}Cs	2.39E+ 1 (8.0E+ 1)	All < LLD			All < LLD	0
Other Vegetation (pCi/kg wet)	Gamma Spec (9)						
	^{131}I	1.17E+1 (6.0E+ 1)	All < LLD			All < LLD	0
	^{134}Cs	1.30E+ 1 (6.0E+ 1)	All < LLD			All < LLD	0
	^{137}Cs	1.34E+ 1 (8.0E + 1)	All < LLD			All < LLD	0
Fish[7] (pCi/kg wet)	Gamma Spec (18)						
	^{54}Mn	1.45E+ 1 (1.3E+ 2)	All < LLD			All < LLD	0
	^{58}Co	1.67E + 1 (1.3E+ 2)	All < LLD			All < LLD	0
	^{59}Fe	4.18E+ 1 (2.6E+ 2)	All < LLD			All < LLD	0

Table 8 (Cont.)- Radiological Environmental Monitoring Program Summary for 2005

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed[1]	Lower Limit of Detection[2] Actual (Max.)	All Indicator Locations Mean[3] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[3] (#/total #) (Range)	Number of Nonroutine Reported[4] Measurements
				Name (Distance & Direction)	Mean[3] (#/total #) (Range)		
Fish[7] (Cont)	^{60}Co	1.90E+1 (1.3E+2)	All < LLD			All < LLD	0
	^{65}Zn	3.79E+1 (2.6E+2)	All < LLD			All < LLD	0
	^{134}Cs	1.38E+1 (1.3E+2)	All < LLD			All < LLD	0
	^{137}Cs	1.49E+1 (1.5E+2)	All < LLD			All < LLD	0
Sediment (pCi/kg)[8]	Gamma Spec (6)						
	^{54}Mn	1.63E+1 N/A	All < LLD			All < LLD	0
	^{58}Co	1.35E+1 N/A	All < LLD			All < LLD	0
	^{60}Co	1.65E+1 N/A	1.25E+1 (1/4) (1.25E+1 to 1.25E+1)	Site 21 Parr Res. (2.7 mi. SSW)	1.25E+1 (1/2) (1.25E+1 to 1.25E+1)	All < LLD	0
	^{134}Cs	1.17E+1 (1.5E+2)	All < LLD			All < LLD	0
	^{137}Cs	* (1.8E+2)	5.65E+1 (4/4) (1.17E+1 to 1.32E+2)	Site 21 Parr Res. (2.7 mi. SSW)	7.19E+1 (2/2) (1.17E+1 to 1.32E+2)	1.60E+2 (2/2) (1.31E+2 to 1.90E+2)	0

Table 8 (cont) - Radiological Environmental Monitoring Program Summary for 2005

Footnotes

1. Includes indicator and control analyses. Does not include supplemental samples. Site 8 Air Particulates and Air Radioiodines are included as indicators. All supplemental sample results were consistent with the tabulated results shown with exception of GW-9 (NPDES well, 0.35 mi. SSE).

2. Values given are maximum MDA values for indicator locations calculated from the program data analyses with maximum acceptable LLD values allowed from NRC guidelines are given in parentheses.

3. Mean and range are based on detectable measurements only. The fractions of detectable measurements (i.e., number of positive results/total number of measurements) at specific locations are indicated in parentheses.

4. Any confirmed measured level of radioactivity in any environmental medium that exceeds the reporting requirements of ODCM, Section 1.4.1.2.

5. Detection sensitivity is approximately 10 mrem/yr (1.0 μR/hr).

6. Elevated levels of ^{214}Pb and ^{214}Bi were observed in all Jenkinsville drinking water samples. The values are not reported here because they are naturally occurring (do not originate from VCSNS) and furnish no quantifiable information of interest.

7. Fish include 3 groups (Bass, Bream/Crappie, Catfish/Carp.)

8. Elevated levels of ^{214}Pb and ^{214}Bi plus other ^{226}Ra daughter products and ^{228}Ac plus other ^{232}Th daughter products were observed in all sediment samples. The values are not reported here because they are naturally occurring (do not originate from VCSNS) and furnish no quantifiable information of interest.

9. Reserved for future use.

10. Drinking water resin prepared and counted for ^{131}I as separate sample.

11. Reserved for future use.

* All measurements had positive results, no MDA values calculated.

Table 9– Radiological Environmental Program Preoperational (Baseline) Summary

Medium or Pathway Sampled (Unit of Measurement and Reporting Period)	Type and Total Number of Analyses Performed	Lower Limit of Detection[1] Actual (Max.)	All Indicator Locations Mean[2] (#/total #) (Range)	Location with Highest Annual Mean: Name (Distance & Direction)	Location with Highest Annual Mean: Mean[2] (#/total #) (Range)	Control Locations Mean[2] (#/total #) (Range)	Number of Nonroutine Reported[3] Measurements
Air Particulate (pCi/m^3) (1981-1982)	Gross Beta (1300)	4.1E-3 (1.0E-2)	1.1E-1 (562/564)[4] (1.3E-2 to 5.5E-1) 2.7E-2 (456/462)[4] (9.3E-3 to 6.6E-2)	Site 13, North Dam (2.9 mi NNW) Site 8, Mon. Res. S of Rd 224 (1.5 ENE)	1.3E-1 (52/52) (2.1E-2 to 5.5E-1) 3.0E-2 (42/42) (1.2E-2 to 6.0E-2)	1.2E-1 (153/155) (7.9E-3 to 6.1E-1) 2.8E-2 (125/126) (1.2E-2 to 5.8E-2)	0
	Gamma Spec (307)						
	^{134}Cs	3.0E-3 (1.0E-2)	All < LLD			All < LLD	0
	^{137}Cs	3.1E-3 (1.0E-2)	3.2E-3 (22/241) (1.5E-3 to 5.2E-3)	Site 10, Met Tower (2.4 mi NNE)	3.8E-3 (2/22) (2.5E-3 to 5.2E-3)	4.2E-3 (4/66) (3.2E-3 to 5.6E-3)	0
Air Radioiodine (pCi/m^3) (1982)	^{131}I (290)	3.6E-2 (7.0E-2)	All < LLD			All < LLD	0
Direct (TLD)[5] (μR/hr) (1978-1982)	Gamma (1220) Monthly	0.5 N/A	9.9 (915/915) (6.7 to 14.7)	Site 13, North Dam (2.9 mi NNW)	13.1 (61/61) (12.2 to 14.2)	9.7 (305/305) (6.4 to 13.5)	0
	Gamma (161) Quarterly	0.5 N/A	10.2 (154/154) (6.8 to 14.7)	Site 55, St. Barnabas Church (2.8 mi E)	14.0(7/7) (13.1 to 14.7)		0
Surface Water (pCi/l) (1981-1982)	^{3}H (43)	1.1E+3 (2.0E+3)	1.4E+3 (18/29) (1.1E+3 to 2.4E+3)	Site 17, Columbia Canal (24.7 mi, SE)	1.6E+3 (2/7) (1.4E+3 to1.8E+3)	1.2E+3 (6/14) (6.7E+2 to 1.6E+3)	0
	Gamma Spec (140)						
	^{54}Mn	2.7E-1 (1.5E+1)	All < LLD			All < LLD	0
	^{58}Co	2.9E-1 (1.5E+1)	All < LLD			All < LLD	0
	^{59}Fe	6.0E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{60}Co	2.4E-1 (1.5E+1)	All < LLD			All < LLD	0
	^{65}Zn	7.9E-1 (3.0E+1)	All < LLD			All < LLD	0
	^{95}Zr	5.2E-1 (1.5E+1)	All < LLD			All < LLD	0
	^{95}Nb	3.3E-1 (1.5E+1)	All < LLD			All < LLD	0
	^{134}Cs	3.0E-1 (1.5E+1)	All < LLD			All < LLD	0

Medium or Pathway Sampled (Unit of Measurement and Reporting Period)	Type and Total Number of Analyses Performed	Lower Limit of Detection[1] Actual (Max.)	All Indicator Locations Mean[2] (#/total #) (Range)	Location with Highest Annual Mean: Name (Distance & Direction)	Location with Highest Annual Mean: Mean[2] (#/total #) (Range)	Control Locations Mean[2] (#/total #) (Range)	Number of Nonroutine Reported[3] Measurements
	^{137}Cs	2.2E-1 (1.8E+1)	All < LLD			All < LLD	0
	^{140}Ba	2.2E+0 (6.0E+1)	All < LLD			All < LLD	0
	^{140}La (1982 only)	5.5E-1 (1.5E+1)	All < LLD			All < LLD	0
Ground Water (pCi/l) (1981-1982)	^{3}H (29)	9.0E+2 (2.0E+3)	1.5E+3 (16/16) (9.5E+2 to 2.3E+3)	Site 26, Onsite Well P4 (265 ft, W)	1.6E+3 (8/8) (9.5E+2 to 2.3E+3)	1.3E+3 (13/13) (1.0E+3 to 1.9E+3)	0
	Gamma Spec (32)						
	^{54}Mn	3.7E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{58}Co	3.8E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{59}Fe	7.8E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{60}Co	3.8E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{65}Zn	8.1E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{95}Zr	6.8E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{95}Nb	4.6E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{134}Cs	3.7E+0 (1.5E + 1)	All < LLD			All < LLD	0
	^{137}Cs	3.8E+0 (1.8E + 1)	All < LLD			All < LLD	0
	^{140}Ba	1.9E+1 (6.0E+1)	All < LLD			All < LLD	0
	^{140}La (1982 only)	5.0E0 (1.5E+1)	All < LLD			All < LLD	0
Drinking Water[6] (pCi/l) (1981-1982)	Gross Beta[7]	(2.0E+0)					
	^{3}H (14)	6.3E+2 (1.0E+3)	7.8E+2 (6/14) (6.8E+2 to 9.8E+2)	Site 28, Jenkinsville (2.0 mi SE)[7]	8.4E+2 (3/7) (7.0E+2 to 9.8E+2)		0
	Gamma Spec (44)						
	^{54}Mn	3.0E-1 (1.5E+1)	All < LLD				0
	^{58}Co	2.7E-1 (1.5E+1)	All < LLD				0

Medium or Pathway Sampled (Unit of Measurement and Reporting Period)	Type and Total Number of Analyses Performed	Lower Limit of Detection[1] Actual (Max.)	All Indicator Locations Mean[2] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[2] (#/total #) (Range)	Number of Nonroutine Reported[3] Measurements
				Name (Distance & Direction)	Mean[2] (#/total #) (Range)		
	^{59}Fe	9.6E0 (3.0E+1)	All < LLD				0
	^{60}Co	2.6E-1 (1.5E+1)	All < LLD				0
	^{65}Zn	3.4E-1 (3.0E+1)	All < LLD				0
	^{95}Zr	4.8E-1 (1.5E+1)	All < LLD				0
	^{131}I	3.4E-1 (1.5E+1)	All < LLD				0
	^{95}Nb	7.4E-1 (1.0E+0)	All < LLD				0
	^{134}Cs	2.2E-1 (1.0E+1)	All < LLD				0
	^{137}Cs	2.4E-1 (1.8E+1)	All < LLD				0
	^{140}Ba	2.5E0 (6.0E+1)	All < LLD				0
	^{140}La (1982 only)	4.4E-1 (1.5E+1)	All < LLD				0
Milk (pCi/l) (1981-1982)	Gamma Spec (94)						
	^{131}I	6.3E-1 (1.0E+0)	All < LLD			All < LLD	0
	^{134}Cs	3.3E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{137}Cs	4.6E0 (1.5E+1)	4.1E+0 (8/47) (2.8E+0 to 6.1E+0)	Site 14, Dairy (5.1 mi., W)	4.1E+0 (8/47) (2.8E+0 to 6.1E+0)	5.7E+0 (37/47) (3.7E+0 to 9.2E+0)	0
	^{140}Ba	1.1E+1 (1.5E + 1)	All < LLD			All < LLD	0
	^{140}La	4.4E+0 (1.5E+1)	All < LLD			All < LLD	0
Grass (pCi/kg wet) (1981-1982)	Gamma Spec (82)						
	^{131}I	6.7E+1 (6.0E+1)	All < LLD			All < LLD	0
	^{134}Cs	2.7E+1 (8.0E+1)	All < LLD			All < LLD	0
	^{137}Cs	3.3E+1 (8.0E+1)	5.0E+1 (13/51) (1.6E+1 to 1.6E+2)	Site 14, Dairy (5.1 mi W)	5.9E+1 (5/29) (1.6E+1 to 1.6E+2)	1.3E+2 (6/31) (1.3E+1 to 3.4E+2)	0

Medium or Pathway Sampled (Unit of Measurement and Reporting Period)	Type and Total Number of Analyses Performed	Lower Limit of Detection[1] Actual (Max.)	All Indicator Locations Mean[2] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[2] (#/total #) (Range)	Number of Nonroutine Reported[3] Measurements
				Name (Distance & Direction)	Mean[2] (#/total #) (Range)		
Broadleaf Vegetation (pCi/kg wet) (1980-1982)	Gamma Spec (10)						
	^{131}I	3.7E+1 (6.0E+1)	All < LLD				0
	^{134}Cs	1.9E+1 (8.0E+1)	All < LLD				0
	^{137}Cs	2.1E+1 (8.0E+1)	3.1E+1 (2/7) (1.8E+1 to 3.6E+1)	Site 2, Trans. Line (1.2 mi SW)	3.6E+1 (1/1) (Single Value)	All < LLD	0
Other Vegetation (pCi/kg wet) (1980-1982)	Gamma Spec (32)						
	^{134}Cs	8.4E+0 (8.0E+1)	All < LLD			All < LLD	0
	^{137}Cs	1.0E+1 (8.0E+1)	All < LLD			All < LLD	0
Fish (pCi/kg wet) (1980 - 1982)	Gamma Spec (92)						
	^{134}Cs	1.4E+1 (1.3E+2)	All < LLD			All < LLD	0
	^{137}Cs	1.8E+1 (1.3E+2)	2.8E+1 (50/71) (1.1E+1 to 1.0E+2)	Site 24, Recreation Lake (5.5 mi, N)	3.4E+1 (17/23) 1.2E+1 to 1.0E+2)	3.1E+1 (19/21) (1.0E+1 to 7.9E+1)	0
	^{58}Co	2.6E+1 (1.3E+2)	All < LLD			All < LLD	0
	^{54}Mn	1.8E+1 (1.3E+2)	All < LLD			All < LLD	0
	^{59}Fe	9.0E+1 (2.6E+2)	All < LLD			All < LLD	0
	^{65}Zn	4.1E+1 (2.6E+2)	All < LLD			All < LLD	0
	^{60}Co	1.8E+1 (1.3E+2)	All < LLD			All < LLD	0
Sediment (pCi/kg) (1980-1982)	Gamma Spec (24)						
	^{134}Cs	2.3E+1 (1.5E+2)	All < LLD			All < LLD	0
	^{137}Cs	2.4E+1 (1.5E+2)	1.7E+2 (12/18) (2.6E+1 to 4.5E+2)	Site 21, Parr Reservoir (2.7 mi, SSW)	2.6E+2 (6/6) (2.6E+1 to 4.5E+2)	4.2E+2 (6/6) (1.8E+1 to 1.0E+3)	0

Table 9 (Cont.)- Radiological Environmental Program Preoperational (Baseline) Summary

Footnotes

1. Values given are MDA values calculated from the program data analyses with maximum acceptable LLD values allowed from NRC guidelines given in parentheses.

2. Mean and range are based on detectable measurements only. The fractions of detectable measurements at specific locations are indicated in parentheses.

3. A non-routine measurement is any confirmed measured level of radioactivity in an environmental medium that exceeds the reporting requirements of VCSNS ODCM, Section 1.4.1.2.

4. The baseline values are high because of the fallout from the Chinese bomb test in 1980. The first set of data reflects the 1981 baseline. The second set of data reflects the 1982 baseline, essentially free of bomb test fallout. The 1982 data covers the period 1/1/82 - 10/22/82.

5. Detection sensitivity is approximately 5 mrem/yr (0.5 μR/hr) determined from the analyses of five years of preoperational data.

6. No control location was specified for drinking water during the preoperational monitoring period.

7. Inconclusive data.

Table 10 - Results of 2005 Environmental Intercomparison Program with Independent Lab, Analytics, Inc.

Comparison Study (Measurement Unit)	Date	Nuclides	Vendor Lab Results	Env Lab Results	Agreement
Gamma Isotopic Liquid 4 Liter (pCi/l)	9/15	^{131}I	78	96	Yes
		^{141}Ce	282	334	Yes
		^{51}Cr	408	334	Yes
		^{59}Fe	74	81	Yes
		^{134}Cs	148	162	Yes
		^{137}Cs	235	265	Yes
		^{58}Co	77	85	Yes
		^{54}Mn	111	131	Yes
		^{65}Zn	149	179	Yes
		^{60}Co	202	215	Yes
Gamma Filter (pCi)	9/15	^{141}Ce	204	206	Yes
		^{51}Cr	296	301	Yes
		^{59}Fe	53	52	Yes
		^{134}Cs	107	90	Yes
		^{137}Cs	171	181	Yes
		^{58}Co	56	53	Yes
		^{54}Mn	81	87	Yes
		^{65}Zn	108	106	Yes
		^{60}Co	147	142	Yes
Alpha/Beta Water (pCi/l)	3/17	Alpha	41	43	Yes
		Beta	268	283	Yes
Gamma Isotopic Pulverized Soil (pCi/g)	3/17	^{141}Ce	3.05E-1	3.12E-1	Yes
		^{51}Cr	4.44E-1	3.92E-1	Yes
		^{134}Cs	1.85E-1	1.54E-1	Yes
		^{137}Cs	1.72E-1	3.02E-1	Yes[1]
		^{58}Co	1.53E-1	1.53E-1	Yes
		^{54}Mn	2.12E-1	2.02E-1	Yes
		^{59}Fe	1.48E-1	1.65E-1	Yes
		^{65}Zn	2.63E-1	3.08E-1	Yes
		^{60}Co	1.91E-1	1.85E-1	Yes
I-131 Solid (pCi)	3/17	^{131}I	102	111	Yes

Comparison Study (Measurement Unit)	Date	Nuclides	Vendor Lab Results	Env Lab Results	Agreement
Gamma Isotopic Liquid 1 Liter (pCi/l)	3/17	^{131}I	66	67	Yes
		^{141}Ce	221	236	Yes
		^{51}Cr	322	333	Yes
		^{134}Cs	134	133	Yes
		^{137}Cs	125	134	Yes
		^{58}Co	111	109	Yes
		^{54}Mn	154	178	Yes
		^{59}Fe	107	123	Yes
		^{65}Zn	191	213	Yes
		^{60}Co	139	143	Yes
Tritium (pCi/l)	3/20	^{3}H	6040	5880	Yes
Gross Beta Filter (pCi)	9/15	N/A	153	158	Yes
Charcoal Cartridge (pCi)	9/15	^{131}I	64	75	Yes

[1]Control site #22 sediment sample was supplied to vendor for preparation as a soil sample. Prior to vender spiking this sample it contained an average of 0.142 pci/g of ^{137}Cs. Environmental Lab Intercomparison analysis indicated 0.302pCi/g ^{137}Cs resulting in a corrected concentration of 0.160 pCi/g ^{137}Cs.

Table 11 – 2005 Environmental Sampling Program Exceptions

Media	Sample Location	Month (Week No.)	Cause for Exception
Air Particulate & Radioiodine	Site 30	Jun (26)	Breaker tripped due to storm
	Site 2	Jul (28)	Breaker tripped
	Site 2	Jul (30)	Breaker tripped due to storm
	Site 6	Aug (34)	Breaker tripped due to faulty pump
	Site 2	Sep (36)	Breaker tripped due to faulty breaker
	Site 17	Sep (38)	Breaker tripped due to insects
	Site 6	Sep (37)	A/S media installed incorrectly
Direct Radiation	Site 9	Apr (14)	TLD missing
	Site 41	Apr (14)	TLD missing
Surface Water	Site 21	July (29)	Equipment failure

N

LEGEND

● CONTROL SAMPLE LOCATIONS

A=AIR PARTICULATE SITE

D=DIRECT (TLD) SITE

I=AIRBORNE RADIOIODINE SITE

W=WATER SITE

O=OTHER (GARDEN PRODUCTS, FISH, SEDIMENT, GRASS, MILK)

REFERENCE:
THE BASE FOR THIS MAP WAS PREPARED FROM A PORTION OF USGS STATE OF GEORGIA, 1970.

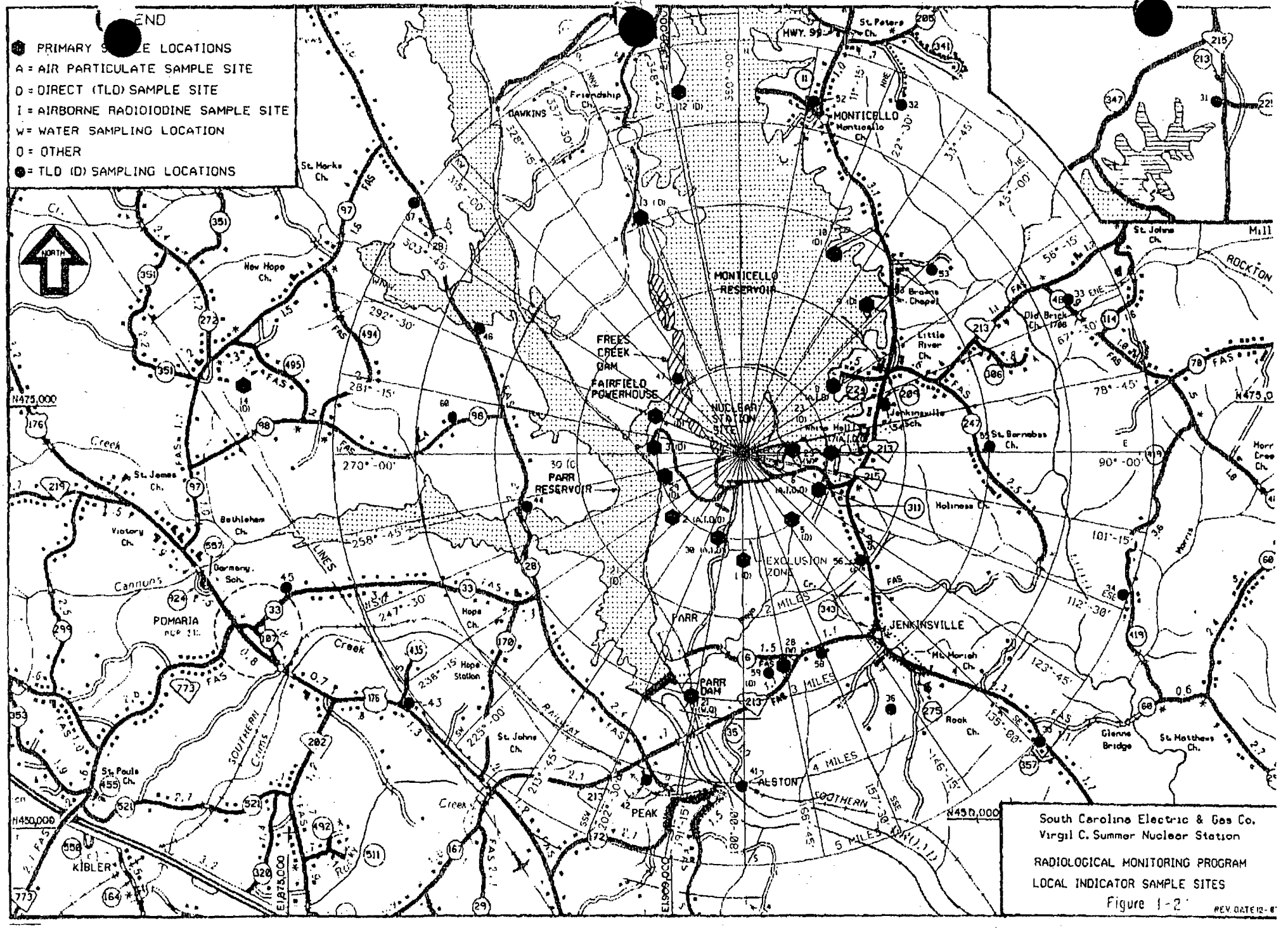
STATUTE MILES
10 0 10 20

South Carolina Electric & Gas Co.
Virgil C. Summer Nuclear Station

Regional Location Map

Figure 1-1

REV. DATE 12-6



South Carolina Electric & Gas Co.
Virgil C. Summer Nuclear Station

RADIOLOGICAL MONITORING PROGRAM
LOCAL INDICATOR SAMPLE SITES

Figure 1-2

REV. DATE 12-8

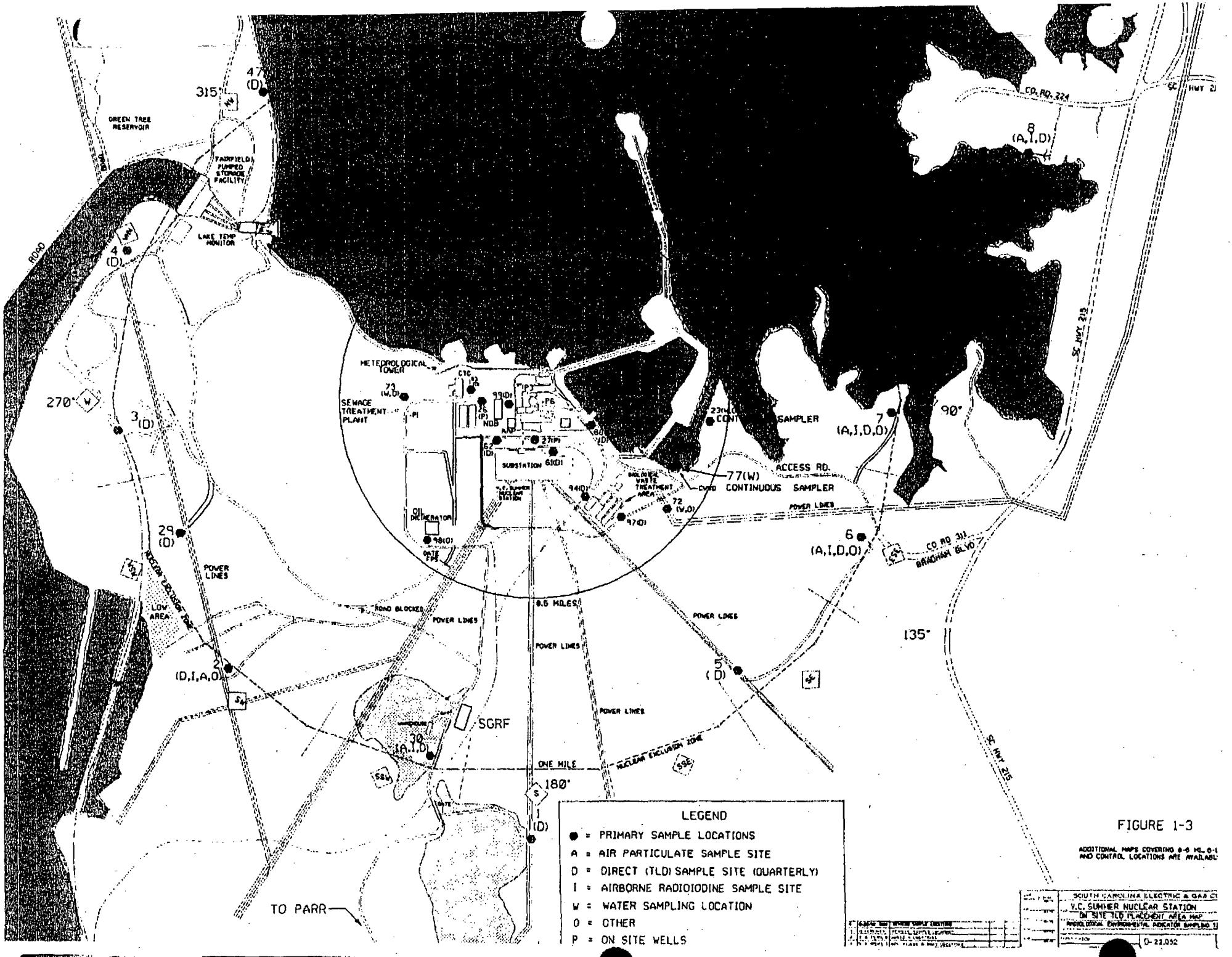


FIGURE 1-3

ADDITIONAL MAPS COVERING 0-6 MI. 0-1
AND CONTROL LOCATIONS ARE AVAILABL

Section 4.5 Ref 2

Thomas D. Gatlin
General Manager, Nuclear Plant Operations
803.345.4342

SCE&G
A SCANA COMPANY

April 28, 2006

Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Sir/Madam:

Subject: VIRGIL C. SUMMER NUCLEAR STATION
DOCKET NO. 50-395
OPERATING LICENSE NO. NPF-12
2005 ANNUAL EFFLUENT AND WASTE DISPOSAL REPORT

Enclosed is the South Carolina Electric & Gas Company (SCE&G) Annual Effluent and Waste Disposal Report as required by 10CFR50.36a, Sections 6.9.1.8 and 6.14.2 of the Virgil C. Summer Nuclear Station Technical Specifications, and Section 1.6.2 of the Offsite Dose Calculation Manual (ODCM). This submittal covers the period of January 1 through December 31, 2005.

Should there be any questions, please contact us at your convenience.

Very truly yours,

Thomas D. Gatlin

SBR/TDG/dr
Enclosure

c: N. O. Lorick
S. A. Byrne
N. S. Carns
J. H. Hamilton (w/o enclosure)
R. J. White (w/o enclosure)
W. D. Travers
R. E. Martin
W. G. Wendland
K. M. Sutton

NRC Resident Inspector
T. P. O'Kelley (SCDHEC)
M. Coleman
J. A. Orr
NSRC
RTS (L-99-0113)
File (818.02-1, RR 8350)
DMS (RC-06-0083)

SCEG

VIRGIL C. SUMMER
JENKINSVILLE, SOUTH CAROLINA

ANNUAL EFFLUENT AND WASTE DISPOSAL REPORT
VIRGIL C. SUMMER NUCLEAR STATION

FOR THE OPERATING PERIOD
JANUARY 1, 2005 - DECEMBER 31, 2005

APRIL 2006

SCE&G
A SCANA COMPANY

Prepared by:

Mike Roberts, Health Physicist

Reviewed by:

Moses Coleman, Health Physicist

Approved by:

Paul Mothena, Manager
Health Physics Services

ANNUAL EFFLUENT AND WASTE DISPOSAL REPORT

JANUARY – DECEMBER, 2005

VIRGIL C. SUMMER NUCLEAR STATION
SOUTH CAROLINA ELECTRIC & GAS

This report is being submitted as a summary of quantities of radioactive liquid and gaseous effluents and solid waste released from the Virgil C. Summer Nuclear Station. This report satisfies the requirements in Sections 6.9.1.8 and 6.14.2 of Technical Specifications, Section 1.6.2 of the Offsite Dose Calculation Manual (ODCM), and 10CFR50.36(a). Also included is an assessment of radiation doses from plant releases.

A brief discussion of the Supplemental Information and Tables 1 through 5 is presented in Sections A through D. An evaluation of the radiological impact on man due to operation of the Virgil C. Summer Nuclear Station is presented in Section E and Table 6. There were no abnormal releases for the period. A summary of the meteorological data for 2005 is presented in Section G and Tables 7 and 8. There were no changes made to the Offsite Dose Calculation Manual (ODCM) during the 12-month period. Section I gives a summary of oil incineration during the year.

A. Supplemental Information

Regulatory limits for doses, dose rate and effluent concentration limits presented in Supplemental Information are from the Virgil C. Summer Nuclear Station ODCM and 40 CFR 190. Average energy ($\bar{E}$ bar) is not applicable to the method for determining release rate limits for fission and activation gaseous effluents; therefore, it has been omitted.

B. Gaseous Effluents

Gaseous effluents released from ground level are summarized in Tables 1 and 2. An elevated release pathway does not exist at Virgil C. Summer Nuclear Station. Cumulative doses are discussed in Section E.

The errors for gaseous effluent totals are given as the square root of the sum of squares of counting errors and flow or volume measurement errors. A systematic error of 15% has been added to estimate total error.

C. Liquid Effluents

Liquid effluents are summarized in Tables 3 and 4. Estimated total errors are expressed as in Section B above.

D. Solid Waste Shipments

Solid waste shipments are summarized in Table 5. Curie content of radioactive waste packages is determined by dose rates and/or gamma spectroscopy analysis of samples. The total error for each type of Curie content determination is conservatively estimated to be the sum of a 15% systematic error and a 20% photon response error for the detector used.

E. Radiological Impact on Man

Potential doses to the maximum exposed individual in the unrestricted area were calculated using measured plant gaseous effluents and meteorological data in accordance with the Offsite Dose Calculation Manual. The source term involved no waste gas decay tank (WGDT) releases, 5.2 days of 6-inch Reactor Building purge releases, 29.0 days of 36-inch Reactor Building purge releases and a continuous 12-month Main Plant vent release. Oil incineration was run for 27.3 hours in 2005. Doses are summarized in Table 6. The total activities released are presented in Tables 1 and 2. The highest quarterly air doses to the maximum exposed individual due to noble gases were 7.74E-03 mrad for gamma and 2.25E-2 mrad for beta during the second quarter. The maximum quarterly organ dose attributed to the releases was 3.56E-02 mrem for the second quarter. Cumulative annual dose was 8.00E-03 mrad, 2.32E-2 mrad and 3.56E-02 mrem for gamma, beta, and organ dose, respectively.

Measured plant liquid effluent data was used to calculate estimates of doses to individuals in accordance with the Offsite Dose Calculation Manual. The source term consisted of the isotopic contents of 223 Waste Monitor Tank batch releases, 26 Condensate Backwash Receiver Tank batch releases, 1 NaOH batch release, 26.7 days of Steam Generator Blowdown release and a continuous Turbine Building Sump release.

Doses are summarized in Table 6 and total radioactivity released is described in Tables 1 and 3. The highest quarterly total body dose to the maximally exposed individual due to the release of radioactive liquid was 1.89E-3 mrem during the second quarter. The highest organ dose was 3.06E-3 mrem to the GI-LLI for the second quarter. Cumulative annual doses for the hypothetical maximally exposed individual were 4.20E-3 mrem for the total body and 4.76E-3 mrem for the GI-LLI, the maximum annual organ. The LIVER was the maximum exposed organ for the first and fourth quarters and the GI-LLI was the maximum exposed organ for the second and third quarters.

Dose rates and concentrations were below the limits specified in Supplemental Information, Section 2a, b, and c during all the effluent releases.

Radiation doses from radioactive effluents to members of the public due to their activities inside the site boundary were assessed using liquid and gaseous effluents along with meteorological data. Quarterly thermoluminescent dosimetry data from four (4) monitoring locations within the site boundary and eight (8) locations around the site boundary perimeter were analyzed and compared with respective pre-operational background and previous year history. Results showed that the 2005 quarterly dose rates did not differ significantly from the pre-operational or 2004 dose rates. It was concluded that doses to members of the public inside the site boundary were indistinguishable from normal background dose.

Radiation doses from radioactive effluents to workers at the Fairfield Hydro Station for the 12-month period were calculated to be 3.76E-4 and 1.09E-3 mrad for gamma and beta, respectively.

Radiation doses from nearby uranium fuel cycle sources were not assessed. The ODCM, Sections 1.3.1 and B/1.3 establish a five (5) mile limit beyond which doses from nearby plants are insignificant. There are no uranium fuel cycle plants within a five (5) mile radius of Virgil C. Summer Nuclear Station.

F. Abnormal Releases

During 2005, the plant had no abnormal releases.

G. Meteorology

The meteorology data for 2005 is summarized in Table 7, by quarter. The data are shown as joint frequency distributions of wind direction and speed by atmospheric stability class.

The wind direction and wind speed data used in the summary were acquired from the 10-meter level of the primary monitoring tower. Stability was determined by the primary differential temperature (61 to 10 meter).

The combined annual data recovery for wind direction, wind speed and stability was 94.8%. Primary variable recovery rates were as follows: wind direction (10 m) – 95.1%, wind speed (10 m) – 95.1%, and differential temperature (61 - 10 m) – 96.7%.

H. Offsite Dose Calculation Manual

The Virgil C. Summer Nuclear Station (VCSNS) Offsite Dose Calculation Manual (ODCM) was not revised during the affected 12-month period.

I. Oil Incineration

The incinerator operated for a period of 27.33 hours, burning 217.8 gallons of oil at the average rate of 7.97 gal/hr. The incinerated oil contained concentrations of 1.37E-08 uCi/ml for Mn-54, 1.14E-07 uCi/ml for Co-60 and 1.92E-08 uCi/ml for Cs-137. The dose to the maximum exposed individual from the incinerated oil was 1.19E-06 mrem.

J. Offsite Dose Calculation Manual Reportable Incidences

There were no reportable effluent incidences during this reporting period.

SUPPLEMENTAL INFORMATION

1. Regulatory Limits:

   a. Fission and Activation Gases:

   The air dose to an individual due to noble gases released in gaseous effluents shall be limited to less than or equal to 5 mrad for gamma radiation and 10 mrad for beta radiation during any calendar quarter and 10 mrad for gamma radiation and 20 mrad for beta radiation during any calendar year (ODCM, Section 1.2.3.1).

   b. Iodines, Particulates (half-lives > 8 days) and Tritium:

   The dose to an individual from radioidines, tritium and radioactive materials in particulate form with half-lives greater than 8 days in gaseous effluents shall be limited to less than or equal to 7.5 mrem to any organ during any calendar quarter and 15 mrem to any organ during any calendar year (ODCM, Section 1.2.4.1).

   c. Liquid Effluents:

   The dose or dose commitment to an individual from radioactive materials in liquid effluents released shall be limited to less than or equal to 1.5 mrem to the total body and 5 mrem to any organ during any calendar quarter and 3 mrem to the total body and 10 mrem to any organ during any calendar year (ODCM, Section 1.1.3.1).

   d. All Sources:

   The annual dose equivalent shall not exceed 25 mrem to the whole body, 75 mrem to the thyroid and 25 mrem to any other organ (40 CFR 190).

2. Dose Rate and Effluent Concentration Limits:

   a. Fission and Activation Gases

      The dose rate in unrestricted areas due to radioactive materials released in gaseous effluents shall be limited to less than or equal to 500 mrem/year to the total body and less than or equal to 3000 mrem/year to the skin (ODCM, Section 1.2.2.1).

   b. Iodines, Particulates (half-lives > 8 days) and Tritium:

      The dose rate in unrestricted areas due to radioactive materials in effluents shall be limited to less than or equal to 1500 mrem/year to any organ (ODCM, Section 1.2.2.1).

   c. Liquid Effluents:

      The concentration of radioactive materials released from the site shall be limited to the concentrations specified in 10 CFR 20, Appendix B, Table 2, Column 2 for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2E-4 µCi/ml total activity (ODCM, Section 1.1.2.1).

3. Average Energy:

   Not Applicable

4. Measurements and Approximations of Total Radioactivity:

   a. Fission and activation gases: Gamma spectrometry (HPGe)

   b. Iodines: Gamma spectrometry (HPGe)

   c. Particulates: Gamma spectrometry (HPGe), beta proportional counting, alpha proportional counting

   d. Tritium: Liquid scintillation

   e. Liquid effluents: Gamma spectrometry (HPGe), liquid scintillation (H-3), beta proportional counting, alpha proportional counting.

5. Batch Releases:

a. Gaseous:

1. Number of batch releases: 0

2. Total time period for batch releases: 0 min

3. Maximum time period for a batch release: 0 min

4. Average time period for a batch release: 0 min

5. Minimum time period for a batch release: 0 min

b. Liquid:

1. Number of batch releases:

56	For first quarter, 2005
120	For second quarter, 2005
48	For third quarter, 2005
26	For fourth quarter, 2005

2. Total time period for batch releases:

4.11E+03	min. for first quarter, 2005
8.17E+03	min. for second quarter, 2005
3.01E+03	min. for third quarter, 2005
1.90E+03	min. for fourth quarter 2005

3. Maximum time period for a batch release:

9.00E+01	min. for first quarter, 2005
8.50E+01	min. for second quarter, 2005
8.00E+01	min. for third quarter, 2005
7.70E+01	min. for fourth quarter, 2005

4. Average time period for batch releases:

7.33E+01	min. for first quarter, 2005
6.81E+01	min. for second quarter, 2005
6.27E+01	min. for third quarter, 2005
7.31E+01	min. for fourth quarter, 2005

5. Minimum time period for a batch release:

6.50E+01	min. for first quarter, 2005
5.00E+00	min. for second quarter, 2005
1.00E+00	min. for third quarter, 2005
6.90E+01	min. for fourth quarter, 2005

6. Average stream flow during periods of release of effluent into a flowing stream for 2005:

8.56E+06	gpm for first quarter, 2005
6.96E+06	gpm for second quarter, 2005
9.22E+06	gpm for third quarter, 2005
7.01E+06	gpm for fourth quarter, 2005

6. Abnormal Releases:

a. Gaseous:

1. Number of releases: 0

2. Total activity released: 0

b. Liquid:

1. Number of releases: 0

2. Total activity released: 0

ANNUAL EFFLUENT AND WASTE DISPOSAL REPORT
January - December 2005

Virgil C. Summer Nuclear Station
South Carolina Electric & Gas

Table 1
Gaseous Effluents Summation of All Releases

	UNITS	FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER	2005 TOTAL	EST. ERROR %
A. Fission & Activation Gases							
1. Total release	Ci	3.16E+00	1.06E+02	0.00E+00	6.07E-02	1.10E+02	18.27
2. Average release rate	uCi / sec	4.07E-01	1.35E+01	0.00E+00	7.63E-03	3.47E+00	
3. Percent ODCM Qtr. gamma air dose limit	%	4.98E-03	1.55E-01	0.00E+00	1.34E-04	N/A	
4. Percent ODCM annual gamma air dose limit	%	2.49E-03	7.99E-02 *	7.99E-02 *	8.00E-02 *	8.00E-02	
5. Percent ODCM Qtr. beta air dose limit	%	6.86E-03	2.25E-01	0.00E+00	2.07E-04	N/A	
6. Percent ODCM annual beta air dose limit	%	3.43E-03	1.16E-01 *	1.16E-01 *	1.17E-01 *	1.17E-01	
B. Iodines							
1.Total iodine - 131	Ci	0.00E+00	1.85E-03	0.00E+00	0.00E+00	1.85E-03	22.22
2. Average release rate	uCi / sec	0.00E+00	2.35E-04	0.00E+00	0.00E+00	5.86E-05	
C. Particulates							
1. Particulates with half - lifes > 8 days	Ci	5.67E-06	1.97E-06	2.98E-06	3.82E-06	1.44E-05	54.64
2. Average release rate	uCi / sec	7.29E-07	2.50E-07	3.75E-07	4.81E-07	4.58E-07	
3. Gross alpha radioactivity	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
D. Tritium							
1. Total release	Ci	2.29E-03	3.12E+00	0.00E+00	3.19E-03	3.12E+00	26.06
2. Average release rate	uCi / sec	2.95E-04	3.96E-01	0.00E+00	4.01E-04	9.90E-02	
E. Organ Dose (from B,C,and D)							
1. Percent ODCM Qtr. organ dose limit	%	1.61E-05	4.75E-01	0.00E+00	2.24E-05	N/A	
2. Percent ODCM annual organ dose limit	%	8.05E-06	2.38E-01 *	2.38E-01 *	2.38E-01 *	2.38E-01	

* Cumulative

ANNUAL EFFLUENT AND WASTE DISPOSAL REPORT
JANUARY - DECEMBER, 2005
TABLE 2
GASEOUS EFFLUENTS -- GROUND-LEVEL RELEASES

Nuclides Released	Units	Continuous Mode					Batch Mode				
		First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Annual Total	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Annual Total
1 Fission gases											
Krypton-85	Ci	0	2.58E-01	0	3.75E-02	2.96E-01	0	0	0	0	0
Krypton-85m	Ci	0	0	0	0	0	0	0	0	0	0
Krypton-87	Ci	0	0	0	0	0	0	0	0	0	0
Krypton-88	Ci	0	0	0	0	0	0	0	0	0	0
Xenon-131m	Ci	0	5.42E-01	0	0	5.42E-01	0	0	0	0	0
Xenon-133	Ci	3.09E+00	1.05E+02	0	2.03E-02	1.08E+02	0	0	0	0	0
Xenon-133m	Ci	0	1.61E-01	0	0	1.61E-01	0	0	0	0	0
Xenon-135	Ci	7.73E-02	3.20E-01	0	2.14E-04	3.98E-01	0	0	0	0	0
Xenon-135m	Ci	0	0	0	0	0	0	0	0	0	0
Xenon-138	Ci	0	0	0	0	0	0	0	0	0	0
Other: Ar-41	Ci	9.64E-04	1.05E-01	0	2.73E-03	1.09E-01	0	0	0	0	0
Unidentified: None	Ci	0	0	0	0	0	0	0	0	0	0
Total for Period	Ci	3.17E+00	1.06E+02	0	6.07E-02	1.10E+02	0	0	0	0	0
2 Iodines and other halogens											
Iodine-131	Ci	0	1.85E-03	0	0	1.85E-03	0	0	0	0	0
Iodine-132	Ci	0	1.64E-04	0	0	1.64E-04	0	0	0	0	0
Iodine-133	Ci	0	2.65E-05	0	0	2.65E-05	0	0	0	0	0
Br-82	Ci	0	0	0	0	0	0	0	0	0	0
Unidentified: None	Ci	0	0	0	0	0	0	0	0	0	0
Total for Period	Ci	0	2.04E-03	0	0	2.04E-03	0	0	0	0	0
3 Particulates											
Cromium-51	Ci	0	0	0	0	0	0	0	0	0	0
Cobalt-58	Ci	0	1.97E-06	0	0	1.97E-06	0	0	0	0	0
Cobalt-60	Ci	0	0	0	0	0	0	0	0	0	0
Stronium-89	Ci	0	0	0	0	0	0	0	0	0	0
Stronium-90	Ci	0	0	0	0	0	0	0	0	0	0
Niobium-95	Ci	0	0	0	0	0	0	0	0	0	0
Cesium-134	Ci	0	0	0	0	0	0	0	0	0	0
Cesium-137	Ci	0	0	0	0	0	0	0	0	0	0
Other: Be-7	Ci	5.67E-06	0	2.98E-06	3.82E-06	1.25E-05	0	0	0	0	0
Unidentified: None	Ci	0	0	0	0	0	0	0	0	0	0
Total for Period	Ci	5.67E-06	1.97E-06	2.98E-06	3.82E-06	1.44E-05	0	0	0	0	0

ANNUAL EFFLUENT AND WASTE DISPOSAL REPORT
JANUARY-DECEMBER, 2005

Virgil C. Summer Nuclear Station
South Carolina Electric & Gas

TABLE 3
Liquid Effluents Summation of All Releases

	UNITS	FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER	2005 TOTAL	EST. ERROR %
A. Fission & Activation Products							
1. Total release	Ci	1.45E-02	5.10E-02	8.29E-03	2.04E-03	7.58E-02	20.58
2. Average diluted concentration	uCi/ml	3.54E-11	1.20E-10	2.37E-11	6.35E-12	5.04E-11	
B. Tritium							
1. Total release	Ci	2.07E+02	1.57E+02	4.83E+01	5.36E+01	4.66E+02	18.12
2. Average diluted concentration	uCi/ml	5.06E-07	3.72E-07	1.38E-07	1.67E-07	3.10E-07	
C. Dissolved and entrained gases							
1. Total release	Ci	1.39E-01	7.11E-01	1.23E-04	2.76E-04	8.50E-01	18.03
2. Average diluted concentration	uCi/ml	3.39E-10	1.68E-09	3.52E-13	8.61E-13	5.65E-10	
3.Percent ODCM limit (2.0E-4 uCi/ml)	%	1.70E-04	8.39E-04	1.76E-07	4.30E-07	2.83E-04	
D. Gross alpha radioactivity							
1. Total release	Ci	0	0	0	0	0	N/A
E. ODCM limits (from A and B)							
1. Percent of ODCM Qtr total body limit	%	1.07E-01	1.26E-01	1.62E-02	3.08E-02	N/A	
2. Percent of ODCM annual total body limit	%	5.34E-02	1.16E-01 *	1.25E-01 *	1.40E-01 *	1.40E-01 *	
3. Percent of ODCM Qtr max. organ limit**	%	3.62E-02	6.12E-02	5.96E-03	1.00E-02	N/A	
4. Percent of ODCM annual max. organ limit**	%	1.81E-02	4.10E-02 *	4.40E-02 *	4.58E-02 *	4.76E-02 *	
E. Volume of waste released (undiluted)	liters	1.08E+07	3.82E+07	9.61E+06	1.01E+07	6.87E+07	3.0
F. Volume of dilution water	liters	4.09E+11	4.24E+11	3.50E+11	3.21E+11	1.50E+12	4.3

* Cumulative

** See page 3 for max. organ for each quarter and cumulative.

ANNUAL EFFLUENT AND WASTE DISPOSAL REPORT

JANUARY - DECEMBER, 2005

Virgil C. Summer Nuclear Station, South Carolina Electric & Gas

TABLE 4

LIQUID EFFLUENTS

		Continuous Mode					Batch Mode				
Nuclides Released*	Units	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Annual Total	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Annual Total
Strontium-89	Ci	0	0	0	0	0	0	0	0	0	0
Strontium-90	Ci	0	0	0	0	0	0	0	0	0	0
Cesium-134	Ci	0	0	0	0	0	1.07E-03	3.87E-04	9.74E-08	1.26E-04	1.58E-03
Cesium-137	Ci	0	0	0	0	0	9.19E-04	3.81E-04	2.16E-07	9.64E-05	1.40E-03
Iodine-131	Ci	0	0	0	0	0	3.08E-04	2.22E-04	0	0	5.30E-04
Cobalt-58	Ci	0	0	0	0	0	3.81E-04	3.98E-03	6.09E-05	9.86E-05	4.52E-03
Cobalt-60	Ci	0	0	0	0	0	1.85E-03	6.05E-03	1.36E-04	2.21E-04	8.26E-03
Iron-59	Ci	0	0	0	0	0	5.58E-05	1.16E-04	0	0	1.72E-04
Zinc-65	Ci	0	0	0	0	0	5.27E-06	9.56E-05	0	0	1.01E-04
Manganese-54	Ci	0	0	0	0	0	3.09E-04	7.70E-04	9.27E-06	2.32E-05	1.11E-03
Chromium-51	Ci	0	0	0	0	0	2.29E-04	8.26E-03	3.02E-05	0	8.52E-03
Zirconium-Niobium-95	Ci	0	0	0	0	0	5.17E-05	2.07E-03	2.72E-05	1.12E-05	2.16E-03
Molybdenum-99	Ci	0	0	0	0	0	0	0	0	0	0
Technetium-99m	Ci	0	0	0	0	0	2.69E-06	1.49E-05	0	0	1.76E-05
Barium-Lanthinum-140	Ci	0	0	0	0	0	0	0	0	0	0
Cerium-141	Ci	0	0	0	0	0	0	0	0	0	0
Other: Be-7	Ci	0	0	0	0	0	1.01E-04	0	0	0	1.01E-04
Fe-55	Ci	0	0	0	0	0	7.70E-03	1.66E-02	2.78E-03	1.44E-03	2.85E-02
Co-57	Ci	0	0	0	0	0	0	1.11E-05	0	0	1.11E-05
As-76	Ci	0	0	0	0	0	0	1.33E-06	4.86E-06	0	6.19E-06
Rb-88	Ci	0	0	0	0	0	1.22E-05	9.29E-06	0	0	2.15E-05
Sn-113	Ci	0	0	0	0	0	1.10E-05	1.09E-05	0	0	2.19E-05
Sn-117m	Ci	0	0	0	0	0	1.09E-05	4.42E-04	1.68E-04	4.70E-06	6.26E-04
Sb-122	Ci	0	0	0	0	0	3.75E-06	0	0	3.14E-06	6.89E-06
Sb-124	Ci	0	0	0	0	0	8.12E-06	1.61E-05	0	0	2.42E-05
Sb-125	Ci	0	0	0	0	0	1.42E-03	2.63E-04	2.31E-07	1.53E-05	1.70E-03
Te-123m	Ci	0	0	0	0	0	0	0	0	1.31E-06	1.31E-06
Te-125m	Ci	0	0	0	0	0	0	1.09E-02	5.02E-03	0	1.59E-02
Te-129m	Ci	0	0	0	0	0	0	2.45E-04	4.62E-05	0	2.91E-04
Te-132	Ci	0	0	0	0	0	0	1.56E-05	0	0	1.56E-05
I-132	Ci	0	0	0	0	0	0	1.80E-05	0	0	1.80E-05
I-133	Ci	0	0	0	0	0	2.01E-05	1.92E-05	0	0	3.93E-05
Cs-136	Ci	0	0	0	0	0	0	1.61E-06	0	0	1.61E-06
Hg-203	Ci	0	0	0	0	0	0	5.81E-07	0	0	5.81E-07
Unidentified: None	Ci	0	0	0	0	0	0	0	0	0	0
Total for Period (above)	Ci	0	0	0	0	0	1.45E-02	5.09E-02	8.28E-03	2.04E-03	7.57E-02
Xenon-133	Ci	0	0	0	0	0	1.32E-01	6.83E-01	1.12E-04	0	8.15E-01
Xenon-135	Ci	0	0	0	0	0	1.49E-03	5.45E-03	1.12E-05	0	6.95E-03
Other: Ar-41	Ci	0	0	0	0	0	1.18E-06	0	0	0	1.18E-06
Kr-85	Ci	0	0	0	0	0	2.26E-03	5.17E-03	0	2.76E-04	7.71E-03
Kr-85m	Ci	0	0	0	0	0	5.16E-06	4.36E-05	0	0	4.88E-05
Kr-88	Ci	0	0	0	0	0	0	0	0	0	0
Xe-131m	Ci	0	0	0	0	0	2.02E-03	9.94E-03	0	0	1.20E-02
Xe-133m	Ci	0	0	0	0	0	1.40E-03	7.98E-03	0	0	9.38E-03
Unidentified: None	Ci	0	0	0	0	0	0	0	0	0	0
Total Entrained Gases	Ci	0	0	0	0	0	1.39E-01	7.12E-01	1.23E-04	2.76E-04	8.51E-01

*Tritium not included. See Table 3 for tritium numbers

ANNUAL EFFLUENT AND WASTE DISPOSAL REPORT
January - December, 2005

Virgil C. Summer Nuclear Station
South Carolina Electric & Gas
Table 5
SOLID WASTE AND IRRADIATED FUEL SHIPMENTS

1. Solid Waste Shipped Offsite for Burial or Disposal (Not irradiated fuel).

Type of Waste	Unit	2005 Total	Est. Total Error, %
a. Spent resins, filters, sludge, evaporator bottoms, etc.	m3 Ci	21.58 219.61	35
b. Dry compressible waste contaminated equip., etc.	m3 Ci	55.82 9.82	35
c. Irradiated components, control rods, etc.	m3 Ci	0 0	N/A
d. Other (describe)	m3 Ci	0 0	N/A

2. Estimate of major nuclide composition for the year (by type of waste) for concentrations above 1.0% (listed in descending order by activity level).

a.	Cs-134	%	27.35
	Cs-137	%	21.61
	Fe-55	%	19.76
	Ni-63	%	16.43
	Mn-54	%	4.72
	Co-58	%	3.53
	Co-60	%	3.39
	Be-7	%	1.9
b.	C-14	%	9.64
	Co-58	%	2.94
	H-3	%	1.44
		%	
c.	None	%	N/A
d.	None	%	N/A

3A. Solid waste Disposition

Numbers of Shipments	Mode of Transportation	Destination
37	Truck	Oak Ridge, TN
8	Truck	Barnwell, S.C.

- Note: 34 are partial shipments of DAW from Duratek (Oak Ridge) to Envirocare

3B. Irradiated Fuel Shipments (Disposition)

Number of Shipments	Mode of Transportation	Destination
0	N/A	N/A

ANNUAL EFFLUENT AND WASTE DISPOSAL REPORT

JANUARY - DECEMBER 2005

Virgil C. Summer Nuclear Station
South Carolina Electric & Gas

Table 6
GASEOUS AND LIQUID DOSES

		FIRST QUARTER		SECOND QUARTER		THIRD QUARTER		FOURTH QUARTER		TOTAL
ODCM Section	GASEOUS LIMITS	DOSE	Percent of Limit	DOSE	Percent of Limit	DOSE	Percent of Limit	DOSE	Percent of Limit	ANNUAL DOSE
1.2.3.1.a,b	5 mrad gamma / qtr. 10 mrad gamma / yr.	2.49E-04 mrad	4.98E-03 2.49E-03	7.74E-03 mrad	1.55E-01 7.99E-02 *	0.00E+00 mrad	0.00E+00 7.99E-02 *	6.71E-06 mrad	1.34E-04 8.00E-02 *	8.00E-03
1.2.3.1.a,b	10 mrad beta / qtr. 20 mrad beta / yr.	6.86E-04 mrad	6.86E-03 3.43E-03	2.25E-02 mrad	2.25E-01 1.16E-01 *	0.00E+00 mrad	0.00E+00 1.16E-01 *	2.07E-05 mrad	2.07E-04 1.16E-01 *	2.32E-02
1.2.4.1.a,b	7.5 mrem organ/qtr 15 mrem organ/yr.	1.21E-06 mrem**	1.61E-05 8.05E-06	3.56E-02 mrem**	4.75E-01 2.38E-01 *	0.00E+00 mrem**	0.00E+00 2.38E-01 *	1.68E-06 mrem**	2.24E-05 2.38E-01 *	3.56E-02
	LIQUID LIMITS									
1.1.3.1a,b	1.5 mrem / qtr. 3 mrem / yr.	1.60E-03 mrem	1.07E-01 5.34E-02	1.89E-03 mrem	1.26E-01 1.16E-01 *	2.43E-04 mrem	1.62E-02 1.25E-01 *	4.62E-04 mrem	3.08E-02 1.40E-01 *	4.20E-03
1.1.3.1a,b	5 mrem organ/qtr*** 10 mrem organ/yr.	1.81E-03 mrem (Liver)	3.62E-02 1.81E-02	3.06E-03 mrem (GI-LLI)	6.12E-02 4.10E-02 *	2.98E-04 mrem (GI-LLI)	5.96E-03 4.40E-02 *	5.00E-04 mrem (Liver)	1.00E-02 4.58E-02 *	4.76E-03 (GI-LLI)

* Includes contribution from previous quarters
** Includes dose from all nuclides
*** See page 3 for max organ for each quarter

TABLE 7

JOINT FREQUENCY DISTRIBUTION

BY QUARTER FOR 2005

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS

SITE: V. C. SUMMER Nuclear Station UNIT 1

Report Date : 06-02-15
Data Period : 5- 1- 1 00:00 to 5- 3-31 23:00
Stability Class: A delta T/ delta z 61->10 m Delta T With Substitution
Wind Sensor Height : 10 meter
Hours at Each Wind Direction and Speed

Wind Direction	Wind Speed (miles/hour) 0.75- <4	4- <8	8- <13	13- <19	19- 24	>24	Total	Mean Speed
N	0	0	1	0	0	0	1	11.68
NNE	0	0	4	0	0	0	4	11.40
NE	0	2	5	9	0	0	16	12.67
ENE	0	2	12	8	1	0	23	12.25
E	0	2	1	0	0	0	3	7.89
ESE	0	0	0	1	0	0	1	15.05
SE	0	1	1	0	0	0	2	8.91
SSE	0	0	0	0	0	0	0	0.00
S	0	0	0	0	0	0	0	0.00
SSW	0	1	7	0	0	0	8	8.85
SW	0	8	8	0	0	0	16	8.35
WSW	0	12	12	2	0	0	26	8.74
W	0	10	13	3	0	0	26	9.41
WNW	0	4	2	0	0	0	6	6.71
NW	0	6	2	2	0	0	10	9.11
NNW	0	1	0	1	3	0	5	16.68
Total	0	49	68	26	4	0	147	

Hours of Calm : 0
Hours of Varying Wind Direction : 0
Hours of Missing Data : 0
Hours of Missing Data for All : 0
Hours of No Stability Class : 6
Total hours of observation : 2160

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS

SITE: V. C. SUMMER Nuclear Station UNIT 1

Report Date : 06-02-15
Data Period : 5- 1- 1 00:00 to 5- 3-31 23:00
Stability Class: B delta T/ delta z 61->10 m Delta T With Substitution
Wind Sensor Height : 10 meter
Hours at Each Wind Direction and Speed

Wind Direction	Wind Speed (miles/hour) 0.75- <4	4- <8	8- <13	13- <19	19- 24	>24	Total	Mean Speed
N	0	2	0	0	0	0	2	6.54
NNE	0	1	3	2	0	0	6	10.60
NE	0	1	2	6	0	0	9	13.33
ENE	0	2	3	4	1	0	10	12.29
E	0	0	1	0	0	0	1	9.73
ESE	0	0	0	3	0	0	3	15.67
SE	0	0	0	0	0	0	0	0.00
SSE	0	1	2	1	0	0	4	11.39
S	0	1	0	0	0	0	1	7.00
SSW	0	2	3	0	0	0	5	8.83
SW	0	7	0	1	0	0	8	7.28
WSW	0	6	9	0	0	0	15	8.53
W	0	8	2	7	0	0	17	10.69
WNW	0	9	2	1	0	0	12	7.78
NW	0	4	4	2	0	0	10	9.96
NNW	0	2	1	0	1	0	4	10.26
Total	0	46	32	27	2	0	107	

Hours of Calm : 0
Hours of Varying Wind Direction : 0
Hours of Missing Data : 0
Hours of Missing Data for All : 0
Hours of No Stability Class : 6
Total hours of observation : 2160

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS

SITE: V. C. SUMMER Nuclear Station UNIT 1

Report Date : 06-02-15
Data Period : 5- 1- 1 00:00 to 5- 3-31 23:00
Stability Class: C delta T/ delta z 61->10 m Delta T With Substitution
Wind Sensor Height : 10 meter
Hours at Each Wind Direction and Speed

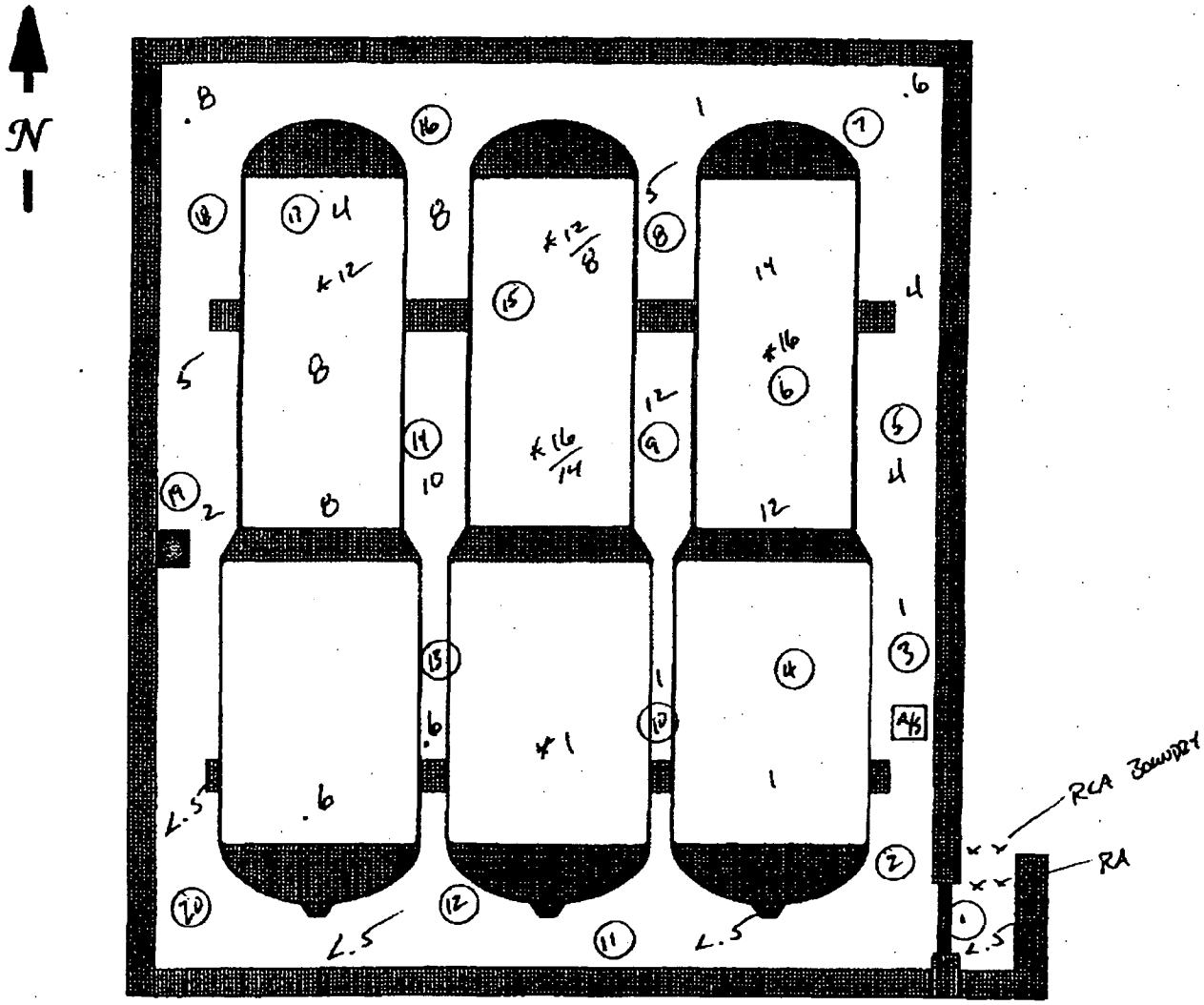
Wind Direction	Wind Speed (miles/hour) 0.75- <4	4- <8	8- <13	13- <19	19- 24	>24	Total'	Mean Speed
N	0	5	1	0	0	0	6	6.29
NNE	0	4	2	4	0	0	10	11.22
NE	0	4	4	12	2	0	22	13.46
ENE	0	2	11	10	1	0	24	13.01
E	0	3	1	0	0	0	4	7.77
ESE	0	3	0	0	0	0	3	6.76
SE	0	0	3	1	0	0	4	11.97
SSE	0	0	2	3	0	0	5	14.02
S	0	1	2	2	0	0	5	12.16
SSW	0	3	3	0	0	0	6	8.86
SW	0	9	2	3	0	0	14	8.44
WSW	0	11	3	1	0	0	15	7.61
W	0	6	4	4	0	0	14	9.35
WNW	0	9	1	1	0	0	11	7.52
NW	0	5	12	1	0	0	18	9.61
NNW	0	4	2	0	0	0	6	7.14
Total	0	69	53	42	3	0	167	

Hours of Calm : 0
Hours of Varying Wind Direction : 0
Hours of Missing Data : 0
Hours of Missing Data for All : 0
Hours of No Stability Class : 6
Total hours of observation : 2160

Section 4.5 Ref 3

Survey #:	Q-8015, 8016
S/RWP#:	06-01
% Rx Power:	100

Steam Generator Recycle Facility



G/A o/s Bldg. = 4-8 mR/hr.

Contamination in DPM/100cm2											
1	< 200	9	< 200	17	< 200	Counter: PIC	Ser.# I, II	Inst. Type:	20-2	Ser.#	1640
2		10		18		Counter: —	Ser.# —	Inst. Type:	RADEYE	Ser.#	10172
3		11		19				Surveyed By:	[illegible]		
4		12		20		Bkg. = —	CPM				
5		13		21		All smears < 20 dpm/100cm²		Time:	1030	Date:	8-14-06
6		14		22		DHEC POSTING SAT		Reviewed By:	[illegible]		
7		15		23				Time:	1125	Date:	8/14/06
8		16		24		Dose Received = 1					

* Denotes Contact Readings -- All Readings are in MR/HR unless otherwise noted.

Section 4.5 Ref 4

OFFSITE DOSE CALCULATION MANUAL

FOR

SOUTH CAROLINA ELECTRIC AND GAS COMPANY

VIRGIL C. SUMMER NUCLEAR STATION

Approval _____ , 1/9/07
General Manager,
Nuclear Plant Operations
Date

PSRC Approval _____ (MTG 2007-01) , 1/9/07
Date

Revision 25
(January 2007)

Reviewed by: _____ , 1-8-07
Date

Approved by: _____ , 1/8/07
Date

LIST OF EFFECTIVE PAGES

Page	Revision	Page	Revision
i	23	1.0-34	25
ii	23	1.0-35	23
iii	24	1.0-36	24
iv	21	1.0-37	23
v	24	1.0-38	24
vi	24	1.0-39	24
vii	21	1.0-40	21
viii	21	1.0-41	21
ix	24	1.0-42	21
x	24	1.0-43	23
xi	24	1.0-44	21
		1.0-45	21
		1.0-46	21
1.0-1	24	1.0-47	21
1.0-2	24	1.0-48	24
1.0-3	24	1.0-49	24
1.0-4	21	1.0-50	25
1.0-5	24	1.0-51	25
1.0-6	21	1.0-52	25
1.0-7	24	1.0-53	25
1.0-8	25	1.0-54	25
1.0-9	24	1.0-55	25
1.0-10	24	1.0-56	21
1.0-11	24	1.0-57	24
1.0-12	24		
1.0-13	25	2.0-1	21
1.0-14	24	2.0-2	21
1.0-15	24	2.0-3	21
1.0-16	24	2.0-4	21
1.0-17	24	2.0-5	21
1.0-18	24	2.0-6	21
		2.0-7	21
1.0-19	24	2.0-8	21
1.0-20	24	2.0-9	21
1.0-21	24	2.0-10	21
1.0-22	24	2.0-11	21
1.0-23	25	2.0-12	21
1.0-24	24	2.0-13	21
1.0-25	24	2.0-14	21
1.0-26	24	2.0-15	21
1.0-27	24	2.0-16	21
1.0-28	24	2.0-17	21
1.0-29	25	2.0-18	21
1.0-30	25	2.0-19	21
1.0-31	23	2.0-20	21
1.0-32	23	2.0-21	21
1.0-33	23	2.0-22	21

LIST OF EFFECTIVE PAGES (continued)

Page	Revision	Page	Revision
2.0-23	21	3.0-26	13
2.0-24	21	3.0-27	25
2.0-25	21	3.0-28	25
2.0-26	21	3.0-29	25
2.0-27	21	3.0-30	25
2.0-28	21	3.0-31	25
2.0-29	21	3.0-32	25
2.0-30	21	3.0-33	25
2.0-31	21	3.0-34	25
2.0-32	21	3.0-35	25
2.0-33	21	3.0-36	13
2.0-34	21	3.0-37	16
2.0-35	21	3.0-38	17
2.0-36	22	3.0-39	17
2.0-37	21	3.0-40	13
2.0-38	24	3.0-41	13
2.0-39	24	3.0-42	13
2.0-40	21	3.0-43	14
2.0-41	21	3.0-44	13
2.0-42	21	3.0-45	16
2.0-43	21	3.0-46	16
		3.0-47	16
3.0-1	13	3.0-48	13
3.0-2	13	3.0-49	13
3.0-3	17	3.0-50	13
3.0-4	13	3.0-51	13
3.0-5	13	3.0-52	13
3.0-6	17		
3.0-7	13	4.0-1	13
3.0-8	18	4.0-2	24
3.0-9	13	4.0-3	24
3.0-10	19	4.0-4	24
3.0-10A	24	4.0-5	25
3.0-11	13	4.0-6	23
3.0-12	15	4.0-7	23
3.0-13	14	4.0-8	23
3.0-14	13	4.0-9	23
3.0-15	16	4.0-10	23
3.0-16	17	4.0-11	23
3.0-17	16	4.0-12	25
3.0-18	13	4.0-13	25
3.0-19	13		
3.0-20	13		
3.0-21	13		
3.0-22	13		
3.0-23	13		
3.0-24	25		
3.0-25	13		

Table of Contents

PAGE

List of Effective Pages i
Table of Contents iii
List of Tables v
List of Figures vi
References vii
Introduction viii
Responsibilities ix

1.0 SPECIFICATION OF CONTROLS
1.1 Liquid Effluents 1.0-1
1.1.1 Radioactive Liquid Effluent Monitoring Instrumentation 1.0-1
1.1.2 Liquid Effluents: Concentration 1.0-8
1.1.3 Liquid Effluents: Dose 1.0-14
1.1.4 Liquid Waste Treatment 1.0-15
1.2 Gaseous Effluents 1.0-17
1.2.1 Radioactive Gaseous Effluent Monitoring Instrumentation 1.0-17
1.2.2 Gaseous Effluents: Dose Rate 1.0-22
1.2.3 Gaseous Effluents: Dose - Noble Gas 1.0-25
1.2.4 Gaseous Effluents: Dose - Radioiodines, Tritium and Radioactive Materials in Particulate Form 1.0-26
1.2.5 Gaseous Radwaste Treatment 1.0-27
1.3 Radioactive Effluents: Total Dose 1.0-29
1.4 Radiological Environmental Monitoring 1.0-31
1.4.1 Monitoring Program 1.0-31
1.4.2 Land Use Census 1.0-41
1.4.3 Interlaboratory Comparison Program 1.0-43
1.5 Bases 1.0-44
1.6 Reporting Requirements 1.0-52
1.6.1 Annual Radiological Environmental Operating Report 1.0-52
1.6.2 Annual Radioactive Effluent Release Report 1.0-53
1.6.3 Major Changes to Radioactive Waste Treatment System (Liquid and Gaseous) 1.0-54
1.6.4 V. C. Summer Groundwater Protection Program 1.0-55
1.7 Definitions 1.0-56

Table of Contents

2.0 LIQUID EFFLUENT

2.1 Liquid Effluent Monitor Setpoint Calculation 2.0-1

2.1.1 Liquid Effluent Monitor Setpoint Calculation Parameters 2.0-2

2.1.2 Liquid Radwaste Effluent Line Monitors 2.0-6

2.1.3 Liquid Radwaste Discharge Via Industrial and Sanitary Waste System 2.0-14

2.1.4 Steam Generator Blowdown, Turbine Building Sump, and Condensate Demineralizer Backwash Effluent Lines 2.0-15

2.2 Dose Calculation for Liquid Effluents 2.0-32

2.2.1 Liquid Effluent Dose Calculation Parameters 2.0-32

2.2.2 Methodology 2.0-33

2.3 Liquid Effluent Releases through the Neutralization Basin 2.0-35

2.3.1 Rainwater Tank 2.0-35

2.3.2 NaOH Spray Tank and Stored NaOH 2.0-36

3.0 GASEOUS EFFLUENT

3.1 Gaseous Effluent Monitor Setpoint 3.0-1

3.1.1 Gaseous Effluent Monitor Setpoint Calculation Parameters 3.0-1

3.1.2 Station Vent Noble Gas Monitors 3.0-5

3.1.3 Waste Gas Decay System Monitor 3.0-7

3.1.4 Alternative Methodology for Establishing Conservative Setpoints 3.0-8

3.1.5 Oil Incineration 3.0-10

3.1.6 Meteorological Release Criteria for Batch Releases 3.0-10

3.2 Dose Calculation for Gaseous Effluent 3.0-12

3.2.1 Gaseous Effluent Dose Calculation Parameters 3.0-12

3.2.2 Unrestricted Area Boundary Dose 3.0-14

3.2.3 Unrestricted Area Dose to Individual 3.0-15

3.3 Meteorological Model for Dose Calculations 3.0-45

3.3.1 Meteorological Model Parameters 3.0-45

3.3.2 Meteorological Model 3.0-46

4.0 RADIOLOGICAL ENVIRONMENTAL MONITORING 4.0-1

LIST OF TABLES

Table No.		Page No.
1.1-1	Radioactive Liquid Effluent Monitoring Instrumentation	1.0-2
1.1-2	Radioactive Liquid Effluent Monitoring Instrumentation Surveillance Requirements	1.0-5
1.1-3	Frequency Notation	1.0-7
1.1-4	Radioactive Liquid Waste Sampling and Analysis Program	1.0-10
1.2-1	Radioactive Gaseous Effluent Monitoring Instrumentation	1.0-18
1.2-2	Radioactive Gaseous Effluent Monitoring Instrumentation Surveillance Requirements	1.0-20
1.2-3	Radioactive Gaseous Waste Sampling and Analysis Program	1.0-23
1.4-1	Radiological Environmental Monitoring Program	1.0-33
1.4-2	Reporting Levels for Radioactivity Concentrations in Environmental Samples Reporting Levels	1.0-38
1.4-3	Maximum Values for the Lower Limits of Detection (LLD) [a,c] Reporting Levels	1.0-39
2.2-1	Bioaccumulation Factors	2.0-37
2.2-2	Adult Ingestion Dose Factors	2.0-38
2.2-3	Site Related Ingestion Dose Commitment Factor (A_{ir})	2.0-40
3.1-1	Dose Factors for Exposure to a Semi-Infinite Cloud of Noble Gases	3.0-4
3.1-2	Favorable Meteorology	3.0-10A
3.2-1	Pathway Dose Factors for Section 3.2.2.2. (P_i)	3.0-18
3.2-2	Pathway Dose Factors for Section 3.2.3.2. (R_i)	3.0-21
3.2-3	Pathway Dose Factors for Section 3.2.3.3. (R_i) (Infant)	3.0-24
3.2-4	Pathway Dose Factors for Section 3.2.3.3. (R_i) (Child)	3.0-27
3.2-5	Pathway Dose Factors for Section 3.2.3.3. (R_i) (Teenager)	3.0-30
3.2-6	Pathway Dose Factors for Section 3.2.3.3. (R_i) (Adult)	3.0-33
3.2-7	Controlling Receptors, Locations, and Pathways	3.0-37
3.2-8	Atmospheric Dispersion Parameters for Controlling Receptor Locations	3.0-39
3.2-9	Parameters Used in Dose Factor Calculations	3.0-40
4.0-1	Radiological Environmental Monitoring Program	4.0-2

LIST OF FIGURES

Figure No.		Page No.
2.1-1	Example Liquid Monitor Calibration Curve	2.0-31
2.2-1	Liquid Radwaste Treatment System	2.0-42
3.1-1	Example Noble Gas Monitor Calibration Curve	3.0-11
3.2-1	Gaseous Radwaste Treatment System	3.0-44
3.3-1	Plume Depletion Effect for Ground Level Releases (δ)	3.0-49
3.3-2	Vertical Standard Deviation of Material in a Plume (σ_z)	3.0-50
3.3-3	Relative Deposition for Ground Level Releases (D_g)	3.0-51
3.3-4	Open Terrain Recirculation Factor	3.0-52
4.0-1	Radiological Environmental Sampling Locations (Remote)	4.0-10
4.0-2	Radiological Environmental Sampling Locations (Local)	4.0-11
4.0-3	Radiological Environmental Sampling Locations (Local)	4.0-12
4.0-4	Radiological Environmental Sampling Locations (Local)	4.0-13

REFERENCES

1. Boegli, T.S., R.R. Bellamy, W.L. Britz, and R.L. Waterfield, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants" NUREG-0133 (October 1978).

2. "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR 50, Appendix I", U.S. NRC Regulatory Guide 1.109 (March 1976).

3. "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR 50, Appendix I", U.S. NRC Regulatory Guide 1.109, Rev. 1 (October 1977).

4. "Final Safety Analysis Report", South Carolina Electric and Gas Company, Virgil C. Summer Nuclear Station.

5. "Operating License Environmental Report", South Carolina Electric and Gas Company, Virgil C. Summer Nuclear Station.

6. Wahlig, B.G., "Estimation of the Radioactivity Release Rate/Equilibrium Concentration Relationship for the Parr Pumped Storage System", Applied Physical Technology, Inc., February 1981.

7. "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light - Water - Cooled Reactors", U.S. NRC Regulatory Guide 1.111 (March 1976).

8. "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light - Water - Cooled Reactors", U.S. NRC Regulatory Guide 1.111, Rev. 1 (July 1977).

9. Slade, D.H., (editor), "Meteorology and Atomic Energy"; U.S. Atomic Energy Commission, AEC TID-24190, 1968.

10. "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants", U.S. NRC Regulatory Guide 1.21, Rev. 1 (June 1974).

11. "Standard Radiological Effluent Technical Specifications for Pressurized Water Reactors", NUREG-0472, Revision 3 (January 1983).

12. "Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment", USNRC Regulatory Guide 4.15, Revision 1 (February 1979).

13. "Age-Specific Radiation Dose Commitment Factors for a One-Year Chronic Intake", NUREG-0172 (November 1977).

14. Generic Letter 89-01, "Implementation of Programmatic Controls for Radiological Effluent Technical Specifications", January 31, 1989.

15. "Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors", Generic Letter 89-01, Supplement No. 1, NUREG-1301, April 1, 1991.

INTRODUCTION

The OFFSITE DOSE CALCULATION MANUAL (ODCM) is an implementing and supporting
CO2→ document of the RADIOLOGICAL EFFLUENT TECHNICAL SPECIFICATIONS (RETS). In accordance with USNRC Generic Letter 89-01, entitled "Implementation of Programmatic Controls for Radiological Effluent Technical Specifications in the Administrative Controls Section of the Technical Specifications and the Relocation of Procedural Details of RETS to the Offsite Dose Calculation Manual or to the Process Control Program", the procedural details for implementing the Radiological Controls have been incorporated into the ODCM. The ODCM describes the methodology and parameters to be used in the calculation of offsite doses due to radioactive liquid and gaseous effluents and in the calculation of liquid and gaseous effluent monitoring instrumentation alarm/trip setpoints. The ODCM contains a list and graphical description of the specific sample locations for the radiological environmental monitoring program. Configurations of the liquid and gaseous radwaste treatment systems are also included.

The ODCM will be maintained at the Station as the reference which details the Radiological Effluent Controls of the V. C. Summer Nuclear Station. Additionally the ODCM will be maintained as the guide for accepted calculational methodologies. Changes in calculation methods or parameters will be incorporated into the ODCM in order to ensure that the ODCM represents the current methodology in all applicable areas. Computer software to perform described calculations will be maintained current with this ODCM.

RESPONSIBILITIES

The ODCM contains the radiological effluent controls, their applicability, remedial actions, surveillance requirements, and their bases. Plant procedures implement responsibilities for compliance with the ODCM that include:

The Operations group is responsible for:

- Declaring radioactive liquid and gaseous effluent monitor channels operable or inoperable.
- Ensuring the minimum number of operable channels for radioactive liquid and gaseous effluent monitors.
- Notifying the responsible group to implement appropriate action if less than the minimum number of radioactive liquid and gaseous effluent monitor channels are operable.
- Initiating a Condition Evaluation Report (CER) in accordance with SAP-999 when less than the minimum number of channels operable condition prevails for more than 30 days.
- Restoring to within limits, the concentration of liquid radioactive material exceeding ODCM limits released from the site.
- Ensuring radioactive liquid and gaseous effluent monitor setpoints are set as prescribed in the effluent release permit.
- Suspending release if radioactive liquid and gaseous effluent monitor setpoints are less conservative than ODCM requirements.
- Declaring liquid and gaseous radwaste treatment systems operable or inoperable.
- Ensuring operability of gaseous and liquid radwaste treatment systems and ventilation exhaust treatment system.
- Ensuring appropriate portions of the gaseous and liquid radwaste treatment systems are used to reduce the radioactive materials in liquid and gaseous waste prior to their discharge when the projected doses exceed limits specified by the ODCM.
- Initiating a CER in accordance with SAP-999 when liquid or gaseous radwaste system is inoperable for more than 31 days.
- Performing channel check and source check at the frequencies shown in Tables 1.1-2 and 1.2-2 for each radioactive liquid and gaseous effluent monitoring instrumentation channel.

Instrumentation and Controls group is responsible for:

- Performing channel calibration and analog channel operational test at the frequencies shown in Tables 1.1-2 and 1.2-2 for each radioactive liquid and gaseous effluent monitoring instrumentation channel.

- Informing the Operations group of surveillance test results.

The Health Physics group is responsible for:

- Establishing setpoints for radioactive liquid and gaseous effluent monitors, consistent with ODCM methodology, and providing setpoints information to Operations.

- Implementing remedial actions as requested by Operations. These actions include grab sampling and analysis and providing the results to Operations.

- Performing periodic radioactive effluent monitor checks to determine backgrounds, normal indications and verifying monitor correlation graphs, and providing this information as necessary to Operations.

- Implementing radioactive gaseous and liquid waste sampling and analysis program in accordance with ODCM Tables 1.1-4 and 1.2-3.

- Informing Operations when at least one Circulating Water Pump or the Circulating Water Jockey Pump is required to provide dilution to the discharge structure.

- Calculating cumulative dose contributions and performing dose projections from liquid and gaseous effluents in accordance with the ODCM and providing the information to Operations.

- Initiating a CER in accordance with SAP-999 when calculated dose from the discharge of radioactive materials in liquid or gaseous effluents are in excess of the limits specified by ODCM Sections 1.1.3.1 or 1.2.3.1.

- Initiating a CER in accordance with SAP-999 when liquid or gaseous waste is discharged without treatment and is in excess of the limits specified by ODCM Sections 1.1.4.1 or 1.2.3.1.

- Initiating a CER in accordance with SAP-999 when the dose or dose commitment to any member of the public due to releases of radioactivity and radiation is in excess of 25 mrem to the total body or any organ (except the thyroid, which shall be limited to less than or equal to 75 mrem) over 12 consecutive months.

- Implementing the Radiological Environmental Monitoring Program as specified in Section 1.4 of the ODCM.

- Initiating a CER in accordance with SAP-999 when the Radiological Environmental Monitoring Program limiting conditions for operation are exceeded.

- Preparation of the Annual Radioactive Effluent Release Report and the Annual Environmental Operating Report.

1.0 SPECIFICATION OF CONTROLS

1.1 LIQUID EFFLUENTS

1.1.1 Radioactive Liquid Effluent Monitoring Instrumentation

CONTROLS

1.1.1.1 The radioactive liquid effluent monitoring instrumentation channels shown in Table 1.1-1 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of ODCM Specification 1.1.2.1 are not exceeded. The alarm/trip setpoints of these channels shall be determined in accordance with ODCM, Section 2.1.

APPLICABLE: At all times.

ACTION:

a. With a radioactive liquid effluent monitoring instrumentation channel alarm/ trip setpoint less conservative than required by the above specification, immediately suspend the release of radioactive liquid effluents monitored by the affected channel or declare the channel inoperable.

b. With less than the minimum number of radioactive liquid effluent monitoring instrumentation channels OPERABLE, take the ACTION shown in Table 1.1-1. Additionally, if this condition prevails for more than 30 days, in the next Annual Radioactive Effluent Release Report explain why this condition was not corrected in a timely manner.

c. The provisions of Technical Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

1.1.1.2 Each radioactive liquid effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION and ANALOG CHANNEL OPERATIONAL TEST operations at the frequencies shown in Table 1.1-2.

Table 1.1-1

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS OPERABLE	ACTION
1. GROSS RADIOACTIVITY MONITORS PROVIDING ALARM AND AUTOMATIC TERMINATION OF RELEASE		
a. Liquid Radwaste Effluent Line - RM-L5 or RM-L9	1	1
b. Nuclear (Processed Steam Generator) Blowdown Effluent Line RM-L7 or RM-L9	1	1
c. Steam Generator Blowdown Effluent Line		
1. Unprocessed during Power Operation - RM-L10 or RM-L3	1	2
2. Unprocessed during Startup - RM-L3	1	2
d. Turbine Building Sump Effluent Line - RM-L8	1	3
e. Condensate Demineralizer Backwash Effluent Line RM-L11	1	6
2. FLOW RATE MEASUREMENT DEVICES*		
a. Liquid Radwaste Effluent Line - Tanks 1 and 2	1/tank	4
b. Penstock Minimum Flow Interlock**	1	4
c. Nuclear Blowdown Effluent Line	1	4
d. Steam Generator (Unprocessed) Blowdown Effluent Line	1	4
3. TANK LEVEL INDICATING DEVICES		
a. Condensate Storage Tank	1	5

* In the event that simultaneous releases from both WMT and NBMT are required (which normally will be prevented by procedure) the flow rate for monitor RM-L9 will be determined by adding flow rates for monitors RM-L5 and RM-L7.

** Minimum dilution flow is assured by an interlock that terminates liquid waste releases if the minimum dilution flow is not available.

Table 1.1-1 (Continued)

TABLE NOTATION

ACTION 1

With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases may continue for up to 14 days provided that prior to initiating a release:

a. At least two independent samples are analyzed in accordance with ODCM Specification 1.1.2.4 and

b. At least two technically qualified members of the Facility Staff independently verify the release rate calculations and discharge line valving.

Otherwise, suspend release of radioactive effluents via this path-way.

ACTION 2

With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue for up to 30 days provided grab samples are analyzed by gamma spectroscopy for radioactivity at the LLD specified in Table 1.1-4 or samples are analyzed for gross radioactivity (beta and gamma) at a limit of detection of at least 1E-7 microcuries/gram.

a. At least once per 12 hours when the specific activity of the secondary coolant is greater than 0.01 microcuries/gram DOSE EQUIVALENT I-131.

b. At least once per 24 hours when the specific activity of the secondary coolant is less than or equal to 0.01 micro-curies/gram DOSE EQUIVALENT I-131.

ACTION 3

With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue for up to 30 days provided that, at least once per 12 hours, grab samples are collected and analyzed by gamma spectroscopy for radioactivity at the LLD specified in Table 1.1-4 or samples are analyzed for gross radioactivity (beta and gamma) at a limit of detection of at least 1E-7 microcuries/gram.

Table 1.1-1 (Continued)

TABLE NOTATION

ACTION 4	With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue for up to 30 days provided the flow rate is estimated at least once per 4 hours during actual releases. Pump curves may be used to estimate flow.
ACTION 5	With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, liquid additions to this tank may continue for up to 30 days provided the tank liquid level is estimated during all liquid additions to the tank to prevent overflow.
ACTION 6	With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases may continue for up to 30 days provided that samples are analyzed in accordance with ODCM Specification 1.1.2.2 and Technical Specification 4.11.1.5.

Table 1.1-2

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

	INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRA-TION	ANALOG CHANNEL OPERATIONAL TEST
1.	GROSS RADIOACTIVITY MONITORS PROVIDING ALARM AND AUTOMATIC TERMINATION OF RELEASE				
	a. Liquid Radwaste Effluent Line - RM-L5 or RM-L9	D	P	R(2)	Q(1)
	b. Nuclear Blowdown Effluent Line RM-L7	D	P	R(2)	Q(1)
	c. Steam Generator Blowdown Effluent Line - RM-L3, RM-L10	D	M	R(2)	Q(1)
	d. Turbine Building Sump Effluent Line - RM-L8	D	M	R(2)	Q(1)
	e. Condensate Demineralizer Backwash Effluent Line RM-L11	D	M	R(2)	Q(4)
2.	FLOW RATE MEASUREMENT DEVICES				
	a. Liquid Radwaste Effluent Line	D(3)	N.A.	R	Q
	b. Penstocks Minimum Flow Interlock	D(3)	N.A.	R	Q
	c. Nuclear Blowdown Effluent Line	D(3)	N.A.	R	Q
	d. Steam Generator Blowdown Effluent Line	D(3)	N.A.	R	Q
3.	TANK LEVEL INDICATING DEVICES				
	a. Condensate Storage Tank	D	N.A.	R	Q

See Table 1.1-3 for explanation of frequency notation.

Table 1.1-2 (Continued)
TABLE NOTATION

(1) The ANALOG CHANNEL OPERATIONAL TEST shall also demonstrate that automatic isolation of this pathway and control room alarm annunciation occurs if any of the following conditions exists:
1. Instrument indicates measured levels above the alarm/trip setpoint.
2. Loss of Power (alarm only).
3. Low Flow (alarm only).
4. Instrument indicates a Downscale Failure (alarm only).
5. Normal/Bypass switch set in Bypass (alarm only).
6. Other instrument controls not set in Operate mode.

(2) The initial CHANNEL CALIBRATION shall be performed using one or more of the reference standards certified by the National Institute of Standards and Technology (NIST) or using standards that have been obtained from suppliers that participate in measurement assurance activities with NIST. These standards shall permit calibrating the system over its intended energy and measurement range. For subsequent CHANNEL CALIBRATION, sources that have been related to the initial calibration shall be used.

(3) CHANNEL CHECK shall consist of verifying indication of flow during periods of release. CHANNEL CHECK shall be made at least once per 24 hours on days on which continuous, periodic or batch releases are made.

(4) The ANALOG CHANNEL OPERATIONAL TEST shall also demonstrate that automatic isolation of this pathway and local panel alarm annunciation occurs if any of the following conditions exists:
1. Instrument indicates measured levels above the alarm/trip setpoint.
2. Loss of Power (alarm only).
3. Low Flow (alarm only).
4. Instrument indicates a Downscale Failure (alarm only).
5. Normal/Bypass switch set in Bypass (alarm only).
6. Other instrument controls not set in Operate mode.

Table 1.1-3

FREQUENCY NOTATION

Notation	Frequency
D	At least once per 24 hours.
W	At least once per 7 days.
M	At least once per 31 days.
Q	At least once per 92 days.
SA	At least once per 184 days.
R	At least once per 18 months.
P	Completed prior to each release.
N.A.	Not applicable.

Note: Each surveillance requirement shall be performed within the specified surveillance interval with a maximum allowable extension of 25% of the specified surveillance interval.

1.1.2 Liquid Effluents: Concentration

CONTROLS

1.1.2.1 The concentration of radioactive material released from the site (see Technical Specification Figure 5.1-4) shall be limited to 10 times the concentration values specified in 10 CFR Part 20, Appendix B, Table 2, Column 2 for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2E-4 microcuries/ml total activity.

APPLICABLE: At all times.

ACTION:

a. With the concentration of radioactive material released to unrestricted areas exceeding the above limits, immediately restore the concentration to within the above limits.

b. The provisions of Technical Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

1.1.2.2 The radioactivity content of each batch of radioactive liquid waste shall be determined prior to release by sampling and analysis in accordance with Table 1.1-4. The results of pre-release analyses shall be used with the calculational methods in ODCM Section 2.1 to assure that the concentration at the point of release is maintained within the limits of ODCM Specification 1.1.2.1.

1.1.2.3 Post-release analyses of samples composited from batch releases shall be performed in accordance with Table 1.1-4. The results of the previous post-release analyses shall be used with the calculational methods in ODCM Section 2.1 to assure that the concentrations at the point of release were maintained within the limits of ODCM Specification 1.1.2.1.

1.1.2.4 The radioactivity concentration of liquids discharged from continuous release points shall be determined by collection and analysis of samples in accordance with Table 1.1-4. The results of the analyses shall be used with the calculational methods in ODCM Section 2.1 to assure that the concentrations at the point of release are maintained within the limits of ODCM Specification 1.1.2.1.

1.1.2.5 At least one Circulating Water Pump or the Circulating Water Jockey Pump shall be determined to be in operation and providing dilution to the discharge structure at least once per 4 hours whenever dilution is required to meet the site radioactive effluent concentration limits of ODCM Specification 1.1.2.1.

Table 1.1-4

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

Liquid Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml)[a]
A. Batch Waste Release[d] Tanks	P Each Batch	P Each Batch	Principal Gamma Emitters[f]	$5X10^{-7}$
			I-131	$1X10^{-6}$
1. Waste Monitor Tanks	P One Batch/M	M	Dissolved and Entrained Gases (Gamma Emitters)	$1X10^{-5}$
2. Condensate Demin-eralizer Backwash Receiving Tank	P Each Batch	M Composite[b]	H-3	$1X10^{-5}$
			Gross Alpha	$1X10^{-7}$
3. Nuclear Blowdown Monitor Tank	P Each Patch	Q Composite[b]	Sr-89, Sr-90	$5X10^{-8}$
			Fe-55	$1X10^{-6}$
B. Continuous Release[e]	D Grab Sample	W Composite[c]	Principal Gamma Emitters[f]	$5X10^{-7}$
			I-131	$1X10^{-6}$
1. Steam Generator Blowdown	M Grab Sample	M	Dissolved and Entrained Gases (Gamma Emitters)	$1X10^{-5}$
2. Turbine Building Sump	D Grab Sample	M Composite[c]	H-3	$1X10^{-5}$
			Gross Alpha	$1X10^{-7}$
3. Service Water	D Grab Sample	Q Composite[c]	Sr-89, Sr-90	$5X10^{-8}$
			Fe-55	$1X10^{-6}$

See Table 1.1-3 for explanation of frequency notation.

Table 1.1-4 (Continued)

TABLE NOTATION

a. The Lower Limit of Detection (LLD) is the smallest concentration of radioactive material in a sample that will yield a net count above background that will be detected with a 95% probability. LLD also yields a 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system (which may include radiochemical separation):

$$LLD = \frac{4.66 s_b}{(E)\,(V)\,(2.22)\,(Y)\,(\exp)\,(-\lambda \Delta t)}$$

Where:

LLD is the "a priori" lower limit of detection as defined above (as pCi per unit mass or volume). Current literature defines the LLD as the detection capability for the instrumentation only and the MDC, the minimum detectable concentration, as the detection capability for a given instrument procedure and type of sample.

4.66 is a factor which corrects for the smallest activity that has a probability, p, of being detected, and a probability, 1-p, of falsely concluding its presence.

$$4.66 = 2k\sqrt{1 + (t_b / t_s)}$$

k = a constant whose value depends on the chosen confidence level (NRC recommends a confidence level of 95%)
= 1.6545 at 95% confidence level
t_b = background time
t_s = sample time

s_b is the standard deviation of the background counting rate or the counting rate of blank sample as appropriate (as counts per minute).

E is the counting efficiency (as counts per transformation).

Table 1.1-4 (Continued)

TABLE NOTATION

V is the sample size (in units of mass or volume).

2.22 is the number of transformations per minute per picoCurie.

Y is the fractional radiochemical yield (when applicable).

λ is the radioactive decay constant for the particular radionuclide.

Δt is the elapsed time between midpoint of sample collection and time of counting (for plant effluents, not environmental samples).

The value of s_b used in the calculation of the LLD for a detection system shall be used on the actual observed variance of the background counting rate or of the counting rate of the blank samples (as appropriate) rather than on an unverified theoretically predicted variance. In calculating the LLD for a radionuclide determined by gamma-ray spectrometry the background should include the typical contributions of other radionuclides normally present in the samples. Typical values of E, V, Y and Δt shall be used in the calculation.

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as a posteriori (after the fact) limit for particular measurement.*

---

*For a more complete discussion of the LLD, and other detection limits, see the following:

(1) HASL Procedures Manual, HASL-300 (revised annually).
(2) Currie, L. A., "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry" Anal. Chem. 40, 586-93 (1968).
(3) Hartwell, J. K., "Detection Limits for Radioisotopic Counting Techniques," Atlantic Richfield Handford Company Report ARH-2537 (June 22, 1972).

Table 1.1-4 (Continued)

TABLE NOTATION

b. A composite sample is one in which the quantity of liquid sampled is proportional to the quantity of liquid waste discharged and in which the method of sampling employed results in a specimen which is representative of the liquids released.

c. To be representative of the quantities and concentrations of radioactive materials in liquid effluents, samples shall be composited in proportion to the rate of flow of the effluent stream. Prior to analyses, all samples taken for the composite shall be thoroughly mixed in order for the composite sample to be representative of the effluent release.

d. A batch release is the discharge of liquid wastes of a discrete volume. Prior to sampling for analyses, each batch shall be isolated, and then thoroughly mixed, by a method described in ODCM Section 2.0, to assure representative sampling.

e. A continuous release is the discharge of liquid wastes of a nondiscrete volume; e.g., from a volume of system that has an input flow during the continuous release.

f. The principal gamma emitters for which the LLD specification applies exclusively are the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, and Ce-141. Ce-144 shall also be measured, but with an LLD of 5×10^{-6}. This list does not mean that only these nuclides are to be detected and reported. Other peaks which are measurable and identifiable, together with the above nuclides, shall also be identified and reported.

1.1.3 Liquid Effluents: Dose

CONTROLS

1.1.3.1 The dose or dose commitment to an individual from radioactive materials in liquid effluents released from the site (see Technical Specification Figure 5.1-4) shall be limited:

a. During any calendar quarter to less than or equal to 1.5 mrem to the total body and to less than or equal to 5 mrem to any organ.

b. During any calendar year to less than or equal to 3 mrem to the total body and to less than or equal to 10 mrem to any organ.

APPLICABLE: At all times.

ACTION:

a. With the calculated dose from the release of radioactive materials in liquid effluents exceeding any of the above limits, in lieu of any other report required by ODCM Section 1.6, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report which identifies the cause (s) for exceeding the limit (s) and defines the corrective actions to be taken to the releases and the proposed actions to be taken to assure that subsequent releases will be in compliance with ODCM Specification 1.1.3.1.

b. The provisions of Technical Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

1.1.3.2 Dose Calculations Cumulative dose contributions from liquid effluents shall be determined in accordance with ODCM Section 2.2 at least once per 31 days.

1.1.4 Liquid Waste Treatment

CONTROLS

1.1.4.1 The liquid radwaste treatment system shall be OPERABLE. The appropriate portions of the system shall be used to reduce the radioactive materials in liquid wastes prior to their discharge when the projected doses due to the liquid effluent from the site (See Technical Specification Figure 5.1-4) when averaged on a sliding 31 day calendar basis, would exceed 0.06 mrem to the total body or 0.2 mrem to any organ.

APPLICABLE: At all times.

ACTION:

a. With the liquid radwaste treatment system inoperable for more than 31 days or with radioactive liquid waste being discharged without treatment and in excess of the above limits, in lieu of any other report required by ODCM Section 1.6, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report which includes the following information:
   1. Identification of the inoperable equipment or subsystems and the reason for inoperability.
   2. Action(s) taken to restore the inoperable equipment to OPERABLE status.
   3. Summary description of action(s) taken to prevent a recurrence.

b. With radioactive waste being discharged, the requirements to process effluents are:

   1. If all streams are unprocessed and projected dose(s) exceed the limits of ODCM Specification 1.1.4.1, process the appropriate streams to the point that the projected dose is within limits.

2. With a combination of processed and unprocessed streams producing a dose projection exceeding the limits of specification 1.1.4.1, process the unprocessed streams if they contribute greater than or equal to 10 percent of Specification 1.1.4.1 limits.

c. The provisions of Technical Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

1.1.4.2 Doses due to liquid releases shall be projected at least once per 31 days.

1.1.4.3 The liquid radwaste treatment system shall be demonstrated OPERABLE by operating the liquid radwaste treatment system equipment for at least 30 minutes at least once per 92 days unless the liquid radwaste system has been utilized to process radioactive liquid effluents during the previous 92 days.

1.2 GASEOUS EFFLUENTS

1.2.1 Radioactive Gaseous Effluent Monitoring Instrumentation

CONTROLS

1.2.1.1 The radioactive gaseous effluent monitoring instrumentation channels shown in Table 1.2.-1 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of ODCM Specification 1.2.2.1 are not exceeded. The alarm/trip setpoints of these channels shall be determined in accordance with ODCM Section 3.1.

APPLICABLE: As shown in Table 1.2-1

ACTION:

a. With a radioactive gaseous effluent monitoring instrumentation channel alarm/trip setpoint less conservative than required by the above ODCM Specification, immediately suspend the release of radioactive gaseous effluents monitored by the affected channel or declare the channel inoperable.

b. With less than the minimum number of radioactive gaseous effluent monitoring instrumentation channels OPERABLE, take the ACTION shown in Table 1.2-1. Additionally if this condition prevails for more than 30 days, in the next Annual Radioactive Effluent Release Report, explain why this condition was not corrected in a timely manner.

c. The provisions of Technical Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

1.2.1.2 Each radioactive gaseous effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION and an ANALOG CHANNEL OPERATIONAL TEST operations at the frequencies shown in Table 1.2-2.

Table 1.2-1

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

	INSTRUMENT	MINIMUM CHANNELS OPERABLE	APPLICA-BILITY	ACTION
1.	WASTE GAS HOLDUP SYSTEM			
	a. Noble Gas Activity Monitor - Providing Alarm and Automatic Termination of Release (RM-A10 or RM-A3)	1	*	7
2.	MAIN PLANT VENT EXHAUST SYSTEM			
	a. Noble Gas Activity Monitor - Providing Alarm and Automatic Termination of Release from Waste Gas Holdup System (RM-A3)	1	*	9
	b. Iodine Sampler	1	*	11
	c. Particulate Sampler	1	*	11
	d. Flow Rate Measuring Device	1	*	8
	e. Sampler Flow Rate Measuring Device	1	*	8
3.	REACTOR BUILDING PURGE SYSTEM			
	a. Noble Gas Activity Monitor Providing Alarm & Automatic Termination of Release (RM-A4)	1	*	10
	b. Iodine Sampler	1	*	11
	c. Particulate Sampler	1	*	11
	d. Flow Rate Measuring Device			
	1. For 36" Purge (IFT09287)	1	*	8
	2. For 6" Purge (IFT08252)	1	*	8
	e. Sampler Flow Rate Measuring Device	1	*	8

Table 1.2-1 (Continued)
TABLE NOTATION

* At all times during releases via this pathway.

ACTION 7 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, the contents of the tank(s) may be released to the environment for up to 14 days provided that prior to initiating the release:

a. At least two independent samples of the tank's contents are analyzed.

b. At least two technically qualified members of the Facility Staff independently verify the release rate calculations and discharge valve lineup.

Otherwise, suspend release of radioactive effluents via this pathway.

ACTION 8 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue for up to 30 days provided the flow rate is estimated at least once per 4 hours.

ACTION 9 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue for up to 30 days provided grab samples are taken at least once per 12 hours and these samples are analyzed for gross activity within 24 hours.

ACTION 10 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, immediately suspend PURGING of radioactive effluents via this pathway.

ACTION 11 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via the affected pathway may continue for up to 30 days provided samples, as specified in Table 1.2-3, are continuously collected with auxiliary sampling equipment.

a. With the monitor taken out of service, by a condition other than a planned action, the action statement is considered met if a conscious, concerted and continuous effort is being made to initiate the collection of the required sample(s) with auxiliary sampling equipment.

b. A planned removal of the monitor from service requires that the auxiliary sampling equipment be staged in the area to reduce the amount of time for the change over from sampling by the installed monitor to the auxiliary sampling equipment.

Table 1.2-2

RADIOACTIVE GASEOUS EFFLUENT
MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	ANALOG CHANNEL OPERATIONAL TEST	MODES IN WHICH SURVEILLANCE REQUIRED
1. WASTE GAS HOLDUP SYSTEM					
a. Noble Gas Activity Monitor - RM-A10 or RM-A3	P	P	R(3)	Q(1)	*
2. MAIN PLANT VENT EXHAUST SYSTEM					
a. Noble Gas Activity Monitor - RM-A3	D	M	R(3)	Q(2)	*
b. Iodine Sampler	W	N.A.	N.A.	N.A.	*
c. Particulate Sampler	W	N.A.	N.A.	N.A.	*
d. Flow Rate Measuring Device	D	N.A.	R	Q	*
e. Sampler Flow Rate Monitor	D	N.A.	R	Q	*
3. REACTOR BUILDING PURGE SYSTEM					
a. Noble Gas Activity Monitor - RM-A4	D	P,M	R(3)	Q(1)	*
b. Iodine Sampler	W	N.A.	N.A.	N.A.	*
c. Particulate Sampler	W	N.A.	N.A.	N.A.	*
d. Flow Rate Measuring Device	D	N.A.	R	Q	*
1. For 36" Purge (IFT09287)	D	N.A.	R	Q	*
2. For 6" Purge (IFT08252)	D	N.A.	R	Q	*
e. Sampler Flow Rate Monitor					

See Table 1.1-3 for explanation of frequency notation.

Table 1.2-2 (Continued)

TABLE NOTATION

* At all times.

(1) The ANALOG CHANNEL OPERATIONAL TEST shall also demonstrate that automatic isolation of this pathway and control room alarm annunciation occurs if any of the following conditions exists:
1. Instrument indicates measured levels above the alarm/trip setpoint.
2. Loss of Power (alarm only).
3. Low Flow (alarm only).
4. Instrument indicates a Downscale Failure (alarm only).
5. Normal/Bypass switch set in Bypass (alarm only).
6. Other instrument controls not set in Operate mode.

(2) The ANALOG CHANNEL OPERATIONAL TEST shall also demonstrate that control room alarm annunciation occurs if any of the following conditions exists:
1. Instrument indicates measured levels above the alarm setpoint.
2. Loss of Power.
3. Low Flow.
4. Instrument indicates a Downscale Failure.
5. Instrument controls not set in Operate mode.

(3) The initial CHANNEL CALIBRATION shall be performed using one or more of the reference standards certified by the National Institute of Standards and Technology (NIST) or using standards that have been obtained from suppliers that participate in measurement assurance activities with NIST. These standards shall permit calibrating the system over its intended range of energy and measurement. For subsequent CHANNEL CALIBRATION, sources that have been related to the initial calibration shall be used.

1.2.2 Gaseous Effluents: Dose Rate

CONTROLS

1.2.2.1 The dose rate in unrestricted areas due to radioactive materials released in gaseous effluents from the site including effluents from oil incineration (see Technical Specification Figure 5.1-3) shall be limited to the following:

a. For noble gases: Less than or equal to 500 mrem/yr to the total body and less than or equal to 3000 mrem/yr to the skin.

b. For Iodine-131, Iodine-133 and for all radioactive materials in particulate form and tritium with half lives greater than 8 days: Less than or equal to 1500 mrem/yr to any organ.

c. Less than 0.1% of the limits in 1.2.2.1 (a) and (b) as a result of oil incineration.

APPLICABLE: At all times.

ACTION:

With the dose rate(s) exceeding the above limits, immediately decrease the release rate to within the above limit(s).

SURVEILLANCE REQUIREMENTS

1.2.2.2 The dose rate due to noble gases in gaseous effluents shall be determined to be within the above limits in accordance with the methods and procedures of the ODCM.

1.2.2.3 The dose rate due to radioiodines, tritium and radioactive materials in particulate form with half lives greater than 8 days in gaseous effluents shall be determined to be within the above limits in accordance with the methods and procedures of ODCM Section 3.2.2 by obtaining representative samples and performing analyses in accordance with the sampling and analysis program specified in Table 1.2-3.

Table 1.2-3
RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

Gaseous Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml)[a]
A. Waste Gas Storage Tank	P Each Tank Grab Sample	P Each Tank	Principal Gamma Emitters[g]	$1X10^{-4}$
B1 Reactor Building - 36" Purge Line	P Each Purge [b,c]	P Each Purge [b]	Principal Gamma Emitters[g]	$1X10^{-4}$
- 6" Purge Line			H-3	$1X10^{-6}$
B2 Reactor Building - 6" Purge Line	M[b] Grab Sample	M[b]	Principal Gamma Emitters[g]	$1X10^{-4}$
(if continuous)			H-3	$1X10^{-6}$
C Main Plant Vent	M[b,e] Grab Sample	M[b]	Principal Gamma Emitters[g]	$1X10^{-4}$
			H-3	$1X10^{-6}$
D1. Reactor Building Purge	Continuous Sampler[f]	W[d] Charcoal Sample	I-131 I-133	$1X10^{-12}$ $1X10^{-10}$
2. Main Plant Vent	Continuous Sampler[f]	W[d] Particulate Sample	Principal Gamma Emitters[g] I-131, others	$1X10^{-11}$
	Continuous Sampler[f]	M Composite Particulate Sample	Gross Alpha	$1X10^{-11}$
	Continuous Sampler[f]	Q Composite Particulate Sample	Sr-89, Sr-90	$1X10^{-11}$
	Continuous Monitor	Noble Gas Monitor	Noble Gases Gross Beta	$1X10^{-6}$
E Oil Incinerator	P Each Batch[h] Grab Sample	P Each Batch	Principal Gamma Emitters[g]	$5X10^{-7}$ [i]
			Noble Gases	1E-5 [i]
			I-131	1E-6 [i]
			H-3	3E-5 [i]
			Sr-89, Sr-90	3E-7 [i]
			Fe-55	1E-6 [i]

See Table 1.1-3 for explanation of frequency notation.

Table 1.2-3 (Continued)
TABLE NOTATION

a. See Table 1.1-4 notation (a) for definition of LLD.

b. Analyses shall be also be performed within 24 hours following shutdown, startup, or a THERMAL POWER change exceeding 15 percent of the RATED THERMAL POWER within a one hour period.

c. Tritium grab samples shall be taken at least once per 24 hours when the refueling canal is flooded.

d. Samples shall be changed at least once per 7 days and analyses shall be completed within 48 hours after changing (or after removal from sampler). Sampling shall also be performed at least once per 24 hours for at least 7 days following each shutdown, startup or THERMAL POWER change exceeding 15 percent of RATED THERMAL POWER in one hour and analyses shall be completed within 48 hours of changing. When samples collected for 24 hours are analyzed, the corresponding LLD's may be increased by a factor of 10.

e. Tritium grab samples shall be taken at least once per 7 days from the ventilation exhaust from the spent fuel pool area, whenever spent fuel is in the spent fuel pool.

f. The ratio of the sample flow rate to the sampled stream flow rate shall be known for the time period covered by each dose or dose rate calculation made in accordance with ODCM Specifications 1.2.2.1, 1.2.3.1 and 1.2.4.1.

g. The principal gamma emitters for which the LLD specification applies exclusively are the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135 and Xe-138 for gaseous emissions and Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141 and Ce-144 for particulate emissions. This list does not mean that only these nuclides are to be detected and reported. Other peaks which are measurable and identifiable, together with the above nuclides, shall also be identified and reported.

h. Prior to sampling for analysis, each batch of oil shall be isolated and representative samples obtained by methods described in ASTM D 4057-81, Volume 05.03, "Standard Practice for Manual Sampling of Petroleum and Petroleum Products".

i. This LLD refers to the liquid sample.

1.2.3 Gaseous Effluents: Dose - Noble Gas

CONTROLS

1.2.3.1 The air dose due to noble gases released in gaseous effluents from the site (see Technical Specification Figure 5.1-3) shall be limited to the following:

a. During any calendar quarter: Less than or equal to 5 mrad for gamma radiation and less than or equal to 10 mrad for beta radiation.

b. During any calendar year: Less than or equal to 10 mrad for gamma radiation and less than or equal to 20 mrad for beta radiation.

APPLICABLE: At all times.

ACTION:

a. With the calculated air dose from radioactive noble gases in gaseous effluents exceeding any of the above limits, in lieu of any other report required by ODCM Section 1.6, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report which identifies the cause(s) for exceeding the limit(s) and defines the corrective actions to be taken to releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with ODCM Specification 1.2.3.1.

b. The provisions of Technical Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

1.2.3.2 Dose Calculations Cumulative dose contributions for the current calendar quarter and current calendar year shall be determined in accordance with ODCM Section 3.2.3 at least once per 31 days.

1.2.4 Gaseous Effluents: Dose - Radioiodines, Tritium, and Radioactive Materials in Particulate Form.

CONTROLS

1.2.4.1 The dose to an individual from radioiodines, tritium, and radioactive materials in particulate form, and radionuclides (other than noble gases) with half-lives greater than 8 days in gaseous effluents including effluents from oil incineration (see Technical Specification Figure 5.1-3) shall be limited to the following:

a. During any calendar quarter: Less than or equal to 7.5 mrem to any organ.

b. During any calendar year: Less than or equal to 15 mrem to any organ.

c. Less than 0.1% of the limits in 1.2.4.1 (a) and (b) as a result of oil incineration.

APPLICABLE: At all times.

ACTION:

a. With the calculated dose from the release of tritium, radioiodines, and radioactive materials in particulate form with half lives greater than 8 days in gaseous effluents exceeding any of the above limits, in lieu of any other report required by ODCM Section 1.6, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report which identifies the cause(s) for exceeding the limit and defines the corrective actions to be taken to releases and the proposed actions to be taken to assure that subsequent release will be in compliance with ODCM Specification 1.2.4.1.

b. The provisions of Technical Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

1.2.4.2 Dose Calculations Cumulative dose contributions for the current calendar quarter and current calendar year shall be determined in accordance with ODCM Section 3.2.3 at least once per 31 days.

1.2.5 Gaseous Effluents: Gaseous Radwaste Treatment

CONTROLS

1.2.5.1 The GASEOUS RADWASTE TREATMENT SYSTEM and the VENTILATION EXHAUST TREATMENT SYSTEM shall be OPERABLE. The appropriate portions of the GASEOUS RADWASTE TREATMENT SYSTEM shall be used to reduce radioactive materials in gaseous waste prior to their discharge when the projected gaseous effluent air doses due to gaseous effluent releases from the site (See Technical Specification Figure 5.1-3), when averaged over 31 days, would exceed 0.2 mrad for gamma radiation and 0.4 mrad for beta radiation. The appropriate portions of the VENTILATION EXHAUST TREATMENT SYSTEM shall be used to reduce radioactive materials in gaseous waste prior to their discharge when the projected doses due to gaseous effluent releases from the site when averaged over 31 days would exceed 0.3 mrem to any organ.

APPLICABLE: At all times*.

ACTION:

a. With the GASEOUS RADWASTE TREATMENT SYSTEM and/or the VENTILATION EXHAUST TREATMENT SYSTEM inoperable for more than 31 days or with gaseous waste being discharged without treatment and in excess of the above limits, in lieu of any other report required by ODCM Section 1.6, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report which includes the following information:
   1. Identification of the inoperable equipment or subsystems and the reason for inoperability.
   2. Action(s) taken to restore the inoperable equipment to OPERABLE status.

*The Waste Gas System may be secured during refueling and defueled operations since there is no gas in the system to be removed and processed. The system is considered "inoperable" during these conditions due to the instrumentation being out of calibration when flow is stopped through the recombiner. This "inoperable" state is the normal system condition during refueling and defueled modes.

3. Summary description of action(s) taken to prevent a recurrence.

b. The provisions of Technical Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

1.2.5.2 Doses due to gaseous releases from the reactor shall be projected at least once per 31 days.

1.2.5.3 The GASEOUS RADWASTE TREATMENT SYSTEM and VENTILATION EXHAUST TREATMENT SYSTEM shall be demonstrated OPERABLE by operating the GASEOUS RADWASTE TREATMENT SYSTEM equipment and VENTILATION EXHAUST TREATMENT SYSTEM equipment for at least 30 minutes, at least once per 92 days unless the appropriate system has been utilized to process radioactive gaseous effluents during the previous 92 days.

1.3 RADIOACTIVE EFFLUENTS: TOTAL DOSE

CONTROLS

1.3.1 The dose or dose commitment to any member of the public, due to releases of radioactivity and radiation, from uranium fuel cycle sources shall be limited to less than or equal to 25 mrem to the total body or any organ (except the thyroid, which shall be limited to less than or equal to 75 mrem) over 12 consecutive months.

APPLICABLE: At all times.

ACTION:

a. With the calculated doses from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of ODCM Specification 1.1.3.1.a, 1.1.3.1.b, 1.2.3.1.a, 1.2.3.1.b, 1.2.4.1.a or 1.2.4.1.b, in lieu of any other report required and ODCM Section 1.6, prepare and submit to the Commission, within 30 days, pursuant to Technical Specification 6.9.2, a Special Report which defines the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the limits of ODCM Specification 1.3.1. This Special Report, defined in 10 CFR 20.2203(a)(4), shall include an analysis which estimates the radiation exposure (dose) to a member of the public from uranium fuel cycle sources (including all effluent pathways and direct radiation) for a 12 consecutive month period that includes the release(s) covered by this report. The report shall also describe levels of radiation and concentrations of radioactive material involved and the cause of the exposure levels or concentrations. If the estimated dose(s) exceeds the limits of ODCM Specification 1.3.1, and if the release condition resulting in violation of 40 CFR 190 has not already been corrected, the Special Report shall include a request for a variance in accordance with the provisions of 40 CFR 190 and including information of § 190.11 (b). Submittal of the report is considered a timely request, and a variance is granted until staff action on the request is complete. The variance only relates to the limits of 40 CFR 190, and does not apply in any way to the requirements for dose limitation of 10 CFR Part 20, as addressed in ODCM Specifications 1.1.2 and 1.2.2.

b. The provisions of Technical Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

1.3.2 Dose Calculations Cumulative dose contributions from liquid and gaseous effluents shall be determined in accordance with ODCM Specifications 1.1.3.2, 1.2.3.2 and 1.2.4.2.

1.4 RADIOLOGICAL ENVIRONMENTAL MONITORING

1.4.1 Monitoring Program

CONTROLS

1.4.1.1 The radiological environmental monitoring program shall be conducted as specified in Table 1.4-1.

APPLICABILITY: At all times.

ACTION:

a. With the radiological environmental monitoring program not being conducted as specified in Table 1.4-1 in lieu of any other report required by ODCM Section 1.6, prepare and submit to the Commission, in the Annual Radiological Environmental Operating Report, a description of the reasons for not conducting the program as required and the plans for preventing a recurrence.

b. With the level of radioactivity in an environmental sampling medium exceeding the reporting levels of Table 1.4-2 when averaged over any calendar quarter, in lieu of any other report required by ODCM Section 1.6, prepare and submit to the Commission within 30 days from the end of the affected calendar quarter a Special Report. When more than one of the radionuclides in Table 1.4-2 are detected in the sampling medium, this report shall be submitted if:

$$\frac{Concentration\ (1)}{Limit\ Level\ (1)} + \frac{Concentration\ (2)}{Limit\ Level\ (2)} + \ldots\ldots\ldots \geq 1.0$$

When radionuclides other than those in Table 1.4-2 are detected and are the result of plant effluents, this report shall be submitted if the potential annual dose to an individual is equal to or greater than the calendar year limits of ODCM Specifications 1.1.3.1, 1.2.3.1 and 1.2.4.1. This report is not required if the measured level of radioactivity was not the result of plant effluents; however, in such an event, the condition shall be reported and described in the Annual Radiological Environmental Operating Report.

c. With milk or fresh leafy vegetable samples permanently unavailable from one or more of the sample locations required by Table 1.4-1, in lieu of any other report required by ODCM Section 1.6 prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report which identifies the cause of the unavailability of samples and identifies locations for obtaining replacement samples. The locations from which samples were unavailable may then be deleted from those required by Table 1.4-1, provided the locations from which the replacement samples were obtained are added to the environmental monitoring program as replacement locations.

d. The provisions of Technical Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

1.4.1.2The radiological environmental monitoring samples shall be collected pursuant to Table 1.4-1 and shall be analyzed pursuant to the requirements of Tables 1.4-1 and 1.4-3.

Table 1.4-1 Radiological Environmental Monitoring Program
Virgil C. Summer Nuclear Station

Exposure Pathway and/or Sample	Minimum Number of Sample Locations and Criteria for Selection	Sampling and Collection Frequency	Type & Frequency of Analysis
AIRBORNE: I. Particulates	A) 3 Indicator samples to be taken at locations (in different sectors) beyond but as close to the exclusion boundary as practicable where the highest offsite sectorial ground level concentrations are anticipated.	Continuous sampler operation with weekly collection.	Gross beta following filter change; quarterly [6] composite (by location) for gamma isotopic.
	B) 1 Indicator sample to be taken in the sector beyond but as close to the exclusion boundary as practicable corresponding to the residence having the highest anticipated offsite ground level concentration or dose.	Continuous sampler operation with weekly collection.	Gross beta following filter change; quarterly [6] composite (by location) for gamma isotopic.
	C) 1 Indicator sample to be taken at the location of one of the dairies being sampled meeting the criteria of VII(A).[2]	Continuous sampler operation with weekly collection.	Gross beta following filter change; quarterly [6] composite (by location) for gamma isotopic.
	D) 1 Control sample to be taken at a location at least 10 air miles from the site and not in the most prevalent wind directions.	Continuous sampler operation with weekly collection.	Gross beta following filter change; quarterly [6] composite (by location) for gamma isotopic.
II. Radioiodine	A) 3 Indicator samples to be taken at two locations as given in I(A) above.	Continuous sampler operation with weekly canister collection.	Gamma isotopic for I-131 weekly.
	B) 1 Indicator sample to be taken at the location as given in I(B) above.	Continuous sampler operation with weekly canister collection.	Gamma isotopic for I-131 weekly.
	C) 1 Indicator sample to be taken at the location as given in I(C) above.	Continuous sampler operation with weekly canister collection.	Gamma isotopic for I-131 weekly.
	D) 1 Control sample to be taken at a location as given in I(D) above.	Continuous sampler operation with weekly canister collection.	Gamma isotopic for I-131 weekly.
III. Direct	A) 13 Indicator stations with two or more dosimeters to form an inner ring of stations in the 13 accessible sectors within 1 to 2 miles of the plant.	Monthly [5] or quarterly [6].	Gamma dose monthly [5] or quarterly [6]
	B) 16 Indicator stations with two or more dosimeters to form an outer ring of stations in the 16 accessible sectors within 3 to 5 miles of the plant.	Monthly [5] or quarterly [6].	Gamma dose monthly [5] or quarterly [6]
	C) 11 Stations with two or more dosimeters to be placed in special interest areas such as population centers, nearby residences, schools and in 4 or 5 areas to serve as control stations.	Monthly [5] or quarterly [6].	Gamma dose monthly [5] or quarterly [6]

Table 1.4-1 Radiological Environmental Monitoring Program
Virgil C. Summer Nuclear Station

Exposure Pathway and/or Sample	Minimum Number of Sample Locations and Criteria for Selection	Sampling and Collection Frequency	Type & Frequency of Analysis
WATERBORNE: IV. Surface Water	A) 1 Indicator sample downstream to be taken at a location which allows for mixing and dilution in the ultimate receiving river.	Time composite samples with collection every month. [5]	Gamma isotopic monthly [5] with quarterly [6] composite (by location) or monthly [5] sample to be analyzed for tritium.
	B) 1 Control sample to be taken at a location on the receiving river sufficiently far upstream such that no effects of pumped storage operation are anticipated.	Time composite samples with collection every month. [5]	Gamma isotopic monthly [5] with quarterly [6] composite (by location) or monthly [5] sample to be analyzed for tritium.
	C) 1 Indicator sample to be taken in the upper reservoir of the pumped storage facility in the plant discharge canal.	Time composite samples with collection every month. [5]	Gamma isotopic monthly [5] with quarterly [6] composite (by location) or monthly [5] sample to be analyzed for tritium.
V. Ground Water	A) 19 Indicator samples to be taken within the exclusion boundary and in the direction of potentially affected ground water supplies.	Quarterly [6] grab sampling.	Gamma isotopic and tritium analyses quarterly [6]
	B) 1 Control sample from unaffected location.	Quarterly [6] grab sampling.	Gamma isotopic and tritium analyses quarterly [6]
VI. Drinking Water	A) 1 Indicator sample from a nearby public ground water supply source.	Monthly [5] grab sampling.	Monthly [5] gamma isotopic and gross beta analyses and quarterly [6] composite for tritium analyses.
	B) 1 Indicator (finished water) sample from the nearest downstream water supply.	Monthly [5] composite sampling.	Monthly [5] gamma isotopic and gross beta analyses and quarterly [6] composite for tritium analyses.
	C) 1 Control (finish water) sample from the nearest unaffected public water supply.	Monthly [5] composite sampling.	Monthly [5] gamma isotopic and gross beta analyses and quarterly [6] composite for tritium analyses.

Table 1.4-1 Radiological Environmental Monitoring Program
Virgil C. Summer Nuclear Station

Exposure Pathway and/or Sample	Minimum Number of Sample Locations and Criteria for Selection	Sampling and Collection Frequency	Type & Frequency of Analysis
INGESTION: VII. Milk[2]	A) Samples from milking animals in 3 locations within 5 km distance having the highest dose potential. If there are none then 1 sample from milking animals in each of 3 areas between 5 to 8 km distance where doses are calculated to be greater than 1 mrem per year [1].	Semimonthly [4] when animals are on pasture, monthly [5] other times.	Gamma isotopic and I-131 analysis semimonthly [4] when animals are on pasture; monthly [5] at other times.
	B) 1 Control sample to be taken at the location of a dairy greater than 20 miles distance and not in the most prevalent wind direction.	Semimonthly [4] when animals are on pasture, monthly [5] other times [6].	Gamma isotopic and I-131 analysis semimonthly [4] when animals are on pasture; monthly [5] at other times.
	C) 1 Indicator grass (forage) sample to be taken at the location of one of the dairies being sampled meeting the criteria of VII(A), above, when animals are on pasture.	Monthly [5] when available.	Gamma isotopic.
	D) 1 Control grass (forage) sample to be taken at the location of VII(B) above.	Monthly [5] when available .[6]	Gamma isotopic.
VIII. Food Products	A) 2 samples of broadleaf vegetation grown in the 2 nearest offsite locations of highest calculated annual average ground level D/Q if milk sampling is not performed within 3 km or if milk sampling is not performed at a location within 5 to 8 km where the doses are calculated to be greater than 1 mrem/yr [1].	Monthly [5] when available.	Gamma Isotopic on edible portion.
	B) 1 Control sample for the same foods taken at a location at least 10 miles distance and not in the most prevalent wind direction if milk sampling is not performed within 3 km or if milk sampling is not at a location within 5 to 8 km where doses are calculated to be greater than 1 mrem/yr [1].	Monthly [5] when available.	Gamma Isotopic on edible portion.
IX. Fish	A) 1 Indicator sample to be taken at a location in the upper reservoir.	Semiannual [7] collection of the following specie types if available: bass; bream, crappie; catfish, carp.	Gamma isotopic on edible portions semiannually [7].
	B) 1 Indicator sample to be taken at a location in the lower reservoir.	Semiannual [7] collection of the following specie types if available: bass; bream, crappie; catfish, carp.	Gamma isotopic on edible portions semiannually [7].
	C) 1 Control sample to be taken at a location on the receiving river sufficiently far upstream such that no effects of pumped storage operation are anticipated.	Semiannual [7] collection of the following specie types if available: bass; bream, crappie; catfish, carp.	Gamma isotopic on edible portions semiannually [7].

Table 1.4-1 Radiological Environmental Monitoring Program
Virgil C. Summer Nuclear Station

Exposure Pathway and/or Sample	Minimum Number of Sample Locations and Criteria for Selection	Sampling and Collection Frequency	Type & Frequency of Analysis
AQUATIC: X. Sediment	A) 1 Indicator sample to be taken at a location in the upper reservoir.	Semiannual [7] grab sample.	Gamma isotopic.
	B) 1 Indicator sample to be taken on or near the shoreline of the lower reservoir.	Semiannual [7] grab sample.	Gamma isotopic.
	C) 1 Control sample to be taken at a location on the receiving river sufficiently far upstream such that no effects of pumped storage operation are anticipated.	Semiannual [7] grab sample.	Gamma isotopic.

Table 1.4-1 (Continued)
TABLE NOTATION

1. The dose shall be calculated for the maximum organ and age group, using the guidance/methodology contained in Regulatory Guide 1.109, Revision 1 and the parameters particular to the Site. The locations are selected based on potential for highest exposure.

2. Milking animal and garden survey results will be analyzed annually. Should the survey indicate new dairying activity, the owners shall be contacted with regard to a contract for supplying sufficient samples. If contractual arrangements can be made, Site(s) will be added for additional milk sampling up to a total of 3 Indicator Locations.

3. Time composite samples are samples which are collected with equipment capable of collecting an aliquot at time intervals which are short (e.g., hourly) relative to the compositing period.

4. At least once per 18 days.

5. Not to exceed 35 days.

6. At least once per 100 days

7. At least once per 200 days.

8. Milk and grass (forage) sampling at the control location is only required when locations meeting the criteria of VII(A) are being sampled.

NOTE: Deviations from this sampling schedule may occasionally be necessary if sample media are unobtainable due to hazardous conditions, seasonal unavailability, insufficient sample size, malfunctions of automatic sampling or analysis equipment and other legitimate reasons. If specimens are unobtainable due to sampling equipment malfunction, every effort shall be made to complete corrective action prior to the end of the next sampling period. Deviations from sampling analysis schedules will be described in the annual report.

Table 1.4-2

Reporting Levels for Radioactivity Concentrations in Environmental Samples

Analysis	Water (pCi/l)	Airborne Particulate or Gases (pCi/m^3)	Fish (pCi/Kg, wet)	Milk (pCi/l)	Food Products (pCi/Kg, wet)
H-3	20,000(a)	N.A.	N.A.	N.A.	N.A.
Mn-54	1,000	N.A.	30,000	N.A.	N.A.
Fe-59	400	N.A.	10,000	N.A.	N.A.
Co-58	1,000	N.A.	30,000	N.A.	N.A.
Co-60	300	N.A.	10,000	N.A.	N.A.
Zn-65	300	N.A.	10,000	N.A.	N.A.
Zr-95	400	N.A.	20,000	N.A.	N.A.
Nb-95	400	N.A.	20,000	N.A.	N.A.
I-131	2	0.9	N.A.	3	100
Cs-134	30	10	1,000	60	1,000
Cs-137	50	20	2,000	70	2,000
Ba-140	200	N.A.	N.A.	300	N.A.
La-140	200	N.A.	N.A.	300	N.A.

(a) For drinking water samples. This is the 40 CFR Part 141 value.

Table 1.4-3

Maximum Values for the Lower Limits of Detection (LLD)[a,c]

Analysis	Water (pCi/l)	Airborne Particulate or Gases (pCi/m^3)	Fish (pCi/Kg, wet)	Milk (pCi/l)	Food Products (pCi/Kg, wet)	Sediment (pCi/Kg, dry)
Gross Beta	4	1×10^{-2}	N.A.	N.A.	N.A.	N.A.
H-3	2000(b)	N.A.	N.A.	N.A.	N.A.	N.A.
Mn-54	15	N.A.	130	N.A.	N.A.	N.A.
Fe-59	30	N.A.	260	N.A.	N.A.	N.A.
Co-58	15	N.A.	130	N.A.	N.A.	N.A.
Co-60	15	N.A.	130	N.A.	N.A.	N.A.
Zn-65	30	N.A.	260	N.A.	N.A.	N.A.
Zr-95	30	N.A.	N.A.	N.A.	N.A.	N.A.
Nb-95	15	N.A.	N.A.	N.A.	N.A.	N.A.
I-131	1[b]	7×10^{-2}	N.A.	1	60	N.A
Cs-134	15	5×10^{-2}	130	15	60	150
Cs-137	18	6×10^{-2}	150	18	80	180
Ba-140	60	N.A.	N.A.	60	N.A.	N.A.
La-140	15	N.A.	N.A.	15	N.A.	N.A.

Table 1.4-3 (Continued)

TABLE NOTATION

a. Table 1.4-3 lists detection capabilities for radioactive materials in environmental samples. These detection capabilities are tabulated in terms of the lower limits of detection (LLDs). See Table 1.1-4 notation (a) for definition of LLD.

b. LLD for drinking water samples.

c. Other peaks potentially due to reactor operations (fission and activation products) which are measurable and identifiable, together with the radionuclides in Table 1.4-3, shall be identified and reported.

1.4.2 Land Use Census

CONTROLS

1.4.2.1A land use census shall be conducted and shall identify the location of the nearest milk animal, the nearest residence and the nearest garden* of greater than 500 square feet producing fresh leafy vegetables in each of the 16 meteorological sectors within a distance of five miles.

APPLICABILITY: At all times.

ACTION:

a. With a land use census identifying a location(s) which yields a calculated dose or dose commitment greater than the values currently being calculated in ODCM Specification 1.2.4.2, in lieu of any other report required by ODCM Section 1.6, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report which identifies the new location(s).

b. With a land use census identifying a location(s) which yields a calculated dose or dose commitment (via the same exposure pathway) 20 percent greater than at a location from which samples are currently being obtained in accordance with ODCM Specification 1.4.1.1, in lieu of any other report required by ODCM Section 1.6, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report which identifies the new location. The new location shall be added to the radiological environmental monitoring program within 30 days. The sampling location, excluding the control station location, having the lowest calculated dose or dose commitment (via the same exposure pathway) may be deleted from this monitoring program after October 31 of the year in which this land use census was conducted.

*Broad leaf vegetation sampling may be performed at the site boundary in the direction sector with the highest D/Q in lieu of the garden census.

c. The provisions of Technical Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

1.4.2.2The land use census shall be conducted at least once per 12 months between the dates of June 1 and October 1 using that information which will provide the best results, such as by a door-to-door survey, aerial survey, or by consulting local agriculture authorities.

1.4.3 Interlaboratory Comparison Program

CONTROLS

1.4.3.1 Analyses shall be performed on radioactive materials supplied by a National Institute of Standards and Technology traceable Laboratory as part of an Interlaboratory Comparison Program.

APPLICABILITY: At all times.

ACTION:

a. With analyses not being performed as required above, report the corrective actions taken to prevent a recurrence to the Commission in the Annual Radiological Environmental Operating Report.

b. The provisions of Technical Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

1.4.3.2 A summary of the results obtained as part of the above required Interlaboratory Comparison Program shall be included in the Annual Radiological Environmental Operating Report.

1.5 BASES

B/1.1 LIQUID EFFLUENTS

B/1.1.1 Radioactive Liquid Effluent Monitoring Instrumentation

The radioactive liquid effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in liquid effluents during actual or potential releases of liquid effluents. The alarm/trip setpoints for these instruments shall be calculated in accordance with the procedures in the ODCM to ensure that the alarm/trip will occur prior to exceeding 10 times the concentration levels specified in 10 CFR 20, Appendix B, Table 2, Column 2. The OPERABILITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63 and 64 of Appendix A to 10 CFR Part 50.

B/1.1.2 Concentration

This control is provided to ensure that concentration of radioactive materials released in liquid waste effluents from the site (see Technical Specification Figure 5.1-4) will be less than 10 times the concentration levels specified in 10 CFR Part 20, Appendix B, Table 2, Column 2. It provides operational flexibility for releasing liquid effluents in concentrations to follow the Section II.A design objectives of Appendix I to 10 CFR 50. This limitation provides additional assurance that the levels of radioactive materials in bodies of water outside the site will result in exposures within:

(1) the Section II.A design objectives of Appendix I, 10 CFR 50, to an individual and

(2) restrictions authorized by 10 CFR 20.1301 (e).

The concentration limit for dissolved or entrained noble gases is based upon the assumption that Xe-135 is the controlling radionuclide and its Effluent concentration in air (submersion) was converted to an equivalent concentration in water. This specification does not affect the requirement to comply with the annual limitations of 10 CFR 20.1301(a).

B/1.1.3 Dose

This control is provided to implement the requirements of Sections II.A, III.A and IV.A of Appendix I, 10 CFR Part 50. The CONTROLS

implement the guides set forth in Section II.A. of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in liquid effluents will be kept "as low as is reasonably achievable". Also, for fresh water sites with drinking water supplies which can be potentially affected by plant operations, there is reasonable assurance that the operation of the facility will not result in radionuclide concentrations in the finished drinking water that are in excess of the requirements of 40 CFR 141. The dose calculations in the ODCM implement the requirements in Section III.A of Appendix I that conformance with guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of an individual through appropriate pathways is unlikely to be substantially underestimated. The equations specified in the ODCM for calculating the doses due to the actual release rates of radioactive materials in liquid effluents are consistent with the methodology provided in NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants", section 4.3. NUREG-0133 implements Regulatory Guide 1.109, Revision 1, October 1977 (Section C.1 and Appendix A) and Regulatory Guide 1.113, April 1977. Regulatory Guide 1.109, October 1977, is titled "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I". Regulatory Guide 1.113, April 1977, is titled "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I".

B/1.1.4 Liquid Waste Treatment

The OPERABILITY of the liquid radwaste treatment system ensures that this system will be available for use whenever liquid effluents require treatment prior to release to the environment. The requirement that the appropriate portions of this system be used when specified provides assurance that the releases of radioactive materials in liquid effluents will be kept "as low as is reasonably achievable". This control implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50 and the design objective given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the liquid radwaste treatment system were specified as a suitable

fraction of the dose design objectives set forth in Section II.A of Appendix I, 10 CFR Part 50, for liquid effluents.

B/1.2 GASEOUS EFFLUENTS

B/1.2.1 Radioactive Gaseous Effluent Monitoring Instrumentation

The radioactive gaseous effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in gaseous effluents during actual or potential releases of gaseous effluents. The alarm/trip setpoints for these instruments shall be calculated in accordance with the procedures in the ODCM to ensure that the alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20. The OPERABILITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63 and 64 of Appendix A to 10 CFR Part 50.

B/1.2.2 Dose Rate

This control along with controls 1.2.3 and 1.2.4 provide reasonable assurance that radioactive material discharged in gaseous effluents, including radioactive effluent resulting from oil incineration, will not result in the exposure of a member of the public in an unrestricted area, either at or beyond the site boundary in excess of the design objectives of Appendix I to 10 CFR 50. This control is provided to ensure that gaseous effluent from all units on the site will be appropriately controlled yet provides operational flexibility for releasing gaseous effluents to satisfy the section II.B and II.C design objectives of Appendix I to 10 CFR 50.

The restrictions of Control 1.2.3 along with limited occupancy times for a member of the public within the site boundary are sufficient to control exposure to gaseous effluent within 10 CFR 20, Appendix B, Table 2, Column 1 effluent concentrations.

The specified release rate limits restrict, at all times, the corresponding gamma and beta dose rates above background to an individual at or beyond the site boundary to less than or equal to 500 mrem/year to the total body or to less than or equal 3000 mrem/year to the skin. These release rate limits also restrict, at all times, the corresponding thyroid dose rate above

background to a child via the inhalation pathway to less than or equal to 1500 mrem/year.

This control does not affect the requirement to comply with the annual limitations of 10 CFR 20.1301(a).

B/1.2.3 Dose - Noble Gases

This control is provided to implement the requirements of Sections II.B, III.A and IV.A of Appendix I, 10 CFR Part 50. The CONTROLS implement the guides set forth in Section II.B of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the release of radioactive material in gaseous effluents will be kept "as low as is reasonably achievable". The Surveillance Requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of an individual through appropriate pathways is unlikely to be substantially underestimated. The dose calculations established in the ODCM for calculating the doses due to the actual release rates of radioactive noble gases in gaseous effluents are consistent with the methodology provided in NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants", section 5.3. NUREG-0133 implements Regulatory Guide 1.109, Revision 1, October 1977 and Regulatory Guide 1.111, Revision 1, July 1977. Regulatory Guide 1.109 is entitled "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I, "Revision 1, October 1977 and Regulatory Guide 1.111 is entitled "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water Cooled Reactors", Revision 1, July 1977. The ODCM equations provided for determining the air doses at the site boundary are based upon the historical average atmospheric conditions.

This control applies to the release of gaseous effluents from all reactors at the site and from the incineration of oil.

B/1.2.4 Dose-Radioiodines, Tritium and Radioactive Materials in Particulate Form

This control is provided to implement the requirements of Sections II.C, III.A and IV.A of Appendix I, 10 CFR Part 50. The Limiting Conditions for Operation are the guides set forth in Section II.C of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A Appendix I to assure that the releases of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable". The ODCM calculational methods specified in the Surveillance Requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of an individual through appropriate pathways in unlikely to be substantially underestimated. The ODCM calculational methods for calculating the doses due to the actual release rates of the subject materials are consistent with the methodology provided in NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants", section 5.3. NUREG-0133 implements Regulatory Guide 1.109, Revision 1, October 1977 and Regulatory Guide 1.111, Revision 1, July 1977. Regulatory Guide 1.109 is entitled "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix ", Revision 1, October 1977 and Regulatory Guide 1.111 is entitled "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors", Revision 1, July 1977. These equations also provide for determining the actual doses based upon the historical average atmospheric conditions. The release rate controls for radioiodines, tritium, and radioactive materials in particulate form are dependent on the existing radionuclide pathways to man, in the unrestricted area. The pathways which were examined in the development of these calculations were: 1) individual inhalation of airborne radionuclides, 2) deposition of radionuclides onto green leafy vegetation with subsequent consumption by man, 3) deposition onto grassy areas where milk animals and meat producing animals graze with consumption of the milk and meat by man and 4) deposition on the ground with subsequent exposure of man.

This specification applies to the release of gaseous effluents from all reactors at the site and from the incineration of oil.

B/1.2.5 Gaseous Radwaste Treatment

The OPERABILITY of the GASEOUS RADWASTE TREATMENT SYSTEM and the VENTILATION EXHAUST TREATMENT SYSTEM ensures that the systems will be available for use whenever gaseous effluents require treatment prior to release to the environment. The requirement that the appropriate portions of these systems be used, when specified, provides reasonable assurance that the releases of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable". This specification implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50, and the design objectives given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the systems were specified as a suitable fraction of the dose design objectives set forth in Sections II.B and II.C of Appendix I, 10 CFR Part 50, for gaseous effluents.

B/1.3 RADIOACTIVE EFFLUENTS: TOTAL DOSE

The control is provided to meet the dose limitations of 40 CFR 190 which have been incorporated into 10 CFR 20.1301(d). The specification requires the preparation and submittal of a Special Report whenever the calculated doses from plant radioactive effluents exceed twice the design objective doses of Appendix I. For sites containing up to 4 reactors, it is highly unlikely that the resultant dose to a member of the public will exceed the dose limits of 40 CFR 190 if the individual reactors remain within twice the 10 CFR 50 Appendix I dose design objectives and if direct radiation doses from the units (including outside storage tanks, etc.) are kept small.

The Special Report will describe a course of action which should result in the limitation of dose to a member of the public for 12 consecutive months to within the 40 CFR 190 limits. For the purposes of the Special Report, it may be assumed that the dose commitment to the member of the public from other uranium fuel cycle sources is negligible, with the exception that dose contributions from other nuclear fuel cycle facilities at the same site or within a radius of 5 miles must be considered. If the dose to any member of

the public is estimated to exceed the requirements of 40 CFR 190, the Special Report with a request for a variance (provided the release conditions resulting in violation of 40 CFR 190 have not already been corrected), in accordance with the provisions of 40 CFR 190.11, is considered to be a timely request and fulfills the requirements of 40 CFR 190 until NRC staff action is completed. The variance only relates to the limits of 40 CFR 190 and does not apply in any way to other dose requirements for dose limitation of 10 CFR 20, as addressed in ODCM Controls 1.1.2.1 and 1.2.2.1. An individual is not considered a member of the public during any period in which he/she is engaged in carrying out any operation which is part of the nuclear fuel cycle.

Demonstration of compliance with the limits of 40 CFR 190 or with the design objectives of Appendix I to 10 CFR 50 will be considered to demonstrate compliance with the 0.1 rem limit of 10 CFR 20.1301.

B/1.4.1 Monitoring Program

The radiological monitoring program required by this control provides measurements of radiation of radioactive materials in those exposure pathways and for those radionuclides, which lead to the highest potential radiation exposures of individuals resulting from the station operation. This monitoring program thereby supplements the radiological effluent monitoring program by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and modeling of the environmental exposure pathways. The initially specified monitoring program will be effective for at least the first three years of commercial operation. Following this period, program changes may be initiated based on operational experience.

The detection capabilities required by Table 1.4-3 are state-of-the-art for routine environmental measurements in industrial laboratories. It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as a posteriori (after the fact) limit for a particular measurement. Analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occasionally background fluctuations, unavoidably small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLDs unachievable. In such cases, the contributing factors will be identified and described in the Annual Radiological Environmental Operating Report.

B/1.4.2 Land Use Census

This control is provided to ensure that changes in the use of unrestricted areas are identified and that modifications to the monitoring program are made if required by the results of this census. The best survey information from the door-to-door, aerial or consulting with local agricultural authorities shall be used. This census satisfies the requirements of Section IV.B.3 of Appendix I to 10 CFR Part 50. Restricting the census to gardens of greater than 500 square feet provides assurance that significant exposure pathways via leafy vegetables will be identified and monitored since a garden of this size is the minimum required to produce the quantity (26 kg/year) of leafy vegetables assumed in Regulatory Guide 1.109 for consumption by a child. To determine this minimum garden size, the following assumptions were used, 1) that 20% of the garden was used for growing broad leaf vegetation (i.e., similar to lettuce and cabbage), and 2) a vegetation yield of 2 kg/square meter.

B/1.4.3 Interlaboratory Comparison Program

The requirement for participation in an Interlaboratory Comparison Program is provided to ensure that independent checks on the precision and accuracy of the measurements of radioactive material in environmental sample matrices are performed as part of the quality assurance program for environmental monitoring in order to demonstrate that the results are reasonably valid.

1.6 REPORTING REQUIREMENTS

1.6.1 Annual Radiological Environmental Operating Report

1.6.1.1 Routine radiological environmental operating reports covering the operation of the unit during the previous calendar year shall be submitted prior to May 1 of each year. The initial report shall be submitted prior to May 1 of the year following initial criticality.

1.6.1.2 The Annual Radiological Environmental Operating Report shall include summaries, interpretations, and an analysis of trends of the results of the radiological environmental surveillance activities for the report period, including a comparison with preoperational studies, operational controls (as appropriate), and previous environmental surveillance reports and an assessment of the observed impacts of the plant operation on the environment. The reports shall also include the results of land use censuses required by ODCM Specification 1.4.2.1. If harmful effects or evidence of irreversible damage are detected by the monitoring, the report shall provide an analysis of the problem and a planned course of action to alleviate the problem.

The Annual Radiological Environmental Operating Report shall include summarized and tabulated results in the format of Regulatory Guide 4.8, December 1975 of all radiological environmental samples taken during the report period. In the event that some results are not available for inclusion with the report, the report shall be submitted noting and explaining the reasons for missing results. The missing data shall be submitted as soon as possible in a supplementary report.

The report shall also include the following: a summary description of the radiological environmental monitoring program; a map of all sampling locations keyed to a table giving distances and directions from one reactor; and the results of licensee participation in the Interlaboratory Comparison Program, required by ODCM Specification 1.4.3.1.

1.6.2 Annual Radioactive Effluent Release Report

1.6.2.1A radioactive effluent release report covering the operation of the unit during the previous year of operation shall be submitted prior to May 1 of each year. The period of the first report shall begin with the date of initial criticality.

1.6.2.2The Radioactive Effluent Release Report shall include a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the unit as outlined in Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants", Revision 1, June 1974, with data summarized on a quarterly basis following the format of Appendix B thereof. The summary will also include quantities of radioactive gaseous effluent and solid waste (ash) released as a result of on-site oil incineration.

The Radioactive Effluent Release Report shall include an annual summary of hourly meteorological data collected over the previous year. This annual summary may be either in the form of an hour-by-hour listing of wind speed, wind direction, and atmospheric stability, and precipitation (if measured) on magnetic tape, or in the form of joint frequency distributions of wind speed, wind direction, and atmospheric stability. This same report shall include an assessment of the radiation doses due to the radioactive liquid and gaseous effluents released from the unit or station and oil incinerator during the previous calendar year. This same report shall also include an assessment of the radiation doses from radioactive liquid and gaseous effluents to members of the public due to their activities inside the site boundary (Figures 5.1-3 and 5.1-4 of the VCSNS Technical Specifications) during the year. All assumptions used in making these assessments (i.e., specific activity, exposure time and location) shall be included in these reports. Historical annual average meteorology or meteorological conditions concurrent with the time of release of radioactive materials in gaseous effluents (as determined by sampling frequency and measurement) shall be used for determining the gaseous pathway doses. The assessment of radiation doses shall be performed in accordance with the OFFSITE DOSE CALCULATION MANUAL (ODCM).

The Radioactive Effluent Release Report shall also include an assessment of radiation doses to the likely most exposed member of the public from reactor releases and other nearby uranium fuel cycle sources (including doses from primary effluent pathways and direct radiation) for the previous 12 consecutive months to show conformance with 40 CFR 190, Environmental Radiation Protection Standards for Nuclear Power Operation. Acceptable methods for calculating the dose contribution from liquid and gaseous effluents are given in Regulatory Guide 1.109, Rev. 1.

The Radioactive Effluent Release Report shall include unplanned releases from site to unrestricted areas of radioactive materials in gaseous and liquid effluents on a quarterly basis.

The Radioactive Effluent Release Report shall also include the following: an explanation as to why the inoperability of liquid or gaseous effluent monitoring instrumentation was not corrected within the time specified in ODCM Specifications 1.1.1.1 and 1.2.1.1, respectively.

1.6.3 Major Changes To Radioactive Waste Treatment Systems (Liquid and Gaseous)

1.6.3.1 Licensee initiated major changes to the radioactive waste systems (liquid and gaseous):

1. Shall be reported to the Commission in the Monthly Operating Report for the period in which the evaluation was reviewed by the Plant Safety Review Committee. The discussion of each change shall contain:
   a. A summary of the evaluation that led to the determination that the change could be made in accordance with 10 CFR 50.59.
   b. Sufficient detailed information to totally support the reason for the change without benefit of additional or supplemental information.
   c. A detailed description of the equipment, components and processes involved and the interfaces with other plant systems.
   d. An evaluation of the change which shows the predicted releases or radioactive materials in liquid and gaseous effluents that differs from those previously predicted in the license application and amendments thereto.
   e. An evaluation of the change which shows the expected maximum exposures to individual in the unrestricted area and to the general population that differ from those previously estimated in the license application and amendments thereto.
   f. A comparison of the predicted releases of radioactive materials, in liquid and gaseous effluents, to the actual releases for the period prior to when the changes are to be made.
   g. An estimate of the exposure to plant operating personnel as a result of the change.
   h. Documentation of the fact that the change was reviewed and found acceptable by the PSRC.
2. Shall become effective upon review and acceptance as set forth in Technical Specification 6.5.

1.6.4 V. C. Summer Groundwater Protection Program

1.6.4.1 The NEI Industry Groundwater Protection Initiative was established to address operating experience with groundwater contamination at several nuclear power stations.

1.6.4.2 The following criteria have been established to require notification of the NRC and South Carolina Department of Health and Environmental Control (SCDHEC).

1. A radioactive leak or spill that exceeds 100 gallons or of an unknown volume.

2. All leaks, regardless of volume or activity from a high risk system or component (e.g. spent fuel pool or outdoor refueling water storage tank) and can potentially get into groundwater

3. A water sample from offsite groundwater or surface water which exceeds the reporting criterion of Table 1.4-2.

4. A water sample from an onsite groundwater monitoring well or surface water that is hydrologically connected to groundwater that exceeds the reporting criterion of Table 1.4-2.

1.6.4.3 If any of the above criteria are met, a telephone notification of the NRC and SCDHEC shall be made in accordance with plant procedures.

1.6.4.4 Prepare and submit a written report to the Commission within 30 days.

1.6.4.5 A description of any spill or leak will be included in the Annual Radioactive Effluent Release Report

1.6.4.6 A description of any sample exceeding the reporting criteria of Table 1.4-2 will be included in the Annual Radiological Environmental Operating Report.

1.7 Definitions

ACTION

1.7.1 ACTION shall be that part of a specification which prescribes measures required under designated conditions.

ANALOG CHANNEL OPERATIONAL TEST

1.7.2 An ANALOG CHANNEL OPERATIONAL TEST shall be the injection of a simulated signal into the channel as close to the sensor as practicable to verify OPERABILITY of alarm, interlock and/or trip functions. The ANALOG CHANNEL OPERATIONAL TEST shall include adjustments, as necessary, of the alarm, interlock and/or trip setpoints such that the setpoints are within the required range and accuracy.

CHANNEL CALIBRATION

1.7.3 A CHANNEL CALIBRATION shall be the adjustment, as necessary, of the channel such that it responds within the required range and accuracy to known values of input. The CHANNEL CALIBRATION shall encompass the entire channel including the sensors and alarm, interlock and/or trip functions, and may be performed by any series of sequential, overlapping or total channel steps such that the entire channel is calibrated.

CHANNEL CHECK

1.7.4 A CHANNEL CHECKS shall be the qualitative assessment of channel behavior during operation by observation. This determination shall include, where possible, comparison of the channel indication and/or status with other indications and/or status derived from independent instrument channels measuring the same parameter.

GASEOUS RADWASTE TREATMENT SYSTEM

1.7.5 A GASEOUS RADWASTE TREATMENT SYSTEM is any system designed and installed to reduce radioactive gaseous effluents by collecting primary coolant system off gases from the primary system and providing for delay or holdup for the purpose of reducing the total radioactivity prior to release to the environment.

OPERABLE - OPERABILITY

1.7.6 A system, subsystem, train, component or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified function(s), and when all necessary attendant instrumentation, controls, electrical power, cooling or seal water, lubrication or other auxiliary equipment that are required for the system, subsystem, train, component or device to perform its function(s) are also capable of performing their related support function(s).

SOURCE CHECK

1.7.7 A SOURCE CHECK shall be the qualitative assessment of channel response when the channel sensor is exposed to a radioactive source.

VENTILATION EXHAUST TREATMENT SYSTEM

1.7.8 A VENTILATION EXHAUST TREATMENT SYSTEM is any system designed and installed to reduce gaseous radioiodine or radioactive material in particulate form in effluents by passing ventilation or vent exhaust gases through charcoal absorbers and/or HEPA filters for the purpose of removing iodines or particulates from the gaseous exhaust stream prior to the release to the environment (such a system is not considered to have any effect on noble gas effluents). Engineered Safety Feature (ESF) atmospheric cleanup systems are not considered to be VENTILATION EXHAUST TREATMENT SYSTEM components.

2.0 LIQUID EFFLUENT

2.1 Liquid Effluent Monitor Setpoint Calculation

The Virgil C. Summer Nuclear Station is located on the Monticello Reservoir which provides supply and discharge for the plant circulating water. This reservoir also provides supply and discharge capacity for the Fairfield Pumped Storage Facility. The Parr Reservoir located below the pumped storage facility is formed by the Parr Dam.

There are two analyzed release pathways and sources of dilution for liquid effluents: the circulating water discharge canal and the liquid effluent line to the penstocks of the pumped storage facility. All liquid effluent pathways discharge to one of these release points. Generally speaking, very low concentrations of radioactive waste are discharged to the circulating water discharge while higher concentrations of radioactive waste are released to the penstocks of the pumped storage facility during the generation cycle.

The calculated setpoint values will be regarded as upper bounds for the actual setpoint adjustments. That is, setpoint adjustments are not required to be performed if the existing setpoint level corresponds to a lower count rate than the calculated value. Setpoints may be established at values lower than the calculated values, if desired.

Calculated monitor setpoints may be added to the ambient background count rate.

GENERAL NOTE: If no discharge is planned for a specific pathway or if the sum of the effluent concentrations of gamma emitting nuclides equals zero, the monitor setpoint should be established as close to background as practical to prevent spurious alarms and yet alarm should an inadvertent release occur.

2.1.1 Liquid Effluent Monitor Setpoint Calculation Parameters

Term		Definition*	Section of Initial Use
A	=	Penstock discharge adjustment factor which will allow the set point to be established in a convenient manner and to prevent spurious alarms. $= f_t/f_{dx}$	2.1.2
B	=	Steam Generator Blowdown adjustment factor which will allow the set point to be established in a convenient manner and to prevent spurious alarms. $= f_d/f_{ds}$	2.1.4.1
C_{ECL}	=	the effluent concentration limit (ODCM Control 1.1.2.1) implementing 10 CFR 20 for the site, in μCi/ml.	2.1.2
C_a	=	the effluent concentration of alpha emitting nuclides observed by gross alpha analysis of the monthly composite sample, in μCi/ml.	2.1.2
C_f	=	the measured concentration of Fe-55 in liquid waste as determined by analysis of the most recent available quarterly composite sample, in μCi/ml.	2.1.2
C_g	=	the effluent concentration of a gamma emitting nuclide, g, observed by gamma-ray spectroscopy of the waste sample, in μCi/ml.	2.1.2
C_i	=	the concentration of nuclide i, in μCi/ml, as determined by the analysis of the waste sample.	2.1.2
C_{ir}	=	the concentration of radionuclide i, in μCi/ml, in the Monticello Reservoir. Inclusion of this term will correct for possible long-term buildup of radioactivity due to recirculation and for the presence of activity recently released to the Monticello Reservoir by plant activities.	2.1.2
C_s	=	the concentration of Sr-89 or Sr-90 in liquid wastes as determined by analysis of the quarterly composite sample, in μCi/ml.	2.1.2
C_t	=	the measured concentration of H-3 in liquid waste as determined by analysis of the monthly composite, in μCi/ml.	2.1.2
c	=	the setpoint, in μCi/ml, of the radioactivity monitor measuring the radioactivity concentration in the effluent line prior to dilution and subsequent release. This setpoint which is proportional to the volumetric flow to the effluent line and inversely proportional to the volumetric flow of the dilution stream plus the effluent stream, represents a value which, if exceeded, would result in concentrations exceeding the limits of 10 CFR 20 in the unrestricted area.	2.1.2

*All concentrations are in units of μCi/ml unless otherwise noted.

Term		Definition	Section of Initial Use
c_B	=	the monitor setpoint concentration for RM-L7, the Nuclear Blowdown Monitor Tank discharge line monitor, in μCi/ml.	2.1.2.2
c_C	=	the monitor setpoint concentration for RM-L9, the combined Liquid Waste Processing System and Nuclear Blowdown System effluent discharge line monitor, in μCi/ml.	2.1.2.3
c_D	=	the monitor setpoint concentration for RM-L11, the Condensate Demineralizer Backwash discharge line monitor, in μCi/ml.	2.1.4.2.2
c_M	=	the monitor setpoint concentration for RM-L5, the Waste Monitor Tank discharge line monitor, in μCi/ml.	2.1.2.1
c_{Sa}	=	the monitor setpoint concentration for RM-L3, the initial Steam Generator Blowdown Effluent line monitor, in μCi/ml.	2.1.4.1.1
c_{Sb}	=	the monitor setpoint concentration for RM-L10, the final Steam Generator Blowdown Effluent line monitor, in μCi/ml.	2.1.4.1.1
c_T	=	the monitor setpoint concentration for RM-L8, the Turbine Building Sump Effluent line monitor, in μCi/ml.	2.1.4.2.1
CF_D	=	the Condensate Demineralize Backwash Effluent Concentration Factor.	2.1.4.2
CF_S	=	the Steam Generator Blowdown Effluent Concentration Factor.	2.1.4.3
CF_T	=	the Turbine Building Sump Effluent Concentration Factor.	2.1.4.2
DF	=	the dilution factor, which is the ratio of the total dilution flow rate to the effluent stream flow rate(s).	2.1.2
F	=	the dilution water flow setpoint as determined prior to the release, in volume per unit time.	2.1.2
F_d	=	the flow rate of the Circulating Water System during the time of release of the Turbine Building Sump and/or the Steam Generator Blowdown, in volume per unit time.	2.1.4.1
F_{dc}	=	the dilution flow rate of the Circulating Water System used for effluent monitor setpoint calculations, based on 90 percent of expected Circulating Water System flow rate during the time of release and corrected for recirculated Monticello Reservoir activity, in volume per unit time.	2.1.4.1
F_{dp}	=	the dilution flow rate through the penstock(s) receiving the radioactive liquid release upon which the effluent monitor setpoint is based, as corrected for any recirculated radioactivity, in volume per unit time.	2.1.2
F_k	=	The near field dilution factor for C_i during release from Turbine Building sump.	2.1.4.4.1
F_t	=	the flow rate of water through the Fairfield Pumped Storage Station penstock(s) to which radioactive liquids are being discharged during the period of effluent release. This flow rate is dependent upon operational status of Fairfield Pumped Storage Station, in volume per unit time.	2.1.2
f	=	the effluent line flow setpoint as determined for the radiation monitor location, in volume per unit time.	2.1.2

Term		Definition	Section of Initial Use
f_d	=	the maximum permissible discharge flow rate for releases to the Circulating Water, in volume per unit time.	2.1.4.1
f_{db}*	=	the flow rate of the Nuclear Blowdown Monitor Tank discharge, in volume per unit time.	2.1.2
f_{dm}*	=	the flow rate of a Waste Monitor Tank discharge, in volume per unit time.	2.1.2
f_{ds}*	=	the flow rate of the Steam Generator Blowdown discharge, in volume per unit time.	2.1.4.1
f_{dx}	=	the flow rate of the tank discharge, either f_{dm} or f_{db}, in volume per unit time.	2.1.2
f_r	=	the recirculation flow rate used to mix the contents of a tank, in volume per unit time.	2.1.2
f_t	=	the maximum permissible discharge flow rate for batch releases to the penstocks, in volume per unit time.	2.1.2
ECL_i	=	ECL_g, ECL_a, ECL_s, ECL_f, and ECL_t = the limiting concentrations of the appropriate gamma emitting, alpha emitting, and strontium radionuclides, Fe-55, and tritium, respectively, from 10 CFR, Part 20, Appendix B, Table 2, Column 2.	2.1.2
SF	=	the safety factor, a conservative factor used to compensate for engineering and measurement uncertainties. SF = 0.5, corresponding to a 100 percent variation.	2.1.2
$[C_i]_{LLD}$	=	the Lower Limit of Detection (LLD) for radionuclide i in liquid waste in the Waste Monitor Tank, as determined by the analysis required in ODCM Table 1.1-4, in μCi/ml.	2.1.3
$[C_i]_M$	=	the concentration of radionuclide i in the waste contained within the Waste Monitor Tank serving as the holding facility for sampling and analysis prior to discharge, in μCi/ml.	2.1.3
$\sum_g C_g$	=	the sum of the concentrations Cg of each measured gamma emitting nuclide observed by gamma-ray spectroscopy of the waste sample, in μCi/ml.	2.1.2
$\left[\sum_g C_g\right]_B$	=	the gamma isotopic concentrations of the Nuclear Blowdown Monitor Tank as obtained from the sum of the measured concentrations determined by the analysis required in ODCM Table 1.1-4, in μCi/ml.	2.1.2

* (Conservatively this value will be either zero, if no release is to be conducted from this system, or the maximum measured capacity of the discharge pump if a release is to be conducted.)

Term		Definition	Section of Initial Use
$\left[\sum_g C_g\right]_D$	=	the gamma isotopic concentrations of the Condensate Demineralizer Backwash effluent (including solids) as obtained from the sum of the measured concentrations determined by the analysis required in ODCM Table 1.1-4, in μCi/ml.	2.1.4.2.2
$\left[\sum_g C_g\right]_M$	=	the gamma isotopic concentrations of the Waste Monitor Tank as obtained from the sum of the measured concentrations determined by the analysis required in ODCM Table 1.1-4, in μCi/ml.	2.1.2
$\left[\sum_g C_g\right]_S$	=	the gamma isotopic concentrations of the Steam Generator Blowdown as obtained from the sum of the measured concentrations determined by the analysis required in ODCM Table 1.1-4, in μCi/ml.	2.1.4.1.1
$\left[\sum_g C_g\right]_T$	=	the gamma isotopic concentrations of the Turbine Building Sump as obtained from the sum of the measured concentrations determined by the analysis required in ODCM Table 1.1-4, in μCi/ml.	2.1.4.2.1
t_r	=	the minimum time for recirculating the contents of a tank prior to sampling, in minutes.	2.1.2
V	=	the volume of liquid in a tank to be sampled, in gallons.	2.1.2
V_j	=	release volume for Turbine Building sump release permit $_j$, in gallons.	2.1.4.4.1

2.1.2 Liquid Radwaste Effluent Line Monitors

(RM-L5, RM-L7, RM-L9)

Liquid Radwaste Effluent Line Monitors provide alarm and automatic termination of release functions prior to exceeding 10 times the concentration limits specified in 10 CFR 20, Appendix B, Table 2, Column 2 at the release point to the unrestricted area. To meet this specification, the alarm/trip setpoints for liquid effluent monitors and flow measurement devices are set to assure that the following equation is satisfied:

$$10C_{ECL} \geq \frac{cf}{F+f} \qquad (1)$$

where:

C_{ECL} = the effluent concentration limit specified in 10 CFR 20 Appendix B, Table 2, Column 2. Note that Control 1.1.2.1 limits release concentrations to 10 times the Appendix B, Table 2, Column 2 values.

c = the setpoint, in μCi/ml, of the radioactivity monitor measuring the radioactivity concentration in the effluent line prior to dilution and subsequent release; the setpoint, which is inversely proportional to the volumetric flow of the effluent line and proportional to the volumetric flow of the dilution stream plus the effluent stream, represents a value which, if exceeded, would result in concentrations exceeding 10 times the effluent concentrations of 10 CFR 20 in the unrestricted area.

F = the dilution water flow setpoint as determined prior to the release point, in volume per unit time.

f = the effluent line flow setpoint as determined at the radiation monitor location, in volume per unit time.

At the Virgil C. Summer Nuclear Station the Liquid Waste Processing System (LWPS) and the Nuclear Blowdown System (NBS) both discharge to the penstocks of the Fairfield Pumped Storage (FPS) Facility through a

common line. The available dilution water flow (F_{dp}) is assumed to be 90 percent of the flow through the FPS penstock(s) to which liquid effluent is being discharged and is dependent upon operational status of the FPS Facility. The waste tank flow rates (f_{dm} and f_{db}) and the monitor setpoints (c_M, c_B and c_C) are set to meet the condition of equation (1) for a given effluent concentration, C. The three monitor setpoints are determined in accordance with the monitor system configuration for this discharge pathway. The LWPS discharges through RM-L5, which has setpoint c_M for alarm/control functions over releases from either Waste Monitor Tanks 1 or 2. The Nuclear Blowdown discharges through RM-L7, which has setpoint c_B for alarm/ control functions over releases from the Nuclear Blowdown Monitor Tank. These two release pathways merge into a common line monitored by RM-L9, which has setpoint c_C for control functions over the common effluent line. Although the piping is arranged so that simultaneous batch releases from the two systems could be practiced, operational releases shall be from only one of the two batch systems at any given time. The method by which their setpoints are determined is as follows:

1) The isotopic concentration for a waste tank to be released is obtained from the sum of the measured concentrations as determined by the analysis required in Table 1.1-4:

$$\sum_i C_i = \sum_g C_g + C_a + C_s + C_t + C_f \qquad (2)$$

where:

C_i = the concentration of nuclide i, in μCi/ml, as determined by the analysis of the waste sample.*

$\sum_g C_g$ = the sum of the concentrations C_g of each measured gamma emitting nuclide observed by gamma-ray spectroscopy of the waste sample, in μCi/ml.

---

* Values for C_a, C_s, C_t and C_f will be based on most recent available composite sample analyses as required by Table 1.14.

C_a^* = the effluent concentration of alpha emitting nuclides observed by gross alpha analysis of the monthly composite sample, in μCi/ml.

C_s^* = the concentration of Sr-89 and Sr-90 in liquid waste as determined by analysis of the quarterly composite sample, in μCi/ml.

C_t^* = the measured concentration of H-3 in liquid waste as determined by analysis of the monthly composite sample, in μCi/ml.

C_f^* = the measured concentration of Fe55 in liquid waste as determined by analysis of the quarterly composite sample, in μCi/ml.

The C_g term will be included in the analysis of each batch; terms for alpha, strontium, Fe-55, and tritium shall be included as appropriate*. Isotopic concentrations for both the Waste Monitor Tanks (WMT) and the Nuclear Blowdown Monitor Tank (NBMT) may be calculated using equation (2).

Prior to being sampled for analysis, the contents of a tank shall be isolated and recirculated. The minimum recirculation time shall be:

$$t_r = 2V/f_r \qquad (3)$$

t_r = the minimum time for recirculating the contents of a tank prior to sampling.

V = the volume of liquid in the tank to be sampled.

f_r = the recirculation flow rate used to mix the contents of a tank.

This is done to ensure that a representative sample will be obtained. Mechanical mixers shall ensure a similar minimum turnover.

*Based on most recent available composite sample analysis as required by Table 1.1-4.

2) Once isotopic concentrations for either Waste Monitor Tank or the Nuclear Blowdown Monitor Tank have been determined, these values are used to calculate a Dilution Factor, DF, which is the ratio of dilution flow rate to tank flow rate(s) required to assure that 10 times the limiting concentration of 10 CFR 20, Appendix B, Table 2, Column 2 are met at the point of discharge for whichever tank is having its contents discharged.

$$DF = \left[\sum_i \frac{C_i}{10\,(E\,CL)_i} \right]_X \div SF \qquad (4)$$

(5)

$$DF = \left[\sum_g \frac{C_g}{10\,(E\,CL)_g} + \left[\frac{C_a}{10\,(E\,CL)_a} + \frac{C_s}{10\,(E\,CL)_s} + \frac{C_f}{10\,(E\,CL)_f} + \frac{C_t}{10\,(E\,CL)_t} \right] \right]_X \div SF$$

where:

$\left[\sum \frac{C_i}{10(ECL)_i} \right]_X$ = the sum of the ratios of the measured concentration of nuclide i to 10 times its limiting ECL value for the tank whose contents are being considered for release. For a WMT, X = M. For the NBMT, X = B.

ECL_i = ECL_g, ECL_a, ECL_s, ECL_f, and ECL_t, = effluent concentration limits of the appropriate gamma emitting, alpha emitting, and strontium radionuclides, Fe-55, and tritium, respectively, given in 10 CFR, Part 20, Appendix B, Table 2, Column 2.

SF = the safety factor; a conservative factor used to compensate for engineering and measurement uncertainties.

= 0.5, Corresponding to a 100 percent variation.

3) The maximum permissible discharge flow rate, f_t, may be calculated for the release of either the WMT or NBMT. First the appropriate Dilution Factor is calculated by applying equation (4), using the appropriate concentration ratio term (i.e. M or B).

Then,

$$f_t = \frac{F_{dp} + f_{dx}}{DF} \cong \frac{F_{dp}}{DF} \text{ for } F_{dp} >> f_{dx} \qquad (6)$$

where:

F_{dp} = dilution flow rate to be used in effluent monitor setpoint calculations, based on 90 percent FPS Station expected flow rate, as corrected for any recirculated radioactivity:

$$F_{dp} = (0.9)\, F_t (1 - \sum_i \frac{C_{ir}}{10\,(E\,CL)_i} \qquad (7)$$

where:

F_t = the flow rate through the Fairfield Pumped Storage Station penstock(s) to which radioactive liquids are being discharged. F_t should normally fall between 2500 and 44800 cfs.

C_{ir} = the concentration of radionuclide i, in μCi/ml, in the intake of Fairfield Pumped Storage Station (that is, in the Monticello Reservoir). Inclusion of this term will correct for possible long-term buildup of radioactivity due to recirculation and for the presence of activity recently released to the Monticello Reservoir by plant activities. For expected discharges of liquid wastes, the summation will be much less than 1.0 and can be ignored (Reference 6).

f_{dx} = the flow rate of the tank discharge, either f_{dm} or f_{db}.

f_{db} = flow rate of Nuclear Blowdown Monitor Tank discharge. (Conservatively this value will be either zero, if no release is

to be conducted from this system, or the maximum measured capacity of the discharge pump if a release is to be conducted.)

f_{dm} = flow rate of Waste Monitor Tank discharge. (Conservatively this value will either be zero, if no release is to be conducted from this system, or the maximum measured capacity of the discharge pump if a release is to be conducted.)

DF = the Dilution Factor from Step 2.

If $f_t \geq f_{dx}$, the release may be made as planned and the flow rate monitor setpoints should be established as in Step 4 (below). Because F_{dp} is normally very large compared to the maximum discharge pump capacities for the Waste Monitor Tank and the Nuclear Blowdown Monitor Tank, it is extremely unlikely that $f_t < f_{dx}$. However, if a situation should arise such that $f_t < f_{dx}$, steps must be taken to assure that equation (1) is satisfied prior to making the release. These steps may include decreasing f_{dx} by decreasing the flow rate of f_{dm} or f_{db}, and/or increasing F_{dp}.

When new candidate flow rates are chosen, the calculations above should be repeated to verify that they combine to form an acceptable release. If they do, the establishment of flow rate monitor setpoints may proceed as follows in Step 4. If they do not, the choice of candidate flow rates must be repeated until an acceptable set is identified.

Note that if DF $\leq$ 1, the waste tank concentration for which the calculation is being performed includes safety factors in Step 2 and meets the instantaneous release rate limits without further dilution. Even though no dilution would be required, there will be no discharge if minimum dilution flow is not available, since the penstock minimum flow interlock will prevent discharge.

4) The dilution flow rate setpoint*, F, is established at 90 percent of the expected available dilution flow rate:

$$F = (0.9)\ F_t \qquad (8)$$

The flow rate monitor setpoint* for the effluent stream shall be set at the selected discharge pump rate (normally the maximum discharge pump rate or zero) f_{dm} or f_{db} chosen in Step 3 above.

5) The radiation monitor setpoints may now be determined based on the values of $\sum C_i$, F, and f which were specified to ensure releases are limited to 10 times the values of 10 CFR 20, Appendix B, Table 2, Column 2. The monitor response is primarily to gamma radiation, therefore, the actual setpoint is based on $\sum C_g$.

The setpoint concentration, c, is determined as follows:

$$c \leq \sum_g C_g XA \qquad (9)$$

A = Adjustment factor which will allow the setpoint to be established in a practical manner for convenience and to prevent spurious alarms.

$$A = f_t / f_{dx} \qquad (10)$$

If $A \geq 1$, Calculate c and determine the maximum value for the actual monitor setpoint (cpm) from the monitor calibration graph.

* Setpoints for flow rates are administrative limits.

If A < 1, No release may be made. Reevaluate the alternatives presented in Step 3.

NOTE: If calculated setpoint values are near actual concentrations planned for release, it may be impractical to set the monitor alarm at this value. In this case a new setpoint may be calculated following the remedial methodology presented in Step 3 for the case of $f_t < f_{dx}$.

Within the limits of the conditions stated above, the specific monitor setpoint concentrations for the three liquid radiation monitors RM-L5, RM-L7, and RM-L9 are determined as follows:

2.1.2.1 RM-L5, Waste Monitor Tank Discharge Line Monitor:

$$C_M \leq \left[\sum_g C_g \right]_M (A) \qquad (11)$$

C_M is in μCi/ml

*See GENERAL NOTE under 2.1.

2.1.2.2 RM-L7, Nuclear Blowdown Monitor Tank Discharge Line Monitor:

$$C_B \leq \left[\sum_g C_g \right]_B (A) \qquad (12)$$

C_B is in μCi/ml

NOTE: In no case should discharge be made directly from the Nuclear Blowdown Holdup Tank to the penstocks.

*See GENERAL NOTE under 2.1.

2.1.2.3 RM-L9, Combined Liquid Waste Processing System and Nuclear Blowdown Waste Effluent Discharge Line Monitor

The monitor setpoint concentration on the common line, c_C, should be the same as the setpoint

concentration for the monitor on the active individual discharge line (i.e., c_M, or c_B as determined above):

$$C_C \leq \text{MAX}\ (C_M, C_B) \tag{13}$$

*See GENERAL NOTE under 2.1.

NOTE: In all cases, c_M, c_B, and c_c are the setpoint concentration values in μCi/ml. The actual monitor setpoints (cpm) for RM-L5, RM-L7, and RM-L9 are determined from the calibration graph for the particular monitor. Initially, the calibration curves were determined conservatively from families of response curves supplied by the monitor manufacturers. A sample is shown in Figure 2.1-1. As releases occur, a historical correlation will be prepared and placed in service when sufficient data are accumulated.

2.1.3 Liquid Radwaste Discharge Via Industrial and Sanitary Waste System (RM-L5)

In the Virgil C. Summer Nuclear Station liquid waste effluent system design, there exists a mechanism for discharging liquid wastes via the Industrial Sanitary Waste System. The sample point prior to discharge is one of the Waste Monitor Tanks. The analysis requirements are the requirements listed in Table 1.14.

This effluent pathway shall only be used when the following condition is met for all radionuclides, i:

$$[C_i]_M \leq [C_i]_{LLD} \qquad (14)$$

$[C_i]_M$ = the concentration of radionuclide i in the waste contained within the Waste Monitor Tank serving as the holding facility for sampling and analysis prior to discharge, in μCi/ml.

$[C_i]_{LLD}$ = the Lower Limit of Detection, (LLD) for radionuclide i in the liquid waste in the Waste Monitor Tank as determined by the analysis required in Table 1.1-4, in μCi/ml.

When the conditions of equation (14) are met, liquid waste may be released via the Industrial and Sanitary Waste System pathway. The RM-L5 setpoint should be established as close to background as practical to prevent spurious alarms and yet alarm should an inadvertent high concentration release occur.

2.1.4 Steam Generator Blowdown, Turbine Building Sump, and Condensate Demineralizer Backwash Effluent Lines

(RM-L3, RM-L10, RM-L8, RM-L11)

Concentrations of radionuclides in the liquid effluent discharges made via the Turbine Building Sump, Steam Generator Blowdown, and Condensate Demineralizer Backwash are expected to be very low or nondetectable. The first two releases are expected to be continuous in nature and the last a batch release. All will be sampled in an appropriate manner as specified in Table 1.1-4 of the ODCM. The Steam Generator Blowdown Monitors, the Turbine Building Sump Monitor, and the Condensate Demineralizer Backwash Monitor provide alarm and automatic termination.

In reality, all of these effluent pathways utilize the circulating water as dilution to the effluent stream, with the circulating water discharge canal being the point of release into an unrestricted area. Steam Generator Blowdown Effluent may be released to the Circulating Water either directly in the Condenser outflow (the normal flow path) or in the first hours following startup via the Industrial and Sanitary Waste System (ISWS) for chemical reasons. The Turbine Building Sump and Condensate Demineralizer Backwash Effluents enter Circulating Water via the sumps and ponds of the Industrial and Sanitary Waste System.

CO3↓ To ensure compliance with ODCM specification 1.1.2.1, normally no dilution is assumed for discharges to the Industrial and Sanitary Waste System. Additionally, releases are normally limited to 1 ECL to ensure that the conditions of 10 CFR 20.1301 are met. These administrative controls provide assurance that ODCM specification 1.1.2.1 would not be compromised in the event circulating water dilution is lost. To add operational flexibility for abnormal conditions (radionuclide concentration in Turbine Building sump > 1 ECL), discharges from the Turbine Building sump and concentrations in the discharging ponds of the ISWS may exceed the operational objective, 1 ECL, provided circulating water dilution is sufficient to ensure compliance with ODCM specification 1.1.2.1 and liquid effluents are being discharged in compliance with ODCM specification 1.1.4.1.

Two separate setpoint calculations are given for Turbine Building sump discharges (RM-L8). Section 2.1.4.2.1 describes the setpoint calculation normally used, limiting discharges to 1 ECL. Section 2.1.4.4 provides an alternate setpoint methodology which may be used during abnormal conditions. RM-L8 setpoints are considered in compliance with ODCM specification 1.1.1.1 provided the setpoints
CO3↑ are adequate to prevent releases in excess of ODCM specification 1.1.2.1.

Two mutually exclusive setpoint calculation processes are outlined below for steam generator blowdown. Section 2.1.4.1 is to be used whenever Steam Generator Blowdown is being released directly to the Circulating Water in the Condenser outflow, which is the normal mode. Section 2.1.4.2 is to be used whenever Steam Generator Blowdown own is being released to the Industrial and Sanitary Waste System, or diverted to the Nuclear Blowdown Processing System, both of which are alternate modes.

Normally, water collected by the Nuclear Blowdown Processing System has very low specific activity. This water may be processed to the Turbine Building sump.

NOTE: When Circulating Water is unavailable for effluent dilution and water is being directed to a releasing ISWS pond, releases containing activity above LLD (excluding tritium) should be discouraged via pathways which lead to it. Steam Generator Blowdown should be diverted to the Nuclear Blowdown

Processing System. Condensate Demineralizer Backwash may be diverted to the Turbine Building sump or not released. Turbine Building sump effluent should be processed through temporary demineralizers or diverted to the Excess Liquid Waste Processing System. (These steps are to keep the calculated dose to individuals as low as reasonably achievable.)

An option for directing water from the TBS with specific activity > LLD to a non releasing pond is provided in Section 2.1.4.5.

2.1.4.1 Steam Generator Blowdown Effluent Direct to Circulating Water (Normal Mode)

Equation (1) is again used to assure that effluents are in compliance with the aforementioned specification:

$$10\ C_{ECL} \geq \frac{cf}{(F+f)}$$

The available dilution water flow (F_{dc}) is dependent upon the mode of operation of the Circulating Water System. Any change in this value will be accounted for in a recalculation of equation (1). The Steam Generator Blowdown flow rate (f_{ds}) and the Steam Generator Blowdown monitor setpoints (c_{sa} and c_{sb}) are set to meet the condition of equation (1).

RM-L3, the first monitor in the Steam Generator Blowdown discharge pathway, alarms and terminates release of the stream. The discharge is then automatically diverted to the Nuclear Blowdown Processing System. RM-L10, the last monitor in the Steam Generator Blowdown discharge pathway, alarms and terminates the release. Thus, RM-L10 is redundant to RM-L3 and the setpoint (c_{sb}) will be determined in the same manner as RM-L3(c_{sa}).

The method by which the monitor setpoints are determined is as follows:

1) The isotopic concentrations for any release source to be or being released are obtained from the sum of the measured

concentrations as determined in Table 1.1-4. Equation (2) is again employed for this calculation:

$$\sum_i C_i = \sum_g C_g + C_a + C_s + C_t + C_f$$

where:

$\sum_i C_i$ = the sum of the measured concentrations as determined by the analysis of the waste sample, in μCi/ml.

$\sum_g C_g$ = the sum of the concentrations C_g of each measured gamma emitting nuclide observed by gamma-ray spectroscopy of the waste sample, in μCi/ml.

C_a = the measured concentration C_a of alpha emitting composite sample, in μCi/ml.

C_s = the measured concentrations of Sr-89 and Sr-90 in liquid waste as determined by analysis of the most recent available quarterly composite sample, in μCi/ml.

C_t = the measured concentration of H-3 in liquid waste determined by analysis of the monthly composite sample, in μCi/ml.

C_f = the measured concentration of Fe-55 in liquid waste as determined by analysis of the most recent available quarterly composite sample, in μCi/ml.

Isotopic concentrations for the Steam Generator Blowdown System effluent, the Turbine Building Sump Effluent, and the Condensate Demineralizer Backwash effluent may be calculated using equation (2).

2) Once isotopic concentrations for the Steam Generator Blowdown have been determined, these values are used to calculate a Dilution Factor (DF) which is the ratio of the total dilution flow rate to effluent stream flow rate

required to limit the effluent concentration at the point of discharge to less than 10 times the values in 10 CFR 20, Appendix B, Table 2, Column 2.

$$DF = \left[\sum_i \frac{C_i}{10\,(E\,CL)_i} \right]_S \div SF \qquad (15)$$

$$DF = \left[\sum_g \frac{C_g}{10(E\,CL)_g} + \frac{C_a}{10(E\,CL)_a} + \frac{C_s}{10(E\,CL)_s} + \frac{C_f}{10(E\,CL)_f} + \frac{C_t}{1\,(E\,CL)_t} \right]_S \div SF \qquad (16)$$

where:

C_i = C_g, C_a, C_s, C_f, and C_t; measured concentrations as defined in Step 1. Terms C_a, C_s, C_f, and C_t will be included in the calculation as appropriate.

$\left[\sum_i \frac{C_i}{10(ECL)_i} \right]_S$ = the sum of the ratios of the measured concentration of nuclide i to its limiting value ECL_i for the Steam Generator Blowdown effluent.

ECL_i = ECL_g, ECL_a, ECL_s, ECL_f, and ECL_t are limiting concentrations of the appropriate radionuclide from 10 CFR, Part 20, Appendix B, Table 2, Column 2 limits.

SF = the same generic term as used in Section 2.1.2, Step 2.

= 0.5

3) The maximum permissible effluent discharge flow rate, f_d, may now be calculated for a release from the Steam Generator Blowdown.

$$f_d = \frac{F_{dc} + f_{ds}}{DF} \cong \frac{F_{dc}}{DF} \text{ for } F_{dc} >> f_{ds} \qquad (17)$$

where:

F_{dc} = Dilution flow rate for use in effluent monitor setpoint calculations, based on 90 percent of the expected flow rate of the Circulating Water System during the time of release and corrected for any recirculated activity:

$$F_{dc} = (0.9)\, F_d \left[1 - \sum_i \frac{C_{ir}}{10(ECL)_i} \right] \qquad (18)$$

where:

F_d = the flow rate of the Circulating Water System during the time of the release. F_d should normally fall between 1.78×10^5 and 5.34×10^5 gpm when the plant is operating and should be 5000 gpm when the plant is shutdown and the Circulating Water Jockey pump is operating.

C_{ir} = the concentration of radionuclide i, in μCi/ml, in the Circulating Water System intake, (that is, in the Monticello Reservoir). Inclusion of this term will correct for possible long-term buildup of radioactivity due to recirculation and for the presence of activity recently released to the Monticello Reservoir by plant activities. For expected discharges of liquid wastes, the summation will be much less than 1.0 and can be ignored (Reference 6).

f_{ds} = Flow rate of Steam Generator Blowdown discharge. (This value normally will be either zero, if no release is to be conducted, or the maximum rated capacity of the discharge pump (250 gpm), if a release is to be conducted.)

Note that the equation is valid only for DF > 1; for DF ≤ 1, the effluent concentration meets the release criteria without dilution as well as being in compliance with the conservatism imposed by the Safety Factor in Step 2.

If $f_d \geq f_{ds}$, releases may be made as planned. Because F_{dc} is normally very large compared to the maximum discharge pump capacity of the Steam Generator Blowdown System, it is extremely unlikely that $f_d < f_{ds}$. However, if a situation should arise such that $f_d < f_{ds}$, steps must be taken to assure that equation (1) is satisfied prior to making the release. These steps may include diverting Steam Generator Blowdown to the Nuclear Blowdown Processing System or decreasing the effluent flow rate.

When new candidate flow rates are chosen, the calculations above should be repeated to verify that they combine to form an acceptable release. If they do, the establishment of flow rate monitor setpoints should proceed as follows in Step 4. If they do not provide an acceptable release, the choice of candidate flow rates must be repeated until an acceptable set is identified.

4) The dilution flow rate setpoint for minimum flow rate, F, is established at 90 percent of the expected available dilution flow rate:

$$F = (0.9)\,(F_d) \qquad (19)$$

Flow rate monitor setpoints for the Steam Generator Blowdown effluent stream shall be set at the selected discharge pump rate (normally the maximum discharge pump rate) f_{ds} chosen in Step 3 above.

5) The Steam Generator Monitor setpoints may be specified based on the values of ΣC_i, F, and f which were specified to

limit discharge within 10 times the limits of 10CFR 20, Appendix B, Table 2, Column 2. Since the monitor responds primarily to gamma radiation, therefore, the actual setpoint is based on ΣC_g. The monitor setpoint in cpm which corresponds to the calculated value c is taken from the monitor calibration graph. (See NOTE, page 2.0-14.) The setpoint concentration, c, is determined as follows:

$$c \leq \sum_{g} C_g \text{ X } B \qquad (20)$$

$$B = f_d / f_{ds} \qquad (21)$$

If $B \geq 1$, Calculate c and determine the maximum value for the actual monitor setpoint (cpm) from the monitor calibration graph.

If $B < 1$, No release may be made. Reevaluate the alternatives presented in step 3.

NOTE: If the calculated setpoint value is near actual concentrations being released or planned for release, it may be impractical to set the monitor alarm at this value. In this case a new setpoint may be calculated following the remedial methodology presented in steps 3 and 4 for the case $f_d < f_{ds}$.

Within the conditions stated above, the specific monitor setpoint concentrations for the two steam generator blowdown monitors RM-L3 and RM-L10 are calculated as shown on the following page.

2.1.4.1.1 <u>For RM-L3, Steam Generator Blowdown Discharge initial monitor, and for RM-L10, Steam Generator Blowdown Discharge final monitor</u>:

$$c_{Sa} \text{ or } c_{Sb} \leq \left[\sum_g C_g\right]_S (B) \qquad (22)$$

$\left[\sum_g C_g\right]_S$ = the isotopic concentration of the Steam Generator Blowdown effluent as obtained from the sum of the measured concentrations determined by the analysis required in ODCM Table 1.1-4, in μCi/ml.

*See GENERAL NOTE under 2.1.

2.1.4.2 Turbine Building Sump and Condensate Demineralizer Backwash (Normal Mode)

For conservatism, the Turbine Building Sump and Condensate Demineralizer Backwash monitor setpoints (c_T and c_D) will claim no dilution from the Circulating Water, and will be set at the applicable concentration limit. That is:

$$C_{ECL} \geq c \qquad (23)$$

The Turbine Building sump monitor, RM-L8, alarms and terminates release upon exceeding the monitor setpoint (c_T). The discharge can then be manually diverted to the Excess Waste Processing System. RM-L11, the Condensate Demineralizer Backwash monitor, alarms and terminates release upon exceeding the monitor setpoint (c_D). The discharge may then be manually diverted to the Turbine Building sump or simply delayed.

The Turbine Building Sump and Condensate Demineralizer Backwash monitor setpoints are to be established independently of each other and without crediting dilution. They are to be based on the measured radionuclide concentrations of the effluent stream and are to ensure that discharge concentrations do not exceed the ECLs specified in 10 CFR 20, Appendix B, Table 2, Column 2 prior to discharge.

For each effluent stream, a concentration factor (CF) is calculated by summing the ratios of detected radionuclides in the

effluent stream to the applicable ECLs, the calculated values normalize the effluent mixture to terms of ODCM Control 1.1.2.1 release criteria and includes a safety factor for engineering uncertainty.

$$CF = \left[\sum_i \frac{C_i}{(ECL)_i}\right] \div SF \tag{24}$$

$$CF_T = \left[\sum_i \frac{C_i}{(ECL)_i}\right]_T \div SF \tag{25}$$

$$CF_D = \left[\sum_i \frac{C_i}{(ECL)_i}\right]_D \div SF \tag{26}$$

where:

$\left[\sum_i \frac{C_i}{(E\,CL)_i}\right]_T$ = the sum of the ratios of the measured concentration of nuclide i to its limiting value ECL_i for the Turbine Building sump effluent.

$\left[\sum_i \frac{C_i}{(E\,CL)_i}\right]_D$ = the sum of the measured concentration of nuclide i (in liquid only) to its limiting value ECL_i for the Condensate Demineralizer Backwash effluent.

CF_T = the concentration factor for the Turbine Building Sump Effluent.

CF_D = the concentration factor for the Condensate Demineralizer Backwash Effluent.

SF = the generic engineering safety factor used in Section 2.1.2, Step 2.

= 0.5

If $CF \leq 1$, calculate c and determine the actual monitor setpoint (cpm) from the calibration curve.

If $CF > 1$, no release may be made via this path. The release must either be delayed, diverted, or processed.

If the concentration factor cannot be reduced to less than or equal to 1, proceed to section 2.1.4.4 or 2.1.4.5 for additional guidance for processing Turbine Building Sump releases.

Within the limits of the conditions stated above, the specific monitor setpoint concentrations for RM-L8 and RM-L11 may now be calculated. Because they are primarily sensitive to gamma radiation, their setpoints will be based on the concentrations of gamma emitting radionuclides as follows:

2.1.4.2.1 For RM-L8, Turbine Building Sump Discharge Monitor:

$$c_T \leq \left[\sum_g C_g\right] T \div CF_T \qquad (27)$$

Where:

$\left[\sum_g C_g\right]_T$ = The gamma isotopic concentration of the Turbine Building sump effluent as obtained from the sum of the measured concentrations determined by the analysis required in ODCM Table 1.1-4, in μCi/ml.

CF_T = The Turbine Building sump Effluent Concentration Factor from equation (25).

*See GENERAL NOTE under 2.1.

2.1.4.2.2 For RM-L11, Condensate Demineralizer Backwash Discharge Monitor:

$$c_D \leq \left[\sum_g C_g\right]_D \div CF_D \qquad (28)$$

where:

$\left[\sum_g C_g\right]_D$ = The gamma isotopic concentration of the Condensate Demineralizer Backwash effluent (including solids) as obtained from the sum of the measured concentrations determined by the analysis required ODCM Table 1.1-4, in μCi/ml.

CF_D = The Condensate Demineralizer Backwash Effluent Concentration Factor from equation (26).
*See GENERAL NOTE under 2.1.

2.1.4.3 Steam Generator Blowdown Effluent Not Directly to Circulating Water (Alternate Mode)

Equation (23) is again used to assure that effluents are in compliance with the aforementioned specification before dilution in the receiving water:

$$C_{ECL} \geq c$$

Because dilution is not considered in the setpoint calculation, it is not necessary to calculate maximum permissible discharge flow rates or anticipated available dilution flow rate.

The functions of the two monitors whose setpoints are to be established are described in Section 2.1.4.1 above. The method for the determination is as follows:

1) If a release is found to be permissible, flow rate monitors for the active effluent streams (Steam Generator Blowdown - f_{ds}, Turbine Building sump - f_{dt}, and Condensate Demineralizer - f_{dd}) may have their setpoints established at any operationally convenient value.

2) The Concentration Factor of equation (24) is again used to ensure the permissibility of the release.

$$CF = \left[\sum_i \frac{C_i}{(ECL)_i} \right] \div SF$$

$$CF_S = \left[\sum_i \frac{C_i}{(ECL)_i} \right]_S \div SF \qquad (29)$$

All terms are defined in subsection 1.1.3.1 and subscript S refers to the Steam Generator Blowdown Effluent.

If CF ≤ 1, calculate c and determine the actual monitor setpoint (cpm) from the calibration curve.

If CF > 1, no release may be made via this path. The release must either be delayed or diverted for additional processing.

Within the above limitation, setpoint concentrations may now be calculated for the two effluent monitors. Because they are primarily sensitive to gamma radiation, their setpoints will be based on the concentrations of gamma emitting radionuclides as follows:

2.1.4.3.1 <u>For RM-L3, Steam Generator Blowdown Discharge initial monitor, and RML-10, Steam Generator Blowdown Discharge final monitor</u>:

$$c_{Sa} \text{ or } c_{Sb} \leq \left[\sum_g C_g \right]_S \div CF_S \qquad (30)$$

Where:

$\left[\sum_g C_g\right]_S$ = The isotopic concentration of the Steam Generator Blowdown effluent as obtained from the sum of the measured concentrations determined by the analysis required in ODCM Table 1.1-4, in μCi/ml.

CF_S = The Steam Generator Blowdown Effluent Concentration Factor from equation (29).

*See GENERAL NOTE under 2.1.

CO3→ 2.1.4.4 Turbine Building Sump (Abnormal Conditions)

Provided circulating water is available, 1 to 3 circulating water pumps, effluent exceeding 1 ECL may be released from the Turbine Building sump to the industrial and sanitary waste system, using the setpoint in this section, provided the following conditions are met:

1) Instantaneous release rate limits of ODCM Specification 1.1.2.1 are not exceeded in the circulating water discharge canal.

2) Annual average concentrations of radioactivity in ISWS ponds will not exceed 1 ECL.

3) The limits of ODCM specification 1.1.4.1 will not be exceeded with actual liquid effluent releases over a 31 day period.

4) Average discharge flow does not exceed values used in setpoint determination.

In addition, the source of radioactivity should be identified and isolated. Radionuclide concentration in Turbine Building sump effluent should be restored to <1 ECL as soon as possible and normal setpoint reestablished. Radionuclide concentration in Pond 6B should be restored to < LLD (excluding tritium) using dilution as necessary (normal flow from the TBS would normally be adequate). Turbine Building sump samples should be obtained and analyzed every twelve hours while the alternate setpoint is being used to ensure that the setpoint remains conservative with respect to the isotopic mixture and to ensure offsite doses are within ODCM limits.

Alternate setpoint methodology for Turbine Building sump (RM-L8) is available to ensure operational flexibility in the event radioactivity is detected in the Turbine Building sump > 1 ECL and the release would result in minimal offsite dose. The alternate setpoint methodology is not intended to be used continuously. To remove restrictions on operation of circulating water, pond concentrations should be restored to < LLD as soon as possible. The setpoint methodology follows:

2.1.4.4.1 <u>For RM-L8, Turbine Building Sump (alternate methodology)</u>

$$c_T \leq \frac{\sum_g C_g}{CF_T} X \frac{1}{F_k} \qquad (57)$$

where,

F_k = The near field dilution factor for C_i during release from Turbine Building sump.

$$= \frac{\text{(average undiluted waste flow)}}{\text{(average flow from discharge structure)}}$$

For purpose of implementing section 2.1.4.4 release condition 2, the following must be satisfied.

$$\frac{\sum_{j=1}^{n} \left[\left[\sum_{i=1}^{x} (C_i / ECL_i) \right]_{Tj} * V_j \right]}{\sum_{j=1}^{n} V_j} < 1.0 \qquad (58)$$

where, $[\Sigma(C_i/ECL_i)]T_j$ = the sum of the ratios of the measured concentration of nuclide $_i$ to its limiting value ECL_i for the Turbine Building sump effluent for release permit $_j$, including proposed permit,

V_j = Release volume for Turbine Building sump release permit $_j$ (gal), and

j = index for batch release permits during the calendar year.

2.1.4.5 Turbine Building Sump - Special Considerations During Station Shutdowns

During periods in which circulating water (CW) is not available for diluting Turbine Building Sump (TBS) discharges, effluent from the TBS may be directed to a non-releasing pond and offsite dose calculations required by Specification 1.1.3.1 deferred until CW is restored. RM-L8 setpoint requirement specified by Specification 1.1.1.1 is not applicable when directing water from the TBS to a non-releasing ISWS pond provided the following conditions are met.

1) Sufficient freeboard is available in the non-releasing pond to ensure that pond contents will not be released to the CW discharge canal prior to reestablishing CW flow.

2) Release of ISWS contents will be in compliance with Specifications 1.1.2.1, 1.1.3.1 and 1.1.4.1 once CW flow has been reestablished.

3) ISWS pond radioactivity will not exceed 1 ECL.

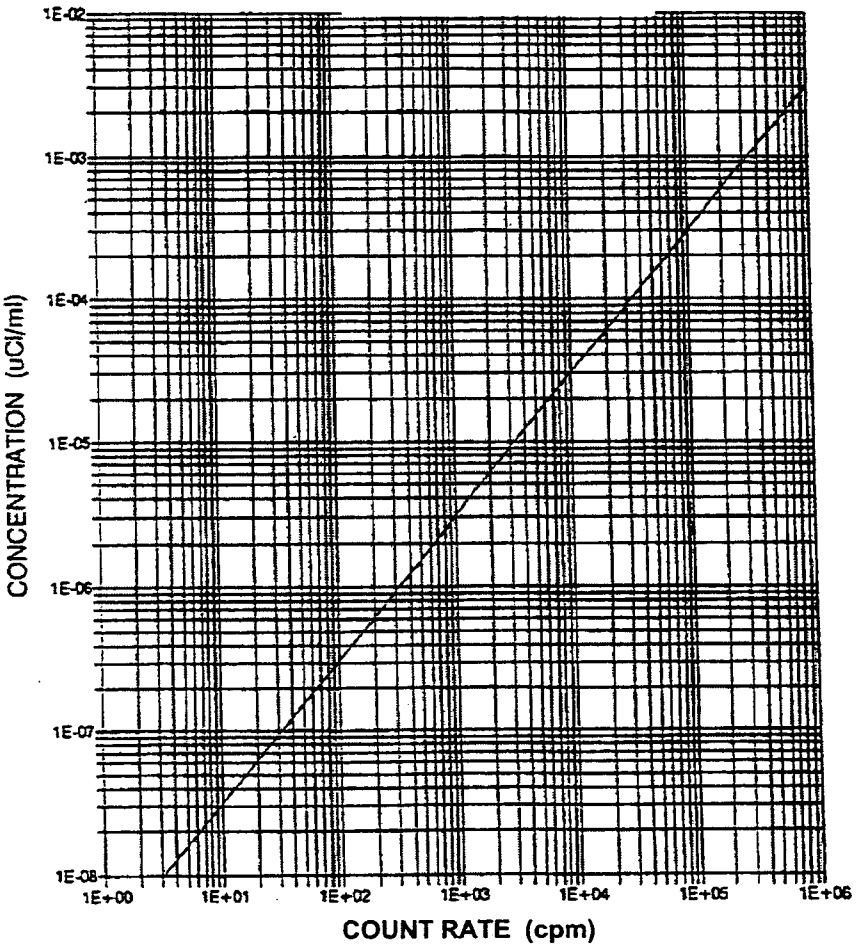
4) TBS samples are obtained and analyzed every 12 hours while water is being directed to a non-releasing pond.

5) Sample non-releasing pond within 12 hours of adding water > 1 ECL and every 12 hours thereafter while TBS discharge concentrations exceed 1 ECL.

Once samples have been obtained and release acceptability determined, RM-L8 setpoint may be increased to 2 times indication to allow release of sump contents to a non-releasing pond.

Demonstrating compliance with item 3 can be performed by calculations using TBS samples and discharge volumes or by sampling ISWS ponds.

Figure 2.1-1
Example Liquid Effluent Monitor
Calibration Curve



2.2 Dose Calculation for Liquid Effluents

The method of this section is to be used in all cases for calculating doses to individuals from routine liquid effluents. Four notes at the end of the section confirm the values which certain parameters are to be assigned in some special cases.

2.2.1 Liquid Effluent Dose Calculation Parameters

Term		Definition	Section of Initial Use
$A_{i\tau}$	=	the site related ingestion dose commitment factor to the total body or any organ τ, for each identified principal gamma and beta emitter listed in Table 2.2-3 in mrem-ml per hr-μCi.	2.2.2
BF_i	=	Bioaccumulation Factor for nuclide i, in fish, pCi/Kg per pCi/l, from Table 2.2-1.	2.2.2
C_{ik}	=	the average concentration of radionuclide, i, in undiluted liquid effluent during time period Δt_k from any liquid released, in μCi/ml.	2.2.2
$DF_{i\tau}$	=	a dose conversion factor for nuclide, i, for adults in preselected organ, τ, in mrem/pCi found in Table 2.2-2.	2.2.2
D_τ	=	the cumulative dose commitment to the total body or any organ, τ, from the liquid effluents for the total time period, $\Sigma\Delta t_k$ in mrem (Ref. 1).	2.2.2
D_w	=	Dilution Factor from the near field area within one-quarter mile of the release points to the potable water intake for adult water consumption; for V. C. Summer, $D_w = 1$.	2.2.2
F_k	=	the near field average dilution factor for C_{ik} during any liquid effluent release.	2.2.2
K_o	=	1.14×10^5, units conversion factor = (10^6 pCi/μCi) (10^3 ml/l) ÷ 8760 hr/yr	2.2.2
Δt_k	=	the length (in hours) of a time period over which concentrations and flow rates are averaged for dose calculations.	2.2.2
U_F	=	21 kg/yr, fish consumption (adult) (Reference 3).	2.2.2
U_w	=	730 kg/yr, water consumption (adult) (Reference 3).	2.2.2
Z	=	applicable near-field dilution factor when no additional dilution is to be considered; Z = 1.	2.2.2

2.2.2 Methodology

The dose contribution from all radionuclides identified in liquid effluents released to unrestricted areas is calculated using the following expression:

$$D_\tau = \sum_i \left[A_{i\tau} \sum_{k=1} {}^{\Delta}t_k \, C_{ik} \, F_k \right] \tag{31}$$

$$A_{i\tau} = K_o \, ((U_w / D_w) + U_F BF_i) \, DF_{i\tau} \tag{32}$$

$$F_k = \frac{\text{(average undiluted liquid waste flow)}}{\text{(average flow from the discharge structure) (Z)}} \tag{33}$$

NOTE 1: If radioactivity in the Monticello Reservoir (C_{ir}) becomes > the LLD specified in ODCM, Table 1.1-4, that concentration must be included in the Dose determination. For this part of the dose calculation, F_k = 1 and Δt_k = the entire time period for which the dose is being calculated.

NOTE 2: Prior to termination of Circulating Water Pumps, an assessment of the dose resulting from pond radioactivity concentrations and discharge flow rates from the Industrial And Sanitary Waste System (ISWS) will be performed as follows. Sampling of the liquid in the ISWS wilt be initiated, and the measured concentrations of radionuclides will be used in the dose calculations with F_k = 1 and Δt_k = the entire time period for which the dose is being calculated.

NOTE 3: For releases through the ISWS pathway when circulating water is not available, dose projections for assessment of release acceptability should be based on the most representative samples obtained from in plant sumps. Normally sump samples are also used to assess actual release. However, due to the ultraconservative assumptions when circulating water is not available, i.e. dose calculations are based on radioactive material concentration in the discharge stream regardless of release volume, representative samples from the ISWS may be used to evaluate impact of releases.

NOTE 4: During periods when the Circulating Water Pumps are in operation, any releases to the ISWS are to be credited with dilution in Circulating Water for dose calculation purposes, even though such dilution is normally not claimed in the setpoint calculation. When taken in union with the note above, this procedure results in some overestimation of dose to the population because discharges made to the ISWS just before loss of Circulating Water will be counted twice in the dose calculation process.

NOTE 5: If radioactivity in the Service Water becomes > LLD as determined by the analysis required by ODCM, Table 1.1-4, that concentration must be included in the Dose determination. For this part of the dose calculation, $F_k = 1$ and Δt_k = the entire time since the last Service Water sample was taken.

2.3 Liquid Effluent Releases through the Neutralization Basin

Releases of slightly contaminated liquids from pathways feeding the Neutralization Basin (Pond 007) through Circulating Water (CW) may be made under strictly controlled conditions. Releases from these pathways (e.g., NaOH sump, RWST sump) will be allowed if the following conditions are adhered to in controlling the radioactive materials released.

2.3.1 Rainwater Tank

Rainwater collected in the RWST sump is pumped to the RWST Pit Drain Tank (Rainwater Tank) for analysis and subsequent release. Normally the rainwater is sampled, found to contain no detectable radioactivity, and is released to the environment via the storm drain system. If measurable amounts of radioactive materials are found in Rainwater Tank samples, the tank may be pumped to a Waste Monitor Tank and released without processing. In order to allow for operational flexibility, the Rainwater Tank containing radioactive materials may be drained to the NaOH sump and discharged to the circulating water (CW) system via the Neutralization basin (007). The following constraints are to be applied for releases through this pathway:

(1) At least one CW pump must be used for dilution to release through this pathway.

(2) Chemistry Services must be notified to verify that conditions in the Neutralization Basin are such that additions to the basin can be made.

(3) Using the Rainwater Tank analysis and available circulating water, a release calculation must be performed that shows that releases will be less than 6.0E-4 mrem (whole body) and 2.0E-3 mrem (any organ). These limits represent 1% of unprocessed effluent 31-day dose limits (ODCM Section 1.1.4.1).

(4) If these limits are met, the Rainwater Tank may be drained through the NaOH sump to the Neutralization Basin. Chemistry will then release the Neutralization Basin contents through circulating water as soon as possible once their procedural and NPDES release criteria are met.

2.3.2 NaOH Spray Tank and Stored NaOH

(1) The same limits and conditions as 2.3.1(1-4) apply for releases from the NaOH sump.

(2) Samples should be obtained and analyzed during performance of NaOH Spray Tank activities that require the draining of NaOH from the tank or sight glass.

(3) If the sample show concentrations of radionuclides that would exceed the dose limits above and the tank must have liquid removed from it, the contaminated NaOH may be drained to appropriate holding containers for temporary storage. Once the conditions for release become favorable (e.g. return of CW), the containers used for temporary storage may be sampled and analyzed for release. If the dose limitations in 2.3.1 (3) are met and Chemistry approval is obtained, a release permit is generated and the containers can be drained through the NaOH sump or emptied directly to the Neutralization Basin for release through CW.

TABLE 2.2-1
BIOACCUMULATION FACTORS*
(pCi/kg per pCi/liter)

ELEMENT	FRESHWATER FISH
H	9.0E- 01
C	4.6E 03
F	1.0E 01
Na	1.0E 02
P	1.0E 05
Cr	2.0E 02
Mn	4.0E 02
Fe	1.0E 02
Co	5.0E 01
Ni	1.0E 02
Cu	5.0E 01
Zn	2.0E 03
Br	4.2E 02
Rb	2.0E 03
Sr	3.0E 01
Y	2.5E 01
Zr	3.3E 00
Nb	3.0E 04
Mo	1.0E 01
Tc	1.5E 01
Ru	1.0E 01
Rh	1.0E 01
Sb	1.0E 00
Te	4.0E 02
I	1.5E 01
Cs	2.0E 03
Ba	4.0E 00
La	2.5E 01
Ce	1.0E 00
Pr	2.5E 01
Nd	2.5E 01
W	1.2E 03
Np	1.0E 01

*Values in Table 2.2-1 are taken from Reference 3, Table A-1.

TABLE 2.2-2
Page 1 of 2
ADULT INGESTION DOSE FACTORS*
(mrem/pCi ingested)

NUCLIDE	BONE	LIVER	T-BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07
C-14	2.84E-06	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07
†F-18	6.24E-07	NO DATA	6.92E-08	NO DATA	NO DATA	NO DATA	1.85E-08
NA-24	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.07E-06	1.70E-06
P-32	1.93E-04	1.20E-05	7.46E-06	NO DATA	NO DATA	NO DATA	2.17E-05
CR-51	NO DATA	NO DATA	2.66E-09	1.59E-09	5.86E-10	3.53E-09	6.69E-07
MN-54	NO DATA	4.57E-06	8-72E-07	NO DATA	1.36E-06	NO DATA	1.40E-05
MN-56	NO DATA	1.15E-07	2.04E-08	NO DATA	1.46E-07	NO DATA	3.67E-06
FE-55	2.75E-06	1.90E-06	4.43E-07	NO DATA	NO DATA	1.06E-06	1.09E-06
FE-59	4.34E-06	1.02E-05	3.91E-06	NO DATA	NO DATA	2.85E-06	3.40E-05
†CO-57	NO DATA	1.75E-07	2.91E-07	NO DATA	NO DATA	NO DATA	4.44E-06
CO-58	NO DATA	7.45E-07	1.67E-06	NO DATA	NO DATA	NO DATA	1.51E-05
CO-60	NO DATA	2.14E-06	4.72E-06	NO DATA	NO DATA	NO DATA	4.02E-05
NI-63	1.30E-04	9.01E-06	4.36E-06	NO DATA	NO DATA	NO DATA	1.88E-06
NI-65	5.28E-07	6.86E-08	3.13E-08	NO DATA	NO DATA	NO DATA	1.74E-06
CU-64	NO DATA	8.33E-08	3.91E-08	NO DATA	2.10E-07	NO DATA	7.10E-06
ZN-65	4.84E-06	1.54E-05	6.96E-06	NO DATA	1.03E-05	NO DATA	9.70E-06
ZN-69	1.03E-08	1.97E-08	1.37E-09	NO DATA	1.28E-08	NO DATA	2.96E-09
†Zn-69m‡	1.70E-07	4.08E-07	3.73E-08	NO DATA	2.47E-07	NO DATA	2.49E-05
†BR-82	NO DATA	NO DATA	2.26E-06	NO DATA	NO DATA	NO DATA	2.59E-06
BR-83‡	NO DATA	NO DATA	4.02E-08	NO DATA	NO DATA	NO DATA	5.79E-08
BR-84	NO DATA	NO DATA	5.21E-08	NO DATA	NO DATA	NO DATA	4.09E 13
BR-85	NO DATA	NO DATA	2.14E-09	NO DATA	NO DATA	NO DATA	LT E-24**
RB-86	NO DATA	2.11E-05	9.83E-06	NO DATA	NO DATA	NO DATA	4.16E-06
RB-88	NO DATA	6.05E-8	3.21E-08	NO DATA	NO DATA	NO DATA	8.36E-19
RB-89‡	NO DATA	4.01E-8	2.82E-08	NO DATA	NO DATA	NO DATA	2.33E-21
SR-89‡	3.08E-04	NO DATA	8.84E-06	NO DATA	NO DATA	NO DATA	4.94E-05
SR-90‡	7.58E-03	NO DATA	1.86E-03	NO DATA	NO DATA	NO DATA	2.19E-04
SR-91‡	5.67E-06	NO DATA	2.29E-07	NO DATA	NO DATA	NO DATA	2.70E-05
SR-92‡	2.15E-06	NO DATA	9.30E-08	NO DATA	NO DATA	NO DATA	4.26E-05
Y-90	9.62E-09	NO DATA	2.58E-10	NO DATA	NO DATA	NO DATA	1.02E-04
Y-91M‡	9.09E-11	NO DATA	3.52E-12	NO DATA	NO DATA	NO DATA	2.67E-10
Y-91	1.41E-07	NO DATA	3.77E-09	NO DATA	NO DATA	NO DATA	7.76E-05
Y-92	8.45E-10	NO DATA	2.47E-11	NO DATA	NO DATA	NO DATA	1.48E-05
Y-93	2.68E-09	NO DATA	7.40E-11	NO DATA	NO DATA	NO DATA	8.50E-05
ZR-95‡	3.04E-08	9.75E-09	6.60E-09	NO DATA	1.53E-08	NO DATA	3.09E-05
ZR-97‡	1.68E-09	3.39E-10	1.55E.10	NO DATA	5.12E-10	NO DATA	1.05E-04
NB-95	6.22E-09	3.46E-09	1.86E-09	NO DATA	3.42E-09	NO DATA	2.10E-05
†NB-97	5.22E-11	1.32E-11	4.82E-12	NO DATA	1.54E-11	NO DATA	4.87E-08
MO-99‡	NO DATA	4.31E-06	8.20E-07	NO DATA	9.76E-06	NO DATA	9.99E-06

‡ Daughter contributions are included (see Reference 13).
† Values taken from Reference 13, Table 4.
* Values other than those footnoted in Table 2.2-2 are taken from Reference 3, Table E-11.
** Less than E-24.

TABLE 2.2-2 (continued)
Page 2 of 2

NUCLIDE	BONE	LIVER	T-BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC-99M	2.47E-10	6.98E-09	8.89E-09	NO DATA	1.06E-08	3.42E-10	4.13E-07
TC-101	2.54E-10	3.66E-10	3.59E-09	NO DATA	6.59E-09	1.87E-10	1.10E-21
RU-103‡	1.85E-07	NO DATA	7.97E-08	NO DATA	7.06E-07	NO DATA	2.16E-05
RU-105‡	1.54E-08	NO DATA	6.08E-07	NO DATA	1.99E-07	NO DATA	9.42E-06
RU-106‡	2.75E-06	NO DATA	3.48E-07	NO DATA	5.31E-06	NO DATA	1.78E-04
AG-110M‡	1.60E-07	1.48E-07	8.79E-08	NO DATA	2.91E-07	NO DATA	6.04E-05
†SB-124	2.80E-06	5.29E-08	1.11E-06	6.79E-09	NO DATA	2.18E-06	7.95E-05
†ST-125	1.79E-06	2.00E-08	4.26E-07	1.82E-09	NO DATA	1.38E-06	1.97E-05
†SB-126	1.15E-06	2.34E-08	4.15E-07	7.04E-09	NO DATA	7.05E-07	9.40E.05
†SB-127	2.58E-07	5.65E-09	9.90E-08	3.10E-09	NO DATA	1.53E-07	5.90E-05
TE-125M	2.68E-06	9.71E-07	3.59E-07	8.06E-07	1.09E-05	NO DATA	1.07E-05
TE-127M‡	6.77E-06	2.42E-06	8.25E-07	1.73E-06	2.75E-05	NO DATA	2.27E-05
TE-127	1.10E-07	3.95E-08	2.38E-08	8.15E-08	4.48E-07	NO DATA	8.68E-06
TE-129M‡	1.15E-05	4.29E-06	1.82E-06	3.95E-06	4.80E-05	NO DATA	5.79E-05
TE-129	3.14E-08	1.18E-08	7.65E-09	2.41E-08	1.32E-07	NO DATA	2.37E-08
TE-131M‡	1.73E-06	8.46E-07	7.05E-07	1.34E-06	8.57E-06	NO DATA	8.40E-05
TE-131‡	1.97E-08	8.23E-09	6.22E-09	1.62E-08	8.63E-08	NO DATA	2.79E-09
TE-132‡	2.52E-06	1.63E-06	1.53E-06	1.80E-06	1.57E-05	NO DATA	7.71E-05
I-130	7.56E-07	2.23E-06	8.80E-07	1.89E-04	3.48E-06	NO DATA	1.92E-06
I-131‡	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1. 02E-05	NO DATA	1.57E-06
I-132	2.03E-07	5.43E-07	1.90E-07	1.90E-05	8.65E-07	NO DATA	1.02E-07
I-133‡	1.42E-06	2.47E-06	7.53E-07	3.63E-04	4.31E-06	NO DATA	2.22E-06
I-134	1.06E-07	2.88E-07	1.03E-07	4.99E-06	4.58E-07	NO DATA	2.51E-10
I-135‡	4.43E-07	1.16E-06	4.28E-07	7.65E-05	1.86E-06	NO DATA	1.31E-06
CS-134	6.22E-05	1.48E-04	1.21E-04	NO DATA	4.79E-05	1.59E-05	2.59E-06
CS-136	6.51E-06	2.57E-05	1.85E-05	NO DATA	1.43E-05	1.96E-06	2.92E-06
CS-137‡	7.97E-05	1.09E-04	7.14E-05	NO DATA	3.70E-05	1.23E-05	2.11E-06
CS-138	5.52E-08	1.09E-07	5.40E-08	NO DATA	8.01E-08	7.91E-09	4.65E-13
BA-139	9.70E-08	6.91E-11	2.84E-09	NO DATA	6.46E-11	3.92E-11	1.72E-07
BA-140‡	2.03E-05	2.55E-08	1.33E-06	NO DATA	8.67E-09	1.46E-08	4.18E-05
BA-141‡	4.71E-08	3.56E-11	1.59E-09	NO DATA	3.31E-11	2.02E-11	2.22E-17
BA-142‡	2.13E-08	2.19E-11	1.34E-09	NO DATA	1.85E-11	1.24E-11	3.00E-26
LA-140	2.50E-09	1.26E-09	3.33E-10	NO DATA	NO DATA	NO DATA	9.25E-05
LA-142	1.28E-10	5.82E-11	1.45E-11	NO DATA	NO DATA	NO DATA	4.25E-07
CE-141	9.36E-09	6.33E-09	7.18E-10	NO DATA	2.94E-09	NO DATA	2.42E-05
CE-143‡	1.65E-09	1.22E-06	1.35E-10	NO DATA	5.37E-10	NO DATA	4.56E-05
CE-144‡	4.88E-07	2.04E-07	2.62E-08	NO DATA	1.21E-07	NO DATA	1.65E-04
PR-143	9.20E-09	3.69E-09	4.56E-10	NO DATA	2.13E-09	NO DATA	4.03E-05
PR-144	3.01E-11	1.25E-11	1.53E-12	NO DATA	7.05E-12	NO DATA	4.33E-18
ND-147‡	6.29E-09	7.27E-09	4.35E-10	NO DATA	4.25E-09	NO DATA	3.49E.05
W-187	1.03E-07	8.61E-08	3.01E-08	NO DATA	NO DATA	NO DATA	2.82E-05
NP-239	1.19E-09	1.17E-10	6.45E-11	NO DATA	3.65E-10	NO DATA	2.40E-05

TABLE 2.2-3
SITE RELATED INGESTION
DOSE COMMITMENT FACTOR, A_{ih}*
(mrem/hr per $_{\mu}$Ci/ml)
Page 1 of 2

NUCLIDE	BONE	LIVER	T-BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	NO DATA	8.96E + 00	8.96E + 00	8.96E + 00	8.96E + 00	8.96E + 00	8.96E + 00
C-14	3.15E + 04	6.30E + 03	6.30 + 03	6.30E + 03	6.30E + 03	6.30E + 03	6.30E + 03
F-18	6.69E + 01	NO DATA	7.42E + 00	NO DATA	NO DATA	NO DATA	1.98E + 00
NA-24	5.48E + 02	5.48E + 02	5.48E + 02	5.48E + 02	5.48E + 02	5.48E + 02	5.48E + 02
P-32	4.62E + 07	2.87E + 06	1.79E + 06	NO DATA	NO DATA	NO DATA	5.20E + 06
CR-51	NO DATA	NO DATA	1.49E + 00	8.94E-01	3.29E-01	1.98E + 00	3.76E + 02
MN-54	NO DATA	4.76E + 03	9.08E + 02	NO DATA	1.42E + 03	NO DATA	1.46E + 04
MN-56	NO DATA	1.20E + 02	2.12E + 01	NO DATA	1.52E + 02	NO DATA	3.82E + 03
FE-55	8.87E + 02	6.13E + 02	1.43E + 02	NO DATA	NO DATA	3.42E + 02	3.52E + 02
FE-59	1.40E + 03	3.29E + 03	1.26E + 03	NO DATA	NO DATA	9.19E + 02	1.10E + 04
CO-57	NO DATA	3.55E + 01	5.91E + 01	NO DATA	NO DATA	NO DATA	9.01E + 02
CO-58	NO DATA	1.51E + 02	3.39E + 02	NO DATA	NO DATA	NO DATA	3.06E + 03
CO-60	NO DATA	4.34E + 02	9.58E + 02	NO DATA	NO DATA	NO DATA	8.16E + 03
NI-63	4.19E + 04	2.91E + 03	1.41E + 03	NO DATA	NO DATA	NO DATA	6.07E + 02
NI-65	1.70E + 02	2.21E + 01	1.01E + 01	NO DATA	NO DATA	NO DATA	5.61E + 02
CU-64	NO DATA	1.69E + 01	7.93E + 00	NO DATA	4.26E + 01	NO DATA	1.44E + 03
ZN-65	2.36E + 04	7.50E + 04	3.39E + 04	NO DATA	5.02E + 04	NO DATA	4.73E + 04
ZN-69	5.02E + 01	9.60E + 01	6.67E + 00	NO DATA	6.24E + 01	NO DATA	1.44E + 01
Zn-69m‡	8.28E + 02	1.99E + 03	1.82E + 02	NO DATA	1.20E + 03	NO DATA	1.21E + 05
BR-82	NO DATA	NO DATA	2.46E + 03	NO DATA	NO DATA	NO DATA	2.82E + 03
BR-83‡	NO DATA	NO DATA	4.38E + 01	NO DATA	NO DATA	NO DATA	6.30E + 01
BR-84	NO DATA	NO DATA	5.67E + 01	NO DATA	NO DATA	NO DATA	4.45E - 04
RB-85	NO DATA	NO DATA	2.33E + 00	NO DATA	NO DATA	NO DATA	1.09E - 15
RB-86	NO DATA	1.03E + 05	4.79E + 04	NO DATA	NO DATA	NO DATA	2.03E + 04
RB-88	NO DATA	2.95E + 02	1.56E + 02	NO DATA	NO DATA	NO DATA	4.07E - 09
RB-89‡	NO DATA	1.95E + 02	1.37E + 02	NO DATA	NO DATA	NO DATA	1.13E - 11
SR-89‡	4.78E + 04	NO DATA	1.37E + 03	NO DATA	NO DATA	NO DATA	7.66E + 03
SR-90‡	1.18E + 06	NO DATA	2.88E + 05	NO DATA	NO DATA	NO DATA	3.48E + 04
SR-91‡	8.79E + 02	NO DATA	3.55E + 01	NO DATA	NO DATA	NO DATA	4.19E + 03
SR-92‡	3.33E + 02	NO DATA	1.44E + 01	NO DATA	NO DATA	NO DATA	6.60E + 03
Y-90	1.38E + 00	NO DATA	3.69E - 02	NO DATA	NO DATA	NO DATA	1.46E + 04
Y-91M‡	1.30E - 02	NO DATA	5.04E - 04	NO DATA	NO DATA	NO DATA	3.82E - 02
Y-91	2.02E + 01	NO DATA	5.39E - 01	NO DATA	NO DATA	NO DATA	1.11E + 04
Y-92	1.21E - 01	NO DATA	3.53E - 03	NO DATA	NO DATA	NO DATA	2.12E + 03
Y-93	3.83E - 01	NO DATA	1.06E - 02	NO DATA	NO DATA	NO DATA	1.22E + 04
ZR-95‡	2.77E + 00	8.88E - 01	6.01E - 01	NO DATA	1.39E + 00	NO DATA	2.82E + 03
ZR-97‡	1.53E - 01	3.09E - 02	1.41E - 02	NO DATA	4.67E - 02	NO DATA	9.57E + 03
NB-95	4.47E + 02	2.49E + 02	1.34E + 02	NO DATA	2.46E + 02	NO DATA	1.51E + 06
NB-97	3.75E + 00	9.49E - 01	3.47E - 01	NO DATA	1.11E + 00	NO DATA	3.50E + 03

‡ Daughter contributions are included (see Reference 13).
*Calculated using equation (32) and Tables 2.2-1 and 2.2-2

TABLE 2.2-3
SITE RELATED INGESTION
DOSE COMMITMENT FACTOR, A_{it}*
(mrem/hr per μCi /ml)
Page 2 of 2

NUCLIDE	BONE	LIVER	T-BODY	THYROID	KIDNEY	LUNG	GI-LLI
MO-99‡	NO DATA	4.62E + 02	8.79E + 01	NO DATA	1.05E + 03	NO DATA	1.07E + 03
TC-99M	2.94E-02	8.32E - 02	1.06E - 00	NO DATA	1.26E + 00	4.07E - 02	4.92E + 01
TC-101	3.03E - 02	4.36E - 02	4.28E - 01	NO DATA	7.85E - 01	2.23E - 02	1.31E - 13
RU-103‡	1.98E + 01	NO DATA	8.54E - 01	NO DATA	7.57E + 01	NO DATA	2.31E + 03
RU-105‡	1.65E + 00	NO DATA	6.52E - 01	NO DATA	2.13E + 01	NO DATA	1.01E + 03
RU-106‡	2.95E + 02	NO DATA	3.73E + 01	NO DATA	5.69E + 02	NO DATA	1.91E + 04
AG-110M‡	1.42E + 01	1.31E + 01	7.80E + 00	NO DATA	2.58E + 01	NO DATA	5.36E + 03
SB-124	2.40E + 02	4.53E + 00	9.50E + 01	5.81E-01	NO DATA	1.87E + 02	6.81E + 03
SB-125‡	1.53E + 02	1.71E + 00	3.65E + 01	1.56E-01	NO DATA	1.18E + 02	1.69E + 03
SB-126	9.85E + 01	2.00E + 00	3.55E + 01	6.03E-01	NO DATA	6.04E + 01	8.05E + 03
SB-127	2.21E + 01	4.84E-01	8.47E + 00	2.65E-01	NO DATA	1.31E + 01	5.05E + 03
TE-125M	2.79E + 03	1.01E + 03	3.74E + 02	8.39E + 02	1.13E + 04	NO DATA	1.11E + 04
TE-127M‡	7.05E + 03	2.52E + 03	8.59E + 02	1.80E + 03	2.86E + 04	NO DATA	2.36E + 04
TE-127	1.14E + 02	4.11E + 01	2.48E + 01	8.48E + 01	4.66E + 02	NO DATA	9.03E + 03
TE-129M‡	1.20E + 04	4.47E + 03	1.89E + 03	4.11E + 03	5.00E + 04	NO DATA	6.03E + 04
TE-129	3.27E + 01	1.23E + 01	7.96E + 00	2.51E + 01	1.37E + 02	NO DATA	2.47E + 01
TE-131M‡	1.88E + 03	8.81E + 02	7.34E + 02	1.39E + 01	8.92E + 03	NO DATA	8.74E + 04
TE-131‡	2.05E + 01	8.57E + 00	6.47E + 00	1.69E + 01	8.98E + 01	NO DATA	2.90E + 00
TE-132‡	2.62E + 03	1.70E + 03	1.59E + 03	1.87E + 03	1.63E + 04	NO DATA	8.02E + 04
I-130	9.01E + 01	2.66E + 02	1.05E + 02	2.25E + 04	4.15E + 02	NO DATA	2.29E + 02
I-131‡	4.96E + 02	7.09E + 02	4.06E + 02	2.32E + 05	1.22E + 02	NO DATA	1.87E + 02
I-132	2.42E 01	6.47E + 01	2.26E + 01	2.26E + 03	1.03E + 02	NO DATA	1.22E + 01
I-133‡	1.69E + 02	2.94E + 02	8.97E + 01	4.32E + 04	5.13E + 02	NO DATA	2.64E + 02
I-134	1.26E + 01	3.43E + 01	1.23E + 01	5.94E + 02	5.46E + 01	NO DATA	2.99E - 02
I-135‡	5.28E + 01	1.38E + 02	5.10E + 01	9.11E + 03	2.22E + 02	NO DATA	1.56E + 02
CS-134	3.03E + 05	7.21E + 05	5.89E + 05	NO DATA	2.33E + 05	7.75E + 04	1.26E + 04
CS-136	3.17E + 04	1.25E + 05	9.01E + 04	NO DATA	6.97E + 04	9.55E + 03	1.42E + 04
CS-137‡	3.88E + 05	5.31E + 05	3.48E + 05	NO DATA	1.88E + 05	5.99E + 04	1.03E + 04
CS-138	2.69E + 02	5.31E + 02	2.63E + 02	NO DATA	3.90E + 02	3.85E + 01	2.27E - 03
BA-139	9.00E + 00	6.41E - 03	2.64E - 01	NO DATA	5.99E - 03	3.64E - 03	1.60E + 01
BA-140‡	1.88E + 03	2.37E + 00	1.23E + 02	NO DATA	8.05E - 01	1.35E + 00	3.88E + 03
BA-141‡	4.27E + 00	3.30E - 03	1.48E - 01	NO DATA	3.07E - 03	1.87E - 03	2.06E - 09
BA-142‡	1.98E + 00	2.03E - 03	1.24E - 01	NO DATA	1.72E - 03	1.15E - 03	2.78E - 18
LA-140	3.58E - 01	1.80E - 01	4.76E - 02	NO DATA	NO DATA	NO DATA	1.32E + 04
LA-142	1.83E - 02	8.33E - 03	2.07E - 03	NO DATA	NO DATA	NO DATA	6.08E + 01
CE-141	8.01E - 01	5.42E - 01	6.15E - 02	NO DATA	2.52E - 01	NO DATA	2.07E + 03
CE-143‡	1.41E - 01	1.04E + 02	1.16E - 02	NO DATA	4.60E - 02	NO DATA	3.90E + 03
CE-144‡	4.18E + 01	1.77E + 01	2.24E + 00	NO DATA	1.04E + 01	NO DATA	1.41E + 04
PR-143	1.32E + 00	5.28E - 011	6.52E - 02	NO DATA	3.05E - 01	NO DATA	5.77E + 03
PR-144	4.31E - 03	1.79E - 03	2.19E - 04	NO DATA	1.01E - 03	NO DATA	6.19E - 10
ND-147‡	9.00E - 01	1.04E + 00	6.22E - 02	NO DATA	6.08E - 01	NO DATA	4.99E + 03
W-187	3.04E + 02	2.55E + 02	8.90E + 01	NO DATA	NO DATA	NO DATA	8.34E + 04
NP-239	1.28E - 01	1.25E - 02	6.91E - 03	NO DATA	3.91E - 02	NO DATA	2.57E + 03

LIQUID RADWASTE TREATMENT SYSTEM
FIGURE 2.2-1

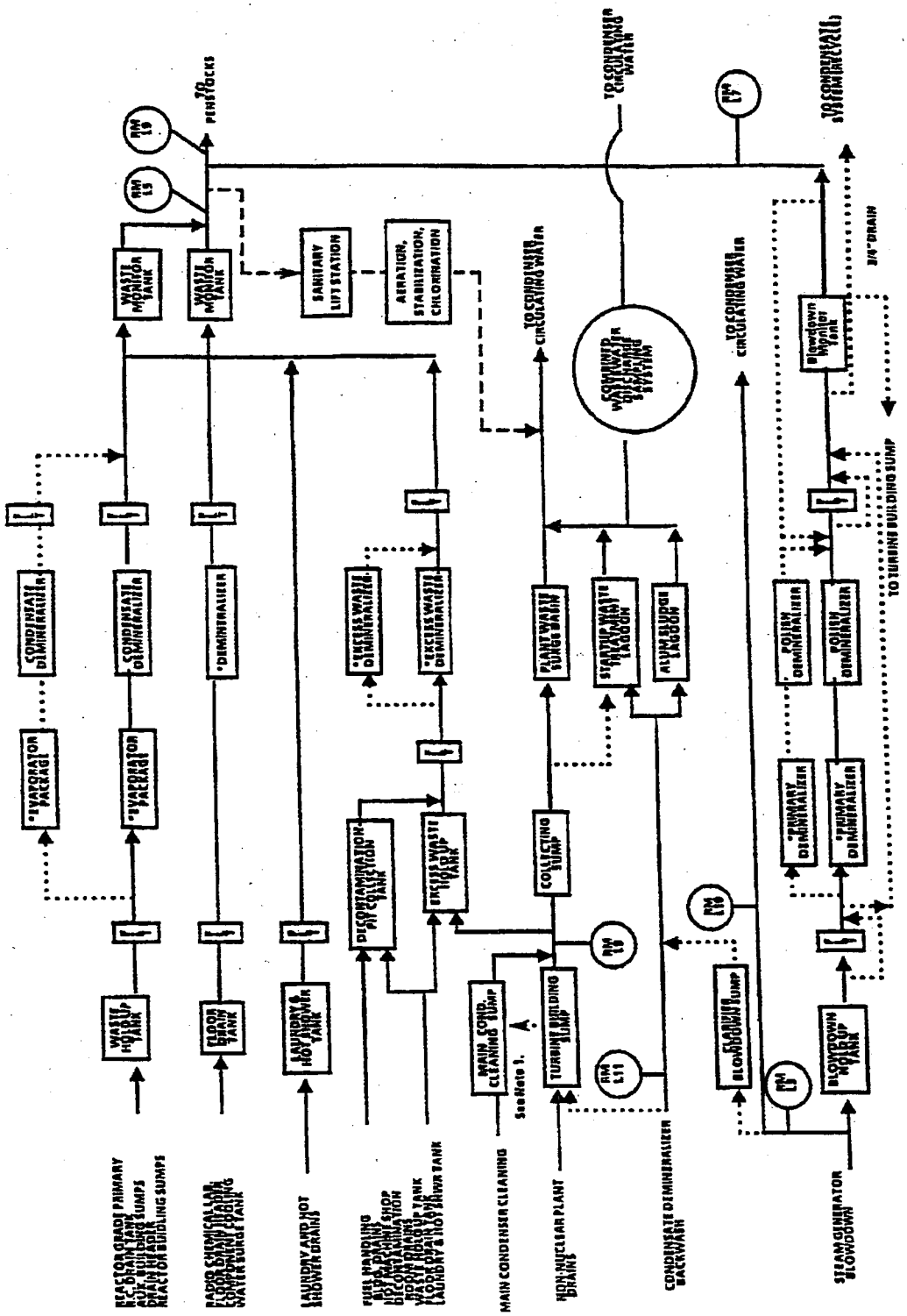


FIGURE 2.2-1

NOTES: 1. Turbine Building Sump contents may be processed to the main condenser cleaning sump through a portable demineralizer. This is an optional treatment pathway which provides processing flexibility in the event processing through excess liquid waste is not desirable. Since a temporary demineralizer is used for this optional treatment pathway, operability tests specified in ODCM specification 1.1.4.1 are not required. To ensure adequacy of the RM-L8 setpoint while using the alternate process pathway, samples must be obtained from the discharge side of the demineralizers or condenser cleaning sump and analyzed every twelve hours.

3.0 GASEOUS EFFLUENT

3.1 Gaseous Effluent Monitor Setpoints

The calculated setpoint values will be regarded as upper bounds for the actual setpoint adjustments. That is, setpoint adjustments are not required to be performed if the existing setpoint level corresponds to a lower count rate than the calculated value. Setpoints may be established at values lower than the calculated values, if desired.

Calculated monitor setpoints may be added to the ambient background count rate.

3.1.1 Gaseous Effluent Monitor Setpoint Calculation Parameters

Term		Definition	Section of Initial Use
C_v	=	count rate of a station vent monitor corresponding to grab sample radionuclide concentrations, X_{iv}, as determined from the monitor's calibration curve, in cpm.	(3.1.2)
C_v'	=	the count rate of the monitor on vent v corresponding to X_v' uCi/cc of Xe-133, in cpm.	(3.1.4)
c	=	count rate of the gas decay system monitor for measured radionuclide concentrations corrected to discharge pressure, in cpm.	(3.1.3)
c'	=	the count rate of the waste gas decay system monitor corresponding to the total noble gas concentration in cpm.	(3.1.4)
D_{SS}	=	limiting dose rate to the skin (3000 mrem/year).	(3.1.2)
D_{TB}	=	limiting dose rate to the total body (500 mrem/year).	(3.1.2)
F_v	=	the flow rate in vent v (cc/sec) (1 cc/sec = 0.002119 cfm).	(3.1.2)
f_s	=	the maximum permissible waste gas discharge rate, based on the actual radionuclide mix and skin dose rate (cc/sec).	(3.1.3)
f_t		the maximum permissible waste gas discharge rate, based on the actual radionuclide mix and	(3.1.3)

Term		Definition	Section of Initial Use
		total body dose rate (cc/sec).	
f_w	=	the maximum permissible waste gas discharge rate, the lesser of f_s and f_t (cc/sec).	(3.1.3)
f_s'	=	the conservative maximum permissible waste gas discharge rate based on Kr-89 skin dose rate (cc/sec).	(3.1.4)
f_t'	=	the conservative maximum permissible waste gas discharge rate based on Kr-89 total body dose rate (cc/sec).	(3.1.4)
K_i	=	total body dose factor due to gamma emissions from isotope i (mrem/year per uCi/m^3) from Table 3.1-1.	(3.1.2)
$K_{kr\text{-}89}$	=	total body dose factor for Kr-89, the most restrictive isotope from Table 3.1-1 (mrem/yr per uCi/m^3).	(3.1.3)
L_i	=	Skin dose factor due to beta emissions from isotope i (mrem/yr per uCi/m^3) from Table 3.-1-1.	(3.1.2)
$L_{Kr\text{-}89}$	=	Skin dose factor for Kr-89, the most restrictive isotope, from Table 3.1-1 (mrem/yr per uCi/m^3).	(3.1.3)
M_i	=	air dose factor due to gamma emissions from isotope i (mrad/yr per uCi/m^3) from Table 3.1-1.	(3.1.2)
$M_{Kr\text{-}89}$	=	air dose factor for Kr-89, the most restrictive isotope, from Table 3.1-1 (mrad/yr per uCi/m^3).	(3.1.3)
R_s	=	count rate per mrem/yr to the skin.	(3.1.2)
R_t	=	count rate per mrem/yr to the total body.	(3.1.2)
R_s'	=	conservative count rate per mrem to the skin (Xe-133 detection, Kr-89 dose).	(3.1.4)
R_t'	=	conservative count rate per mrem to the total body (Xe-133 detection, Kr-89 dose).	(3.1.4)

Term		Definition	Section of Initial Use
S_d	=	count rate of the waste gas decay system noble gas monitor at the alarm setpoint, in cpm.	(3.1.3)
S_v	=	count rate of a station vent noble gas monitor at the alarm setpoint, in cpm.	(3.1.2)
S_{vc}	=	count rate of the containment purge noble gas monitor at the alarm setpoint, in cpm.	(3.1.2)
S_{vp}	=	count rate of the plant vent noble gas monitor at the alarm setpoint, in cpm.	(3.1.2)
X_{id}	=	the concentration of noble gas radionuclide i in a waste gas decay tank, as corrected to the pressure of the discharge stream at the point of its flow measurement in uCi/cc.	(3.1.3)
X_{iv}	=	the measured concentration of noble gas radionuclide i in the last grab sample analyzed for vent v in uCi/cc.	(3.1.2)
X_d'	=	the total noble gas concentration in a waste gas decay tank, as corrected to the pressure of the discharge stream at the point of its flow measurement in uCi/cc.	(3.1.4)
X_v'	=	a concentration of Xe-133 chosen to be in the operating range of the monitor on vent v in uCi/cc.	(3.1.4)
$\overline{X/Q}$	=	the highest annual average relative concentration in any sector, at the site boundary in sec/m^3.	(3.1.2)
1.1	=	mrem skin dose per mrad air dose	(3.1.2)
0.25	=	the safety factor applied to each of the two vent noble gas monitors (plant vent and containment purge) to assure that the sum of the releases has a combined safety factor of 0.5 which allows a 100 percent margin for cumulative uncertainties of measurements.	(3.1.2)

TABLE 3.1-1

DOSE FACTORS FOR EXPOSURE TO A SEMI-INFINITE CLOUD OF NOBLE GASES,*

Nuclide	γ-Body***(K_i)	β-Skin***(L_i)	γ-Air**(M_i)	β-Air**(N_i)
Kr-85m	1.17E + 03****	1.46E + 03	1.23E + 03	1.97E + 03
Kr-85	1.61E + 01	1.34E + 03	1.72E + 01	1.95E + 03
Kr-87	5.92E + 03	9.73E + 03	6.17E + 03	1.03E + 04
Kr-88	1.47E + 04	2.37E + 03	1.52E + 04	2.93E + 03
Kr-89	1.66E + 04	1.01E + 04	1.73E + 04	1.06E + 04
Kr-90	1.56E + 04	7.29E + 03	1.63E + 04	7.83E + 03
Xe-131m	9.15E + 01	4.76E + 02	1.56E + 02	1.11E + 03
Xe-133m	2.51E + 02	9.94E + 02	3.27E + 02	1.48E + 03
Xe-133	2.94E + 02	3.06E + 02	3.53E + 02	1.05E + 03
Xe-135m	3.12E + 03	7.11E + 02	3.36E + 03	7.39E + 02
Xe-135	1.81E + 03	1.86E + 03	1.92E + 03	2.46E + 03
Xe-137	1.42E + 03	1.22E + 04	1.51E + 03	1.27E + 04
Xe-138	8.83E + 03	4.13E + 03	9.21E + 03	4.75E + 03
Ar-41	8.84E + 03	2.69E + 03	9.30E + 03	3.28E + 03

*Values taken from Reference 3, Table B-1

** $\frac{\text{mrad} - \text{m}^3}{\mu\text{Ci} - \text{yr}}$

*** $\frac{\text{mrem} - \text{m}^3}{\mu\text{Ci} - \text{yr}}$

****1.17E + 03 = 1.17×10^3

CO1→ 3.1.2 Station Vent Noble Gas Monitors (RM-A3 and RM-A4

For the purpose of implementation of section 1.2.1 of the ODCM, the alarm setpoint level for the station vent noble gas monitors will be calculated as follows:

S_v = count rate of the plant vent noble gas monitor (= S_{vp} for RM-A3) or the containment purge noble gas monitor (= S_{vc} for RM-A4) at the alarm setpoint level.

$$\leq \text{the lesser of} \quad \begin{array}{c} 0.25 \times R_t \times D_{TB} \quad (34) \\ \text{or} \\ 0.25 \times R_s \times D_{SS} \quad (35) \end{array}$$

0.25 = the safety factor applied to each of the two vent noble gas monitors (plant vent and containment purge) to assure that the sum of the releases has a combined safety factor of 0.5 which allows a 100 percent margin for cumulative uncertainties of measurements.

D_{TB} = Dose rate limit to the total body of an individual
= 500 mrem/yr

R_t = count rate per mrem/yr to the total body

$$= C_v / (\overline{(X/Q)} \times F_v \times \sum_i K_i X_{iv}) \quad (36)$$

Dss = Dose rate limit to the skin of the body of an individual in an unrestricted area.
= 3000 mrem/year.

Rs = count rate per mrem/yr to the skin.

$$= C_v \div [\overline{X/Q} \times F_v \times \sum_i (L_i + 1.1\, M_i)\, X_{iv}] \quad (37)$$

X_{iv} = the measured concentration of noble gas radionuclide i in the last grab sample analyzed for vent v, μCi/ml. (For the plant vent, grab samples are taken at least

monthly. For the 6" and 36" containment purge lines, the sample is taken just prior to the release and also monthly, if the release is continuous.)

F_v = the flow rate in vent v, cc/sec. (1 cc/sec = 0.002119 cfm)

C_v = count rate, (cpm) of the monitor on station vent v corresponding to grab sample noble gas concentrations, X_{iv}, as determined from the monitor's calibratopm curve; i.e., product of the monitor response curve slope (^{cpm}/uCi/ml) and the sum of the noble gas concentrations in the grab sample (uCi/ml). (Initial calibration curves of the type shown in Figure 2.1-1 have been determined conservatively from families of response curves supplied by the monitor manufacturers. As releases occur, a historical correlation will be prepared and placed in service when sufficient data are accumulated.)

$\overline{X/Q}$ = the highest annual average relative concentration in any sector, at the site boundary (seven year average).

= 6.3E-6 sec/m^3 in the ENE sector.

K_i = total body dose factor due to gamma emissions from isotope i (mrem/yr per μCi/m^3) from Table 3.1-1.

L_i = skin dose factor due to beta emissions from isotope i (mrem/yr per μCi/m^3) from Table 3.1-1.

1.1 = mrem skin dose per mrad air dose.

M_i = air dose factor due to gamma emissions from isotope i (mrad/yr per μCi/m^3) from Table 3.1-1.

NOTE: At plant startups when no grab sample analysis is available for the continuous releases, the Alternate Methodology of Section 3.1.4 must be used.

3.1.3 Waste Gas Decay System Monitor (RM-A10)

The permissible conditions for discharge through the waste gas decay system monitor (RM-A10) will be calculated in a manner similar to that for the plant vent noble gas monitor. In the case of the waste gas system, however, the discharge flow rate is continuously controllable by valve HCV-014 and permissible release conditions are therefore defined in terms of both flow rate and concentration. Therefore, RM-A10 is used only to insure that a representative sample was obtained.

For operational convenience, (to prevent spurious alarms due to fluctuations in background) the setpoint level will be established at 1.5 times the measured waste concentration.

The maximum permissible flow rate will be set on the same basis but include the engineering safety factor of 0.5. The RM-A10 setpoint level S_d is defined as:

$$S_d \leq 1.5c \qquad (38)$$

where:

c = count rate in CPM of the waste gas decay system monitor corresponding to the measured concentration (taken from the monitor calibration curves).

The maximum permissible waste gas flow rate f_w (cc/sec) is calculated from the maximum permissible dose rates at the site boundary according to:

$$f_w \leq \text{the lesser of } f_t \text{ or } f_s \qquad (39)$$

f_t = the maximum permissible discharge rate based on total body dose rate.

$$= 0.25 \, x \, D_{TB} \; / \; [\overline{X/Q} \text{ x } 1.5 \sum_i X_{id} \, K_i] \qquad (40)$$

f_s = the maximum permissible discharge rate based on skin dose rate.

$$= 0.25 \, x \, D_{SS} \; / \, [\overline{X/Q} \, x \, 1.5 \sum_i X_{id} \, (L_i + 1.1 M_i)] \qquad (41)$$

X_{id} = the concentration of noble gas radionuclide i in the waste gas decay tank whose contents are to be discharged, as corrected to the pressure of the discharge stream at the point of the flow rate measurement. The maximum discharge pressure as governed by the diaphragm valve, 7896, is 30 psia.

NOTE: The factor of 1.5 in the denominators of equations (40) and (41) places f_w on the same basis as S_d.

When a discharge is to be conducted, valve HCV-014 is to be opened until (a) the waste gas discharge flow rate reaches 0.9 x f_w or (b) the count rate of the plant vent noble gas monitor RM-A3 approaches its setpoint, whichever of the above conditions is reached first.

When no discharges are being made from the Waste Gas Decay System, the RM-A10 setpoint should be established as near background as practical to prevent spurious alarms and yet alarm in the event of an inadvertent release.

3.1.4 <u>Alternative Methodology for Establishing Conservative Setpoints</u>

As an alternate to the methodology of section 3.1.2, to minimize necessity for frequent adjustment of setpoint, a conservative setpoint may be calculated as follows:

For a plant vent:

R_t' = conservative count rate per mrem/yr to the total body (Xe-133 detection, Kr-89 dose).

$$= C_v' \div [\overline{X/Q} \times K_{kr\text{-}89} \times X_v' \times F_v], \quad (42)$$

where:

X_v' = a concentration of Xe-133 chosen to be in the operating range of the monitor on vent v, μCi/cc.

C_v' = the count rate in CPM of the monitor on vent v corresponding to X_v' μCi/cc of XE-133.

$K_{Kr\text{-}89}$ = total body dose factor for Kr-89, the most restrictive isotope from Table 3.1-1.

R_s' = count rate per mrem/yr to the skin.

$$= C_v' \div [\overline{X/Q} \times (L_{Kr\text{-}89} + 1.1M_{kr\text{-}89}) \times X_v' \times F_v] \quad (43)$$

where:

$L_{Kr\text{-}89}$ = skin dose factor for Kr-89, the most restrictive isotope from Table 3.1-1.

$M_{Kr\text{-}89}$ = air dose factor for Kr-89, the most restrictive isotope, from Table 3.1-1.

For the waste gas decay system:

f_t' = the conservative maximum permissible discharge rate based on Kr-89 total body dose rate.

$$= 0.25 \times D_{TB} \div [\overline{X/Q} \times 1.5 \times X_d' \; K_{kr\text{-}89}] \quad (44)$$

f_s' = the conservative maximum permissible discharge rate based on Kr-89 skin dose rate.

$$= 0.25 \times D_{SS} \div [\overline{X/Q} \times 1.5 \times X_d' \times (L_{Kr\text{-}89} + 1.1M_{Kr\text{-}89})] \quad (45)$$

X_d' = the total concentration of noble gas radionuclides in the waste gas decay tank whose contents are to be discharged, as corrected to the pressure of the discharge stream at the point of the flow measurement.

c' = count rate in cpm of the waste gas decay system monitor corresponding to X_d' μCi/cc of Kr-85.

3.1.5 Oil Incineration

3.1.5.1 Releases from the oil incinerator will be limited such that

$$\overline{X/Q}_{(oil)} \Sigma P_i Q_{(oil)} < 1.5 \text{ mrem/yr.} \qquad \text{Eq. (60)}$$

where:

$\overline{X/Q}$ (oil) = highest annual average dispersion coefficient (sec/m^3) at the site boundary

= 3.3E-5 sec/m^3

P_i = dose parameter for radionuclide $_i$ for inhalation, from Table 3.2-1 (mrem/yr per uCi/m^3),

$Q_{(oil)}$ = $C_{i(oil)}$ X R

where:

$C_{i(oil)}$ = concentration of radionuclide $_i$ in oil (uCi/ml), and

R = burn rate (ml/s).

3.1.5.2 Incinerator operation will be administratively controlled such that the combination of gaseous releases from the station and oil incineration will be less than Specifications 1.2.2.1(b) and 1.2.5.1. If noble gases are detected in waste oil, an assessment of release acceptability should be performed using the general methodology described in sections 3.2.2.1 and 3.2.3.1.

3.1.6 Meteorological Release Criteria for Batch Releases

Planned gaseous batch releases (WGDT) and oil incineration will be performed during favorable meteorology. Limiting releases to favorable meteorology provides assurance that release conditions will be conservative with respect to annual average dispersion values, ($\overline{X/Q}$, $\overline{X/Q'}$) . Favorable meteorology is defined in Table 3.1-2.

Table 3.1-2

Favorable Meteorology

Differential Temperature (ΔT)[1] °F		Stability Class	Wind Speed[2] (mph)	
61m - 10m	40m - 10m		10m	61m
$\Delta T \leqq -1.74$	$\Delta T \leqq -1.03$	A	*	*
$-1.74 < \Delta T \leqq -1.56$	$-1.03 < \Delta T \leqq -0.92$	B	*	*
$-1.56 < \Delta T \leqq -1.38$	$-0.92 < \Delta T \leqq -0.81$	C	1.3	1.6
$-1.38 < \Delta T \leqq -0.46$	$-0.81 < \Delta T \leqq -0.27$	D	3.1	4.1
$-0.46 < \Delta T \leqq 1.38$	$-0.27 < \Delta T \leqq 0.81$	E	3.5	6.6
$1.38 < \Delta T \leqq 3.67$	$0.81 < \Delta T \leqq 2.16$	F	5.2	14.0
$3.67 < \Delta T$	$2.16 < \Delta T$	G	7.0	18.9

Notes:

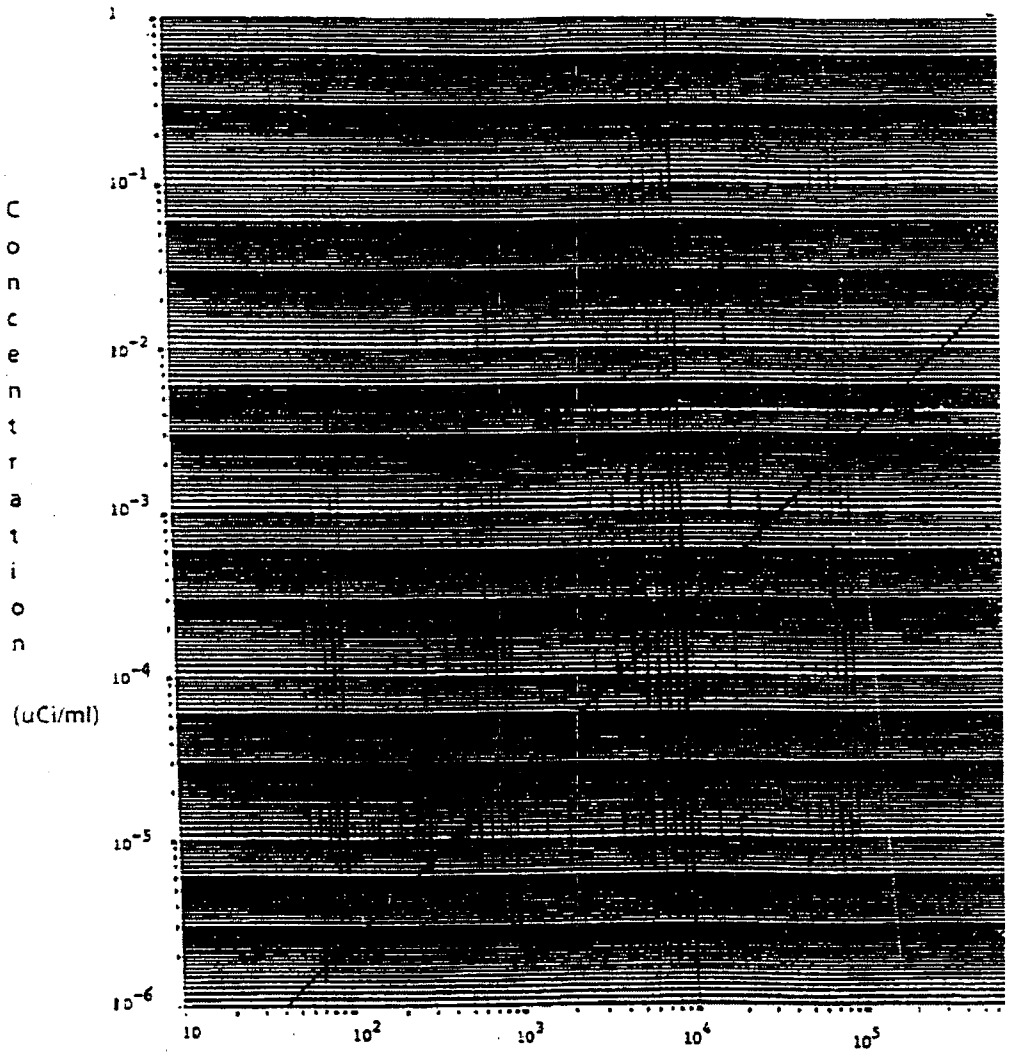
1 The ΔT values for 61m - 10m are considered as primary indicators for determination of stability class. The 40m - 10m ΔT values are used only when 61m - 10m values are not available. All ΔT values are listed in °F and are based on values in USNRC Regulatory Guide 1.23.

2 The 10m wind speed is considered the primary indication for windspeed. The 61m wind speed indication should only be used if 10m is not available.

* No wind is required for planned releases.

Figure 3.1-1

Example Noble Gas Monitor
Calibration Curve



3.2 Dose Calculation for Gaseous Effluent

3.2.1 Gaseous Effluent Dose Calculation Parameters

Term		Definition	Section of Initial Use
D_o	=	average organ dose rate in the current year (mrem/yr).	(3.2.2.2)
D_p	=	dose to an individual from radioiodine and radionuclides in particulate form and radionuclides (other than noble gases), with half-lives greater than eight days (mrem).	(3.2.3.2)
D_s	=	average skin dose rate in current year (mrem/year).	(3.2.2.1)
D_t	=	current total body dose rate (mrem/yr)	(3.2.2.1)
D_β	=	air dose due to beta emissions from noble gas radionuclides (mrad).	(3.2.3.1)
D_γ	=	air dose due to gamma emissions from noble gas radionuclides (mrad).	(3.2.3.1)
K_i	=	total body dose factor due to gamma emissions from isotope i (mrem/year per uCim^3) from Table 3.1-1.	(3.2.2.1)
L_i	=	skin dose factor due to beta emissions from noble gas radionuclide i (mrad/yr per μCi/m^3) from Table 3.1-1.	(3.2.2.1)
M_i	=	air dose factor due to gamma emissions from noble gas radionuclide i (mrad/yr per μCi/m^3) from Table 3.1-1.	(3.2.2.1)
N_i	=	air dose factor due to beta emissions from noble gas radionuclide i (mrad per μCi/m^3) from Table 3.1-1.	(3.2.3.1)
P_i	=	dose parameter for radionuclide i, (mrem/yr per μCi/m^3) for inhalation, from Table 3.2-1.	(3.2.2.2)
$\overline{Q}_i$	=	the release rate of noble gas radionuclide i as determined from the concentrations measured in the analysis of the appropriate sample required by Table 1.2-3 (μCi/sec).	(3.2.2.1)

Term		Definition	Section of Initial Use
$\overline{Q_i}'$	=	the release of non-noble gas radionuclide i as determined from the concentrations measured in the analysis of the appropriate sample required by Table 1.2-3 (μCi/sec).	(3.2.2.2)
$\tilde{Q}_i$	=	cumulative release of noble gas radionuclide i over the period of interest (μCi).	(3.2.3.1)
$\tilde{Q}_i'$	=	cumulative release of non-noble gas radionuclide i (required by ODCM Specification 1.2.4.1) over the period of interest (μCi).	(3.2.3.2)
R_{ij}	=	dose factor for radionuclide i and pathway j, (mrem/yr per uCi/m^3) or (m^2-mrem/yr per μCi/sec) from Tables 3.2-2 through 3.2-6.	(3.2.3.2)
W_{ij}'	=	relative dispersion parameter for the maximum exposed individual, as appropriate for his exposure pathway j and radionuclide i.	(3.2.3.2)
	=	$\overline{X/Q}'$ for inhalation and all tritium pathways	
	=	$\overline{D/Q}'$ for other pathways and non-tritium radionuclides	
$\overline{X/Q}$	=	the highest annual average relative concentration in any sector, at the site boundary in sec/m^3.	(3.2.2.1)
3.17×10^{-8}	=	the fraction of one year per one second	(3.2.3.1)
$\overline{X/Q}'$	=	Annual average relative concentration for the location of the maximum exposed individual for the site (sec/m^3).	(3.2.3.2)
$\overline{D/Q}'$	=	Annual average relative deposition for the location of the maximum exposed individual for the site (m^{-2}).	(3.2.3.2)

3.2.2 Unrestricted Area Boundary Dose

3.2.2.1 For the purpose of implementation of section 1.2.2.1a, (≤ 500 mrem/year - total body, ≤ 3000 mrem/year - skin) the dose at the unrestricted area boundary due to noble gases shall be calculated as follows:

D_t = current total body dose rate (mrem/yr)

$$= \overline{X/Q} \sum_i K_i \overline{\dot{Q}_i} \qquad (46)$$

D_s = current skin dose rate (mrem/yr)

$$= \overline{X/Q} \sum_i (L_i + 1.1M_i) \overline{\dot{Q}_i} \qquad (47)$$

where:

$\overline{\dot{Q}_i}$ = the release rate of noble gas radionuclide i as determined from the concentration measured in the analysis of the appropriate sample required by Table 1.2-3 (μCi/sec.).

$\overline{X/Q}$ = the highest annual average relative concentration in any sector, at the site boundary (for value, see Section 3.1.2).

K_i, L_i, and M_i will be selected for the appropriate radionuclide from Table 3.1-1.

3.2.2.2 For the purpose of implementation of section 1.2.2.1.b (≤ 1500 mrem/yr - any organ) organ doses due to radioiodines and all radioactive materials in particulate form and radionuclides (other than noble gases) with half-lives greater than eight days, will be calculated as follows:

D_o = current organ dose rate (mrem/yr)

$$= \sum_i \overline{X/Q}\, P_i \overline{\dot{Q}_i}' \qquad (48)$$

where:

$\overline{X/Q}$ = the highest annual average relative concentration in any sector, at the site boundary (for value, see Section 3.1.2)

P_i = dose parameter for radionuclide i, (mrem/yr per $\mu Ci/m^3$) for inhalation, from Table 3.2-1.

$\overline{\dot{Q}_i}'$ = the release rate of non-noble gas radionuclide i as determined from the concentrations measured in the analysis of the appropriate sample required by Table 1.2-3 (μCi/sec.).

3.2.3 Unrestricted Area Dose (Air Dose and Dose to Individual)

3.2.3.1 For the purpose of implementation of section 1.2.3.1 (Calendar quarter: $\leq$ 5 mrad - γ and $\leq$ 10 mrad - β, Calendar year: $\leq$ 10 mrad - γ and $\leq$ 20 mrad - β) and section 1.2.5.1 (air dose averaged over 31 days: $\leq$ 0.2 mrad - γ and $\leq$ 0.4 mrad - β), the air dose in unrestricted areas shall be determined as follows:

$D\gamma$ = air dose due to gamma emissions from noble gas radionuclide i (mrad)

$$= 3.17 \times 10^{-8} \sum_i M_i \overline{X/Q} \tilde{Q}_i \qquad (49)$$

where:

3.17×10^{-8} = the fraction of one year per one second

$\tilde{Q}_i$ = cumulative release of noble gas radionuclide i over the period of interest (μCi).

D_β = air dose due to beta emissions from noble gas radionuclide i (mrad).

$$= 3.17 \times 10^{-8} \sum_i N_i \overline{X/Q} \tilde{Q}_i \qquad (50)$$

where, N_i = air dose factor due to beta emission from noble gas radionuclide i (mrad/yr per uCi/m^3) from Table 3.1-1.

3.2.3.2 For all gaseous effluents including oil incineration, dose to an individual from radioiodines and radioactive materials in particulate form and radionuclides (other than noble gases), with half-lives greater than eight (8) days (Calendar quarter: $\leq$ 7.5 mrem any organ, Calendar year: $\leq$ 15 mrem any organ) will be calculated for the purpose of implementation of section 1.2.4.1 as follows:

D_p = dose to an individual from radioiodines and radionuclides in particulate form, with half-lives greater than eight days (mrem)

$$= 3.17 \times 10^{-8} \sum_{ij} R_{ij} W'_{ij} \tilde{Q}'_i \qquad (51)$$

where:

W'_{ij} = relative concentration or relative deposition for the maximum exposed individual, as appropriate for exposure pathway j and radionuclide i.

$\overline{X/Q'}$ for inhalation and all tritium pathways
= 3.5×10^{-6} sec/m^3

=

$\overline{D/Q'}$ for other pathways and non-tritium radionuclides
= 1.1×10^{-8} m^{-2}

(See the notes to Table 3.2-7 and 3.2-8 for the origin of these factors.)

R_{ij} = dose factor for radionuclide i and pathway j, (mrem/yr per μCi/m^3) or (m^2 - mrem/yr per μCi/sec) from Table 3.2-2.

$\tilde{Q}_i'$ = Cumulative release of non-noble gas radionuclide i (required by ODCM Specification 1.2.4.1) over the period of interest (μCi).

3.2.4 For the purpose of initial assessments of the impact of unplanned gaseous releases, dose calculations for the critical receptor in each affected sector may be performed using section 3.2.3.1 and section 3.2.3.2 equations as follows:

(1) For each affected sector, X/Q and D/Q will be calculated for one mile and critical receptor locations using actual meteorological conditions occurring during the unplanned release. Actual X/Q and D/Q values will be compared to annual average dispersion coefficients ($\overline{X/Q}$, $\overline{X/Q'}$, and $\overline{X/Q'}$). The more limiting dispersion coefficients will be used along with methodology in sections 3.2.3.1 and 3.2.3.2 for the initial assessment.

(2) The location of the critical receptors and the pathways j which should be analyzed are shown in Table 3.2-7. (For very rough calculations, the annual average dispersion coefficients ($\overline{X/Q}$ and $\overline{D/Q}$) for each receptor are shown in Table 3.2-8.)

(3) The R_{ij} for the appropriate exposure pathways and age groups will be selected from Tables 3.2-3 through 3.2-6.

TABLE 3.2-1

PATHWAY DOSE FACTORS FOR SECTION 3.2.2.2 (P_i)*

Page 1 of 3

AGE GROUP	(CHILD)
ISOTOPE	**INHALATION**
H-3	1.125E + 03
C-14	3.589E + 04
NA-24	1.610E + 04
P-32	2.605E + 06
CR-51	1.698E + 04
MN-54	1.576E + 06
MN-56	1.232E + 05
FE-55	1.110E + 05
FE-59	1.269E + 06
CO-58	1.106E + 06
CO-60	7.067E + 06
NI-63	8.214E + 05
NI-65	8.399E + 04
CU-64	3.670E + 04
ZN-65	9.953E + 05
ZN-69	1.018E + 04
BR-83	4.736E + 02
BR-84	5.476E + 02
BR-85	2.531E + 01
RB-86	1.983E + 05
RB-88	5.624E + 02
RB-89	3.452E + 02
SR-89	2.157E + 06
SR-90	1.010E + 08
SR-91	1.739E + 05

*See note, page 3.0-20

Units - mrem/yr per $\mu Ci/m^3$

TABLE 3.2-1

PATHWAY DOSE FACTORS FOR SECTION 3.2.2.2 (P_i)

AGE GROUP	(CHILD)
ISOTOPE	INHALATION
SR-92	2.424E + 05
Y-90	2.679E + 05
Y-91M	2.812E + 03
Y-91	2.627E + 06
Y-92	2.390E + 05
Y-93	3.885E + 05
ZR-95	2.231E + 06
ZR-97	3.511E + 05
NB-95	6.142E + 05
MO-99	1.354E + 05
TC-99M	4.810E + 03
TC-101	5.846E + 02
RU-103	6.623E + 05
RU-105	9.953E + 04
RU-106	1.476E + 07
AG-110M	5.476E + 06
TE-125M	4.773E + 05
TE-127M	1.480E + 06
TE-127	5.624E + 04
TE-129M	1.761E + 06
TE-129	2.549E + 04
TE-131M	3.078E + 05
TE-131	2.054E + 03
TE-132	3.774E + 05
I-130	1.846E + 06

*See note, page 3.0-20

Units - mrem/yr per $\mu Ci/m^3$

TABLE 3.2-1

PATHWAY DOSE FACTORS FOR SECTION 3.2.2.2 (P_i)

AGE GROUP	(CHILD)
ISOTOPE	**INHALATION**
I-131	1.624E + 07
I-132	1.935E + 05
I-133	3.848E + 06
I-134	5.069E + 04
I-135	7.918E + 05
CS-134	1.014E + 06
CS-136	1.709E + 05
CS-137	9.065E + 05
CS-138	8.399E + 02
BA-139	5.772E + 04
BA-140	1.743E + 06
BA-141	2.919E + 03
BA-142	1.643E + 03
LA-140	2.257E + 05
LA-142	7.585E + 04
CE-141	5.439E + 05
CE-143	1.273E + 05
CE-144	1.195E + 07
PR-143	4.329E + 05
PR-144	1.565E + 03
ND-147	3.282E + 05
W-187	9.102E + 04
NP-239	6.401E + 04

NOTE: The P_i values of Table 3.2-1 were calculated according to the methods of Reference 1, Section 5.2.1, for children. The values used for the various parameters and the origins of those values are given in Table 3.2-9 and its notes.

Units - mrem/yr per $\mu Ci/m^3$

TABLE 3.2-2

PATHWAY DOSE FACTORS FOR SECTION 3.2.3.2 (R_i)*

AGE GROUP	(CHILD)	(N.A.)	(CHILD)
ISOTOPE	INHALATION	GROUND PLANE	VEGETATION
H-3	1.125E+03 (Total Body)	0.000E+00 (Skin)	3.627E+03 (Total Body)
C-14	3.589E+04 (Bone)	0.000E+00 (Skin)	8.894E+08 (Bone)
NA-24	1.610E+04(Total Body)	3.33E+08 (Skin)	3.729E+05(Total Body)
P-32	2.605E+06 (Bone)	0.000E+00 (Skin)	3.366E+09 (Bone)
CR-51	1.698E+04 (Lung)	5.506E+06 (Skin)	6.213E+06 (GI-LLI)
MN-54	1.576E+06 (Lung)	1.625E+09 (Skin)	6.648E+08 (Liver)
MN-56	1.232E+05 (GI-LLI)	1.068E+06 (Skin)	2.723E+03 (GI-LLI)
FE-55	1.110E+05 (Lung)	0.000E+00 (Skin)	8.012E+08 (Bone)
FE-59	1.269E+06 (Lung)	3.204E+08 (Skin)	6.693E+08 (GI-LLI)
CO-58	1.106E+06 (Lung)	4.464E+08 (Skin)	3.771E+08 (GI-LLI)
CO-60	7.067E+06 (Lung)	2.532E+10 (Skin)	2.095E+09 (GI-LLI)
NI-63	8.214E+05 (Bone)	0.000E+00 (Skin)	3.949E+10 (Bone)
NI-65	8.399E+04 (GI-LLI)	3.451E+05 (Skin)	1.211E+03 (GI-LLI)
CU-64	3.670E+04 (GI-LLI)	6.876E+05 (Skin)	5.159E+05 (GI-LLI)
ZN-65	9.953E+05 (Lung)	8.583E+08 (Skin)	2.164E+09 (Liver)
ZN-69	1.018E+04 (GI-LLI)	0.000E+00 (Skin)	9.893E-04 (GI-LLI)
BR-83	4.736E+02(Total Body)	7.079E+03 (Skin)	5.369E+00(Total Body)
BR-84	5.476E+02(Total Body)	2.363E+05 (Skin)	3.822E - 11(Total Body)
BR-85	2.531E+01 (Total Body)	0.000E+00 (Skin)	0.000E+00(Total Body)
RB-86	1.983E+05 (Liver)	1.035E+07 (Skin)	4.584E+08 (Liver)
RB-88	5.624E+02 (Liver)	3.779E+04 (Skin)	4.374E - 22 (Liver)
RB-89	3.452E+02 (Liver)	1.452E+05 (Skin)	1.642E - 26 (Liver)
SR-89	2.157E+06 (Lung)	2.509E+04 (Skin)	3.593E+10 (Bone)
SR-90	1.010E+08 (Bone)	0.000E+00 (Skin)	1.243E+12 (Bone)
SR-91	1.739E+ 05 (GI-LLI)	2.511E+06 (Skin)	1.157E+06 (GI-LLI)

* See note, page 3.0-36

** Reference 1, section 5.3.1, page 30, paragraph 1 explains the logic used in selecting these specific pathways.

*** Critical organs for each pathway by nuclide in parentheses.

Units -

Inhalation and all tritium - mrem/yr per $\mu Ci/m^3$

Other pathways for all other radionuclides - m^2 • mrem/yr per $\mu Ci/sec$

TABLE 3.2-2 (continued)

PATHWAY DOSE FACTORS FOR SECTION 3.2.3.2 (R_i)

AGE GROUP	(CHILD)	(N.A.)	(CHILD)
ISOTOPE	INHALATION	GROUND PLANE	VEGETATION
SR - 92	2.424E+05 (GI-LLI)	8.631E+05 (Skin)	1.378E+04 (GI-LLI)
Y - 90	2.679E+05 (GI-LLI)	5.308E+03 (Skin)	6.569E+07 (GI-LLI)
Y - 91M	2.812E+03 (Lung)	1.161E+05 (Skin)	1.737E - 05 (GI-LLI)
Y - 91	2.627E+06 (Lung)	1.207E+06 (Skin)	2.484E+09 (GI-LLI)
Y - 92	2.390E+05 (GI-LLI)	2.142E+05 (Skin)	4.576E+04 (GI-LLI)
Y - 93	3.885E+05 (GI-LLI)	2.534E+05 (Skin)	4.482E+06 (GI-LLI)
ZR - 95	2.231E+06 (Lung)	2.837E+08 (Skin)	8.843E+08 (GI-LLI)
ZR - 97	3.511E+05 (GI-LLI)	3.445E+06 (Skin)	1.248E+07 (GI-LLI)
NB - 95	6.142E+05 (Lung)	1.605E+08 (Skin)	2.949E+08 (GI-LLI)
MO - 99	1.354E+05 (Lung)	4.626E+06 (Skin)	1.647E+07 (Kidney)
TC - 99M	4.810E+03 (GI-LLI)	2.109E+05 (Skin)	5.255E+03 (GI-LLI)
TC - 101	5.846E+02 (Lung)	2.277E+04 (Skin)	4.123E - 29 (Kidney)
RU - 103	6.623E+05 (Lung)	1.265E+08 (Skin)	3.971E+08 (GI-LLI)
RU - 105	9.953E+04 (GI-LLI)	7.212E+05 (Skin)	5.981E+04 (GI-LLI)
RU - 106	1.476E+07 (Lung)	5.049E+08 (Skin)	1.159E+10 (GI-LLI)
AG - 110M	5.476E+06 (Lung)	4.019E+09 (Skin)	2.581E+09 (GI-LLI)
TE - 125M	4.773E+05 (Lung)	2.128E+06 (Skin)	3.506E+08 (Bone)
TE - 127M	1.480E+06 (Lung)	1.083E+05 (Skin)	3.769E+09 (Kidney)
TE - 127	5.624E+04 (GI-LLI)	3.293E+03 (Skin)	3.903E+05 (GI-LLI)
TE - 129M	1.761E+06 (Lung)	2.312E+07 (Skin)	2.430E+09 (GI-LLI)
TE - 129	2.549E+04 (GI-LLI)	3.076E+04 (Skin)	7.200E - 02 (GI-LLI)
TE - 131M	3.078E+05 (GI-LLI)	9.459E+06 (Skin)	2.163E+07 (GI-LLI)
TE - 131	2.054E+03 (Lung)	3.450E+07 (Skin)	1.349E - 14 (GI-LLI)
TE - 132	3.774E+05 (Lung)	4.968E+06 (Skin)	3.111E+07 (GI-LLI)
I - 130	1.846E+06 (Thyroid)	6.692E+06 (Skin)	1.371E+08 (Thyroid)

Units -

Inhalation and all tritium - mrem/yr per $\mu Ci/m^3$

Other pathways for all other radionuclides -m^2 • mrem/yr per $\mu Ci/sec$

TABLE 3.2-2 (continued)

PATHWAY DOSE FACTORS FOR SECTION 3.2.3.2 (R_i)

AGE GROUP	(CHILD)	(N.A.)	(CHILD)
ISOTOPE	INHALATION	GROUND PLANE	VEGETATION
I-131	1.624E+07 (Thyroid)	2.089E+07 (Skin)	4.754E+10 (Thyroid)
I-132	1.935E+05 (Thyroid)	1.452E+06 (Skin)	7.314E+03 (Thyroid)
I-133	3.848E+06 (Thyroid)	2.981E+06 (Skin)	8.113E+08 (Thyroid)
I-134	5.069E+04 (Thyroid)	5.305E+05 (Skin)	6.622E - 03 (Thyroid)
I-135	7.918E+05 (Thyroid)	2.947E+06 (Skin)	9.973E+06 (Thyroid)
CS-134	1.014E+06 (Liver)	8.007E+09 (Skin)	2.631E+10 (Liver)
CS-136	1.709E+05 (Liver)	1.710E+08 (Skin)	2.247E+08 (Liver)
CS-137	9.065E+05 (Bone)	1.201E+10 (Skin)	2.392E+10 (Bone)
CS-138	8.399E+02 (Liver)	4.102E+05 (Skin)	9.133E - 11 (Liver)
BA-139	5.772E+04 (GI-LLI)	1.194E+05 (Skin)	2.950E+00 (GI-LLI)
BA-140	1.743E+06 (Lung)	2.346E+07 (Skin)	2.767E+08 (Bone)
BA-141	2.919E+03 (Lung)	4.734E+04 (Skin)	1.605E - 21 (Bone)
BA-142	1.643E+03 (Lung)	5.064E+04 (Skin)	4.105E - 39 (Bone)
LA-140	2.257E+05 (GI-LLI)	2.180E+07 (Skin)	3.166E+07 (GI-LLI)
LA-142	7.585E+04 (Lung)	9.117E+05 (Skin)	2.141E+01 (GI-LLI)
CE-141	5.439E+05 (Lung)	1.540E+07 (Skin)	4.082E+08 (GI-LLI)
CE-143	1.273E+05 (GI-LLI)	2.627E+06 (Skin)	1.364E+07 (GI-LLI)
CE-144	1.195E+07 (Lung)	8.042E+07 (Skin)	1.039E+10 (GI-LLI)
PR-143	4.329E+05 (Lung)	0.000E+00 (Skin)	1.575E+08 (GI-LLI)
PR-144	1.565E+03 (Lung)	2.112E+03 (Skin)	3.829E - 23 (GI-LLI)
ND-147	3.282E+05 (Lung)	1.009E+07 (Skin)	9.197E+07 (GI-LLI)
W-187	9.102E+04 (GI-LLI)	2.740E+06 (Skin)	5.380E+06 (GI-LLI)
NP-239	6.401E+04 (GI-LLI)	1.976E+06 (Skin)	1.357E+07 (GI-LLI)

Units -

Inhalation and all tritium - mrem/yr per $\mu Ci/m^3$

Other pathways for all other radionuclides -m^2 • mrem/yr per $\mu Ci/sec$

TABLE 3.2-3

PATHWAY DOSE FACTORS FOR SECTION 3.2.4 (R_i)*

AGE GROUP	(INFANT)	(N.A.)	(INFANT)	(INFANT)	(INFANT)	(INFANT)	(INFANT)	(INFANT)
ISOTOPE	INHALATION	GOUND PLANE	GRS/COW/ MILK	GRS/COW/ MEAT	GRS/COW/ MILK	GRS/GOT/ MEAT	GRS/GOT/ MILK	VEGETATION
H-3	6.468E+02	0.000E+00	2.157E+03	0.000E+00	2.157E+03	0.000E+00	4.398E+03	0.000E+00
C-14	2.646E+04	0.000E+00	2.340E+09	0.000E+00	8.189E+08	0.000E+00	2.340E+09	0.000E+00
NA-24	1.056E+04	1.385E+07	1.542E+07	0.000E+00	2.300E-37	0.000E+00	1.851E+06	0.000E+00
P-32	2.030E+06	0.000E+00	1.602E+11	0.000E+00	7.088E+08	0.000E+00	1.924E+11	0.000E+00
CR-51	1.284E+04	5.506E+06	4.700E+06	0.000E+00	1.729E+05	0.000E+00	5.641E+05	0.000E+00
MN-54	9.996E+05	1.625E+09	3.900E+07	0.000E+00	1.118E+07	0.000E+00	4.680E+06	0.000E+00
MN-56	7.168E+04	1.068E+06	2.862E+00	0.000E+00	0.000E+00	0.000E+00	3.436E - 01	0.000E+00
FE-55	8.694E+04	0.000E+00	1.351E+08	0.000E+00	4.439E+07	0.000E+00	1.757E+06	0.000E+00
FE-59	1.015E+06	3.204E+08	3.919E+08	0.000E+00	3.384E+07	0.000E+00	5.096E+06	0.000E+00
CO-58	7.770E+05	4.464E+08	6.055E+07	0.000E+00	8.824E+06	0.000E+00	7.251E+06	0.000E+00
CO-60	4.508E+06	2.532E+10	2.098E+08	0.000E+00	7.107E+07	0.000E+00	2.517E+07	0.000E+00
NI-63	3.388E+05	0.000E+00	3.493E+10	0.000E+00	1.221E+10	0.000E+00	4.192E+09	0.000E+00
NI-65	5.012E+04	3.451E+05	3.020E+01	0.000E+00	0.000E+00	0.000E+00	3.635E+00	0.000E+00
CU-64	1.498E+04	6.876E+05	3.807E+06	0.000E+00	7.934E-46	0.000E+00	4.246E+05	0.000E+00
ZN-65	6.468E+05	8.583E+08	1.904E+10	0.000E+00	5.160E+09	0.000E+00	2.285E+09	0.000E+00
ZN-69	1.322E+04	0.000E+00	3.855E-09	0.000E+00	0.000E+00	0.000E+00	3.581E - 10	0.000E+00
BR-83	3.808E+02	7.079E+03	9.339E-01	0.000E+00	0.000E+00	0.000E+00	1.124E - 01	0.000E+00
BR-84	4.004E+02	2.363E+05	1.256E-22	0.000E+00	0.000E+00	0.000E+00	1.527E - 23	0.000E+00
BR-85	2.044E+01	0.000E+00	0.00E+00	0.000E+00	0.000E+00	0.000E+00	0.000E00	0.000E+00
RB-86	1.904E+05	1.035E+07	2.234E+10	0.000E+00	2.827E+08	0.000E+00	2.671E+09	0.000E+00
RB-88	5.572E+02	3.779E+04	1.874E-44	0.000E+00	0.000E+00	0.000E+00	2.304E - 45	0.000E+00
RB-89	3.206E+02	1.452E+05	3.414E-52	0.000E+00	0.000E+00	0.000E+00	4.056E - 53	0.000E+00
SR-89	2.030E+06	2.509E+04	1.258E+10	0.000E+00	1.280E+09	0.000E+00	2.643E+10	0.000E+00
SR-90	4.088E+07	0.000E+00	1.216E+11	0.000E+00	4.230E+10	0.000E+00	2.553E+11	0.000E+00
SR-91	7.336E+04	2.511E+06	3.215E+05	0.000E+00	0.000E+00	0.000E+00	6.758E+05	0.000E+00
			(PASTURE)	(PASTURE)	(FEED)	(PASTURE)	(PASTURE)	

*See note, page 3.0-36

Units -

Inhalation and all tritium - mrem/yr per $\mu Ci/m^3$

Other pathways for all other radionuclides -m^2 • mrem/yr per $\mu Ci/sec$

TABLE 3.2-3 (continued)

PATHWAY DOSE FACTORS FOR SECTION 3.2.4 (R_i)*

AGE GROUP	(INFANT)	(N.A.)	(INFANT)	(INFANT)	(INFANT)	(INFANT)	(INFANT)	(INFANT)
ISOTOPE	INHALATION	GROUND PLANE	GRS/COW/ MILK	GRS/COW/ MEAT	GRS/COW/ MILK	GRS/GOT/ MEAT	GRS/GOT/ MILK	VEGETATION
SR - 92	1.400E+05	8.631E+05	5.005E+01	0.000E+00	0.000E+00	0.000E+00	1.054E+02	0.000E+00
Y - 90	2.688E+05	5.308E+03	9.406E+05	0.000E+00	2.335E-05	0.000E+00	1.129E+05	0.000E+00
Y - 91M	2.786E+03	1.161E+05	1.876E-15	0.000E+00	0.000E+00	0.000E+00	2.290E - 16	0.000E+00
Y - 91	2.450E+06	1.207E+06	5.251E+06	0.000E+00	6.324E+05	0.000E+00	6.302E+05	0.000E+00
Y - 92	1.266E+05	2.142E+05	1.026E+01	0.000E+00	0.000E+00	0.000E+00	1.234E+00	0.000E+00
Y - 93	1.666E+05	2.534E+05	1.776E+04	0.000E+00	2.386E-61	0.000E+00	2.046E+03	0.000E+00
ZR - 95	1.750E+06	2.837E+08	8.257E+05	0.000E+00	1.090E+05	0.000E+00	9.910E+04	0.000E+00
ZR - 97	1.400E+05	3.445E+06	4.446E+04	0.000E+00	4.980E-35	0.000E+00	5.339E+03	0.000E+00
NB -95	4.788E+05	1.605E+08	2.062E+08	0.000E+00	1.213E+07	0.000E+00	2.475E+07	0.000E+00
MO - 99	1.348E+05	4.626E+06	3.108E+08	0.000E+00	1.523E-02	0.000E+00	3.731E+07	0.000E+00
TC - 99M	2.030E+03	2.109E+05	1.646E+04	0.000E+00	0.000E+00	0.000E+00	1.978E+03	0.000E+00
TC - 101	8.442E+02	2.277E+04	1.423E-56	0.000E+00	0.000E+00	0.000E+00	6.530E - 58	0.000E+00
RU - 103	5.516E+05	1.265E+08	1.055E+05	0.000E+00	7.573E+03	0.000E+00	1.265E+04	0.000E+00
RU - 105	4.844E+04	7.212E+05	3.204E+00	0.000E+00	0.000E+00	0.000E+00	3.851E - 01	0.000E+00
RU - 106	1.156E+07	5.049E+08	1.445E+06	0.000E+00	4.266E+05	0.000E+00	1.734E+05	0.000E+00
AG - 110M	3.668E+06	4.019E+09	1.461E+10	0.000E+00	3.984E+09	0.000E+00	1.752E+09	0.000E+00
TE - 125M	4.466E+05	2.128E+06	1.508E+08	0.000E+00	1.799E+07	0.000E+00	1.809E+07	0.000E+00
TE - 127M	1.312E+06	1.083E+05	1.037E+09	0.000E+00	2.046E+08	0.000E+00	1.244E+08	0.000E+00
TE - 127	2.436E+04	3.293E+03	1.359E+05	0.000E+00	1.269E-65	0.000E+00	1.594E+04	0.000E+00
TE - 129M	1.680E+06	2.312E+07	1.392E+09	0.000E+00	7.559E+07	0.000E+00	1.672E+08	0.000E+00
TE - 129	2.632E+04	3.076E+04	2.187E-07	0.000E+00	0.000E+00	0.000E+00	2.624E - 08	0.000E+00
TE - 131M	1.988E+05	9.459E+06	2.288E+07	0.000E+00	1.653E-15	0.000E+00	2.747E+06	0.000E+00
TE - 131	8.218E+03	3.450E+07	1.384E-30	0.000E+00	0.000E+00	0.000E+00	1.688E - 31	0.000E+00
TE - 132	3.402E+05	4.968E+06	6.513E+07	0.000E+00	1.041E-01	0.000E+00	7.842E+06	0.000E+00
I - 130	1.596E+06	6.692E+06	8.754E+08	0.000E+00	7.115E-45	0.000E+00	1.051E+09	0.000E+00
			(PASTURE)	(PASTURE)	(FEED)	(PASTURE)	(PASTURE)	

Units -

Inhalation and all tritium - mrem/yr per $\mu Ci/m^3$

Other pathways for all other radionuclides -m^2 • mrem/yr per $\mu Ci/sec$

TABLE 3.2-3 (continued)

PATHWAY DOSE FACTORS FOR SECTION 3.2.4 (R_i)*

AGE GROUP	(INFANT)	(N.A.)	(INFANT)	(INFANT)	(INFANT)	(INFANT)	(INFANT)	(INFANT)
ISOTOPE	INHALATION	GROUND PLANE	GRS/COW/ MILK	GRS/COW/ MEAT	GRS/COW/ MILK	GRS/GOT/ MEAT	GRS/GOT/ MILK	VEGETATION
I - 131	1.484E+07	2.089E+07	1.053E+12	0.000E+00	1.567E+08	0.000E+00	1.264E+12	0.000E+00
I - 132	1.694E+05	1.452E+06	1.188E+02	0.000E+00	0.000E+00	0.000E+00	1.638E+02	0.000E+00
I - 133	3.556E+06	2.981E+06	9.601E+09	0.000E+00	1.776E-22	0.000E+00	1.153E+10	0.000E+00
I - 134	4.452E+04	5.305E+05	8.402E-10	0.000E+00	0.000E+00	0.000E+00	1.017E - 09	0.000E+00
I - 135	6.958E+05	2.947E+06	2.002E+07	0.000E+00	0.000E+00	0.000E+00	2.406E+07	0.000E+00
CS - 134	7.028E+05	8.007E+09	6.801E+10	0.000E+00	2.191E+10	0.000E+00	2.040E+11	0.000E+00
CS - 136	1.345E+05	1.710E+08	5.795E+09	0.000E+00	1.729E+07	0.000E+00	1.744E+10	0.000E+00
CS - 137	6.118E+05	1.201E+10	6.024E+10	0.000E+00	2.096E+10	0.000E+00	1.087E+12	0.000E+00
CS - 138	8.764E+02	4.102E+05	2.180E-22	0.000E+00	0.000E+00	0.000E+00	6.628E - 22	0.000E+00
BA - 139	5.096E+04	1.194E+05	2.874E-05	0.000E+00	0.000E+00	0.000E+00	3.265E - 06	0.000E+00
BA - 140	1.596E+06	2.346E+07	2.410E+08	0.000E+00	6.409E+05	0.000E+00	2.893E+07	0.000E+00
BA - 141	4.746E+03	4.734E+04	4.916E-44	0.000E+00	0.000E+00	0.000E+00	5.899E - 45	0.000E+00
BA - 142	1.554E+03	5.064E+04	1.049E-78	0.000E+00	0.000E+00	0.000E+00	1.259E - 79	0.000E+00
LA - 140	1.680E+05	2.180E+07	1.880E+05	0.000E+00	4.563E-12	0.000E+00	2.253E+04	0.000E+00
LA - 142	5.950E+04	9.117E+05	1.078E-05	0.000E+00	0.000E+00	0.000E+00	1.278E - 06	0.000E+00
CE - 141	5.166E+05	1.540E+07	1.366E+07	0.000E+00	7.008E+05	0.000E+00	1.640E+06	0.000E+00
CE - 143	1.162E+05	2.627E+06	1.536E+06	0.000E+00	1.039E-14	0.000E+00	1.844E+05	0.000E+00
CE - 144	9.842E+06	8.042E+07	1.334E+08	0.000E+00	3.749E+07	0.000E+00	1.601E+07	0.000E+00
PR - 143	4.326E+05	0.000E+00	7.845E+05	0.000E+00	2.771E+03	0.000E+00	9.407E+04	0.000E+00
PR - 144	4.284E+03	2.112E+03	1.171E-48	0.000E+00	0.000E+00	0.000E+00	1.259E - 49	0.000E+00
ND - 147	3.220E+05	1.009E+07	5.743E+05	0.000E+00	6.902E+02	0.000E+00	6.885E+04	0.000E+00
W - 187	3.962E+04	2.740E+06	2.501E+06	0.000E+00	5.275E-22	0.000E+00	2.983E+05	0.000E+00
NP - 239	5.950E+04	1.976E+06	9.400E+04	0.000E+00	1.025E-07	0.000E+00	1.132E+04	0.000E+00
			(PASTURE)	(PASTURE)	(FEED)	(PASTURE)	(PASTURE)	

Units -

Inhalation and all tritium - mrem/yr per $\mu Ci/m^3$

Other pathways for all other radionuclides -m^2 • mrem/yr per $\mu Ci/sec$

TABLE 3.2-4

PATHWAY DOSE FACTORS FOR SECTION 3.2.4 (R_i)*

AGE GROUP	(CHILD)	(N.A.)	(CHILD)	(CHILD)	(CHILD)	(CHILD)	(CHILD)	(CHILD)
ISOTOPE	INHALATION	GROUND PLANE	GRS/COW/ MILK	GRS/COW/ MEAT	GRS/COW/ MILK	GRS/GOT/ MEAT	GRS/GOT/ MILK	VEGETATION
H-3	1.125E+03	0.000E+00	1.421E+03	2.118E+02	1.421E+03	2.543E+01	2.899E+03	3.627E+03
C-14	3.589E+04	0.000E+00	1.195E+09	3.834E+08	4.181E+08	4.601E+07	1.195E+09	8.894E+08
NA-24	1.610E+04	1.385E+07	8.853E+06	1.725E - 03	1.321E - 37	2.070E - 04	1.063E+06	3.729E+05
P-32	2.605E+06	0.000E+00	7.775E+10	7.411E+09	3.440E+08	8.893E+08	9.335E+10	3.366E+09
CF-51	1.698E+04	5.506E+06	5.398E+06	4.661E+05	1.985E+05	5.593E+04	6.478E+05	6.213E+06
MN-54	1.576E+06	1.625E+09	2.097E+07	8.011E+06	6.012E+06	9.613E+05	2.517E+06	6.648E+08
MN-56	1.232E+05	1.068E+06	1.865E+00	2.437E - 51	0.000E+00	2.924E - 52	2.238E - 01	2.723E+03
FE-55	1.110E+05	0.000E+00	1.118E+08	4.571E+08	3.673E+07	5.486E+07	1.453E+06	8.012E+08
FE-59	1.269E+06	3.204E+08	2.025E+08	6.338E+08	1.749E+07	7.605E+07	2.633E+06	6.693E+08
CO-58	1.106E+06	4.464E+08	7.080E+07	9.596E+07	1.032E+07	1.152E+07	8.487E+06	3.771E+08
CO-60	7.067E+06	2.532E+10	2.391E+08	3.838E+08	8.103E+07	4.605E+07	2.870E+07	2.095E+09
NI-63	8.214E+05	0.000E+00	2.964E+10	2.912E+10	1.036E+10	3.495E+09	3.557E+09	3.949E+10
NI-65	8.399E+04	3.451E+05	1.909E+01	4.061E - 51	0.000E+00	4.873E - 52	2.298E+00	1.211E+03
CU-64	3.670E+04	6.876E+05	3.502E+06	1.393E - 05	7.299E - 46	1.672E - 06	3.907E+05	5.159E+05
ZN-65	9.953E+05	8.583E+08	1.101E+10	1.000E +09	2.985E+09	1.200E+08	1.322E+09	2.164E+09
ZN-69	1.018E+04	0.000E+00	1.123E- 09	0.000E+00	0.000E+00	0.000E+00	1.043E - 10	9.893E-04
BR-83	4.736E+02	7.079E+03	4.399E - 01	9.519E - 57	0.000E+00	1.142E - 57	5.190E - 02	5.369E+00
BR-84	5.476E+02	2.363E+05	6.508E- 23	0.000E+00	0.000E+00	0.000E+00	7.758E - 24	3.822E - 11
BR-85	2.531E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	1.983E+05	1.035E+07	8.804E+09	5.816E+08	1.114E+08	6.979E+07	1.053E+09	4.584E+08
RB-88	5.624E+02	3.779E+04	7.150E - 45	0.000E+00	0.000E+00	0.000E+00	8.789E - 46	4.374E - 22
RB-89	3.452E+02	1.452E+05	1.397E - 52	0.000E+00	0.000E+00	0.000E+00	1.659E - 53	1.642E - 26
SR-89	2.157E+06	2.509E+04	6.618E+09	4.815E+08	6.730E+08	5.778E+07	1.390E+10	3.593E+10
SR-90	1.010E+08	0.000E+00	1.117E+11	1.040E+10	3.887E+10	1.248E+09	2.346E+11	1.243E+12
SR-91	1.739E+ 05	2.511E+06	2.878E+05	55.292E-10	0.000E+00	6.351E - 11	6.050E+05	1.157E+06
			(PASTURE)	(PASTURE)	(FEED)	(PASTURE)	(PASTURE)	

*See note, page 3.0-36

Units -

Inhalation and all tritium - mrem/yr per $\mu Ci/m^3$

Other pathways for all other radionuclides -m^2 • mrem/yr per $\mu Ci/sec$

TABLE 3.2-4 (continued)

PATHWAY DOSE FACTORS FOR SECTION 3.2.4 (R_i)*

AGE GROUP	(CHILD)	(N.A.)	(CHILD)	(CHILD)	(CHILD)	(CHILD)	(CHILD)	(CHILD)
ISOTOPE	INHALATION	GROUND PLANE	GRS/COW/ MILK	GRS/COW/ MEAT	GRS/COW/ MILK	GRS/GOT/ MEAT	GRS/GOT/ MILK	VEGETATION
SR - 92	2.424E+05	8.631E+05	4.134E+01	3.492E - 48	0.000E+00	4.191E - 49	8.706E+01	1.378E+4
Y - 90	2.679E+05	5.308E+03	9.171E+05	4.879E+05	2.277E - 05	5.855E+04	1.101E+05	6.569E+7
Y - 91M	2.812E+03	1.161E+05	5.622E - 16	0.000E+00	0.000E+00	0.000E+00	6.344E - 17	1.737E-5
Y - 91	2.627E+06	1.207E+06	5.199E+06	2.400E+08	6.261E+05	2.880E+07	6.240E+05	2.484E+9
Y - 92	2.390E+05	2.142E+05	7.310E+00	6.959E - 35	0.000E+00	8.350E - 36	8.791E - 01	4.576E+4
Y - 93	3.885E+05	2.534E+05	1.573E+04	1.547E- 07	9.134E - 61	1.857E - 08	1.888E+03	4.482E+6
ZR - 95	2.231E+06	2.837E+08	8.786E+05	6.106E+08	1.160E+05	7.328E+07	1.054E+05	8.843E+8
ZR - 97	3.511E+05	3.445E+06	4.199E+04	7.015E - 01	4.703E - 35	8.418E - 02	5.042E+03	1.248E+7
NB - 95	6.142E+05	1.605E+08	2.287E+08	2.288E+09	1.346E+07	2.673E+08	2.747E+07	2.949E+8
MO - 99	1.354E+05	4.626E+06	1.738E+08	2.456E+05	8.512E - 03	2.947E+04	2.086E+07	1.647E+7
TC - 99M	4.810E+03	2.109E+05	1.474E+04	6.915E - 18	0.000E+00	8.298E - 19	1.771E+03	5.255E+3
TC - 101	5.846E+02	2.277E+04	5.593E - 58	0.000E+00	0.000E+00	0.000E+00	2.566E - 59	4.123E-29
RU - 103	6.623E+05	1.265E+08	1.108E+05	4.009E+09	7.952E+03	4.811E+08	1.329E+04	3.971E+8
RU - 105	9.953E+04	7.212E+05	2.493E+00	5.885E - 25	0.000E+00	7.061E - 26	2.997E - 01	5.981E+4
RU - 106	1.476E+07	5.049E+08	1.437E+06	6.902E+10	4.243E+05	8.282E+09	1.725E+05	1.159E+10
AG - 110M	5.476E+06	4.019E+09	1.678E+10	6.742E+08	4.576E+09	8.090E+07	2.013E+09	2.581E+9
TE - 125M	4.773E+05	2.128E+06	7.377E+07	5.690E+08	8.802E+06	6.828E+07	8.853E+06	3.506E+8
TE - 127M	1.480E+06	1.083E+05	5.932E+08	5.060E+09	1.171E+08	6.072E+08	7.118E+07	3.769E+9
TE - 127	5.624E+04	3.293E+03	1.191E+05	1.607E-08	0.000E+00	1.929 - 09	1.396E+04	3.903E+5
TE - 129M	1.761E+06	2.312E+07	7.961E+08	5.245E+09	4.324E+07	6.294E+08	9.563E+07	2.46E+9
TE - 129	2.549E+04	3.076E+04	7.96E-08	0.000E+00	0.000E+00	0.000E+00	9.641E - 09	7.204E-2
TE - 131M	3.078E+05	9.459E+06	2.244E+07	9.815E+03	1.621E - 15	1.178E+03	2.094E+06	2.163E+7
TE - 131	2.054E+03	3.450E+07	8.489E - 32	0.000E+00	0.000E+00	0.000E+00	1.036E - 32	1.349E-14
TE - 132	3.774E+05	4.968E+06	4.551E+07	9.325E+06	7.272E - 02	1.119E+06	5.480E+06	3.111E+7
I - 130	1.846E+06	6.692E+06	3.845E+08	6.758E - 04	3.125E - 45	8.109E - 05	4.617E+08	1.371E+8
			(PASTURE)	(PASTURE)	(FEED)	(PASTURE)	(PASTURE)	

Units -

Inhalation and all tritium - mrem/yr per $\mu Ci/m^3$

Other pathways for all other radionuclides -m^2 • mrem/yr per $\mu Ci/sec$

TABLE 3.2-4 (continue)

PATHWAY DOSE FACTORS FOR SECTION 3.2.4 (R_i)*

AGE GROUP	(CHILD)	(N.A.)	(CHILD)	(CHILD)	(CHILD)	(CHILD)	(CHILD)	(CHILD)
ISOTOPE	INHALATION	GROUND PLANE	GRS/COW/ MILK	GRS/COW/ MEAT	GRS/COW/ MILK	GRS/GOT/ MEAT	GRS/GOT/ MILK	VEGETATION
I-131	1.624E+07	2.089E+07	4.333E+11	5.503E+09	6.448E+07	6.604E+08	5.201E+11	4.754E+10
I-132	1.935E+05	1.452E+06	5.129E+01	2.429E - 57	0.000E+00	2.915E - 58	7.072E+01	7.314E+03
I-133	3.848E+06	2.981E+06	3.945E+09	1.304E+02	7.299E - 23	1.564E+01	4.737E+09	8.113E+08
I-134	5.069E+04	5.305E+05	3.624E - 10	0.000E+00	0.000E+00	0.000E+00	4.386E - 10	6.622E - 03
I-135	7.918E+05	2.947E+06	8.607E+06	1.039E - 14	0.000E+00	1.247E - 15	1.034E+07	9.973E+06
CS-134	1.014E+06	8.007E+09	3.715E+10	1.513E+09	1.197E+10	1.816E+08	1.115E+11	2.631E+10
CS-136	1.709E+05	1.710E+08	2.773E+09	4.426E+07	8.276E+06	5.311E+06	8.344E+09	2.247E+08
CS-137	9.065E+05	1.201E+10	3.224E+10	1.334E+09	1.122E+10	1.600E+08	9.672E+10	2.392E+10
CS-138	8.399E+02	4.102E+05	5.528E -23	0.000E+00	0.000E+00	0.000E+00	1.681E - 22	9.133E - 11
BA-139	5.772E+04	1.194E+05	1.231E - 05	0.000E+00	0.000E+00	0.000E+00	1.398E - 06	2.950E+00
BA-140	1.743E+06	2.346E+07	1.171E+08	4.384E+07	3.114E+05	5.261E+06	1.406E+07	2.767E+08
BA-141	2.919+03	4.734E+04	1.894E - 45	0.000E+00	0.000E+00	0.000E+00	2.273E - 46	1.605E-21
BA-142	1.643E+03	5.064E+04	1.208E - 79	0.000E+00	0.000E+00	0.000E+00	1.450E - 80	4.105E - 39
LA-140	2.257E+05	2.180E+07	1.894E+05	5.492E+02	4.596E -12	6.590E+01	2.269E+04	3.166E+07
LA-142	7.585E+04	9.117E+05	5.203E - 06	0.000E+00	0.000E+00	0.000E+00	6.166E - 07	2.141E+01
CE-141	5.439E+05	1.540E+07	1.361E+07	1.382E+07	6.980+05	1.658E+06	1.633E+06	4.082E+08
CE-143	1.273E+05	2.627E+06	1.488E+06	2.516E+02	1.006E - 14	3.020E+01	1.787E+05	1.364E+07
CE-144	1.195E+07	8.042E+07	1.326E+08	1.893E+08	3.727E+07	2.271E+07	1.592E+07	1.039E+10
PR-143	4.329E+05	0.000E+00	7.754E+05	3.609E+07	2.738E+03	4.331E+06	9.297E+04	1.575E+08
PR-144	1.565E+03	2.112E+03	2.040E - 50	0.000E+00	0.000E+00	0.000E+00	2.353E - 51	3.829E - 23
ND-147	3.282E+05	1.009E+07	5.712E+05	1.505E+07	6.864E+02	1.805E+06	6.846E+04	9.197E+07
W-187	9.102E+04	2.740E+06	2.420E+06	2.790E+00	5.103E - 22	3.348E - 01	2.886E+05	5.380E+06
NP-239	6.401E+04	1.976E+06	9.138E+04	2.232E+03	9.336E - 08	2.679E+02	1.100E+04	1.357E+07
			(PASTURE)	(PASTURE)	(FEED)	(PASTURE)	(PASTURE)	

Units -

Inhalation and all tritium - mrem/yr per $\mu Ci/m^3$

Other pathways for all other radionuclides -m^2 • mrem/yr per $\mu Ci/sec$

TABLE 3.2-5

PATHWAY DOSE FACTORS FOR SECTION 3.2.4 (R_i)*

AGE GROUP	(TEENAGER)	(N.A.)	(TEENAGER)	(TEENAGER)	(TEENAGER)	(TEENAGER)	(TEENAGER)	(TEENAGER)
ISOTOPE	INHALATION	GROUND PLANE	GRS/COW/ MILK	GRS/COW/ MEAT	GRS/COW/ MILK	GRS/GOT/ MEAT	GRS/GOT/ MILK	VEGETATION
H-3	1.272E+03	0.000E+00	8.993E+02	1.754E+02	8.993E+02	2.104E+01	1.835E+03	2.342E+03
C-14	2.600E+04	0.000E+08	4.859E+08	2.040E+08	1.700E+08	2.448E+07	4.859E+08	3.690E+08
NA-24	1.376E+04	1.385E+07	4.255E+06	1.084E - 03	6.347E - 38	1.301E - 04	5.110E+05	2.389E+05
P-32	1.888E+06	0.000E+00	3.153E+10	3.931E+09	1.395E+08	4.717E+08	3.785E+10	1.608E+09
CR-51	2.096E+04	5.506E+06	8.387E+06	9.471E+05	3.085E+05	1.137E+05	1.006E+06	1.037E+07
MN-54	1.984E+06	1.625E+09	2.875E+07	1.436E+07	8.240E+06	1.723E+06	3.450E+06	9.320E+08
MN-56	5.744E+04	1.068E+06	4.856E - 01	8.302E - 52	0.000E+00	9.962E - 53	5.829E - 02	9.451E+02
FE-55	1.240E+05	0.000E+00	4.454E+07	2.382E+08	1.463E+07	2.859E+07	5.790E+05	3.259E+08
FE-59	1.528E+06	3.204E+08	2.861E+08	1.171E+09	2.470E+07	1.405E+08	3.720E+06	9.895E+08
CO-58	1.344E+06	4.464E+08	1.095E+08	1.942E+08	1.596E+07	2.330E+07	1.313E+07	6.034E+08
CO-60	8.720E+06	2.532E+10	3.621E+08	7.600E+08	1.227E+08	9.120E+07	4.345E+07	3.238E+09
NI-63	5.800E+05	0.000E+00	1.182E+10	1.519E+10	4.130E+09	1.823E+09	1.419E+09	1.606E+10
NI-65	3.672E+04	3.451E+05	4.692E+00	1.305E - 51	0.000E+00	1.566E - 52	5.647E - 01	3.966E+02
CU-64	6.144E+04	6.876E+05	3.293E+06	1.713E - 05	6.863E - 46	2.072E - 06	3.673E+05	6.465E+05
ZN-65	1.240E+06	8.583E+08	7.315E+09	8.688E+08	1.983E+09	1.043E+08	8.779E+08	1.471E+09
ZN-69	1.584E+03	0.000E+00	1.760E - 11	0.000E+00	0.000E+00	0.000E+00	1.635E - 12	2.067E - 05
BR-83	3.440E+02	7.079E+03	1.790E - 01	5.066E - 57	0.000E+00	6.079E - 58	2.112E - 02	2.911E+00
BR-84	4.328E+02	2.363E+05	2.877E - 23	0.000E+00	0.000E+00	0.000E+00	3.429E - 24	2.251E - 11
BR-85	1.832E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000+00	0.000E+00	0.000E+00
RB-86	1.904E+05	1.035E+07	4.746E+09	4.101E+08	6.006E+07	4.921E+07	5.675E+08	2.772E+08
RB-88	5.456E+02	3.779E+04	3.886E - 45	0.000E+00	0.000E+00	0.000E+00	4.777E - 46	3.168E - 22
RB-89	3.520E+02	1.452E+05	7.957E - 53	0.000E+00	0.000E+00	0.000E+00	9.454E - 54	1.247E - 26
SR-89	2.416E+06	2.509E+04	2.674E+09	2.545E+08	2.719E+08	3.054E+07	5.617E+09	1.513E+10
SR-90	1.080E+08	0.000E+00	6.612E+10	8.049E+09	2.301E+10	9.659E+08	1.389E+11	7.507E+11
SR-91	2.592E+05	2.511E+06	2.409E+05	5.794E - 10	0.000E+00	6.953E - 11	5.064E+05	1.291E+06
			(PASTURE)	(PASTURE)	(FEED)	(PASTURE)	(PASTURE)	

*See note, page 3.0-36

Units -

Inhalation and all tritium - mrem/yr per $\mu Ci/m^3$

Other pathways for all other radionuclides -m^2 • mrem/yr per $\mu Ci/sec$

TABLE 3.2-5 (continued)

PATHWAY DOSE FACTORS FOR SECTION 3.2.4 (R_i)*

AGE GROUP	(TEENAGER)	(N.A.)	(TEENAGER)	(TEENAGER)	(TEENAGER)	(TEENAGER)	(TEENAGER)	(TEENAGER)
ISOTOPE	INHALATION	GROUND PLANE	GRS/COW/ MILK	GRS/COW/ MEAT	GRS/COW/ MILK	GRS/GOT/ MEAT	GRS/GOT/ MILK	VEGETATION
SR - 92	1.192E+05	8.631E+05	2.277E+01	2.516E - 48	0.000E+00	3.019E - 49	4.795E+01	1.012E+04
Y-90	5.592E+05	5.308E+03	1.074E+06	7.470E+05	2.666E - 05	8.965E+04	1.289E+05	1.025E+08
Y - 91M	3.200E+03	1.161E+05	5.129E-18	0.000E+00	0.000E+00	0.000E+00	6.260E - 19	2.285E - 07
Y - 91	2.936E+06	1.207E+06	6.147E+06	3.910E+08	7.797E+05	4.691E+07	7.780E+05	3.212E+09
Y - 92	1.648E+05	2.142E+05	2.828E+00	3.522E - 35	0.000E+00	4.226E - 36	3.402E - 01	2.360E+04
Y - 93	5.792E+05	2.534E+05	1.312E+04	1.688E - 07	7.620E - 61	2.026E - 08	1.511E+03	4.983E+06
ZR - 95	2.688E+06	2.837E+08	1.201E+06	1.092E+09	1.585E+05	1.310E+08	1.441E+05	1.253E+09
ZR - 97	6.304E+05	3.44E+06	4.225E+04	9.231E - 01	4.732E - 35	1.108E - 01	5.073E+03	1.673E+07
NB - 95	7.512E+05	1.605E+08	3.338E+08	4.251E+09	1.963E+07	5.101E+08	4.008E+07	4.551E+08
MO - 99	2.688E+05	4.626E+06	1.023E+08	1.892E+05	5.013E - 03	2.270E+04	1.228E+07	1.293E+07
TC - 99M	6.128E+03	2.109E+05	1.055E+04	6.471E - 18	0.000E+00	7.766E - 19	1.267E+03	5.011E+03
TC - 101	6.672E+02	2.277E+04	1.343E - 58	0.000E+00	0.000E+00	0.000E+00	1.508E - 59	3.229E - 29
RU - 103	7.832E+05	1.265E+08	1.513E+05	7.162E+09	1.086E+04	8.595E+08	1.815E+04	5.706E+08
RU - 105	9.040E+04	7.212E+05	1.263E+00	3.900E - 25	0.000E+00	4.680E - 26	1.519E - 01	4.039E+04
RU - 106	1.608E+07	5.049E+08	1.799E+06	1.130E+11	5.312E+05	1.356E+10	2.159E+05	1.484E+10
AG - 110M	6.752E+06	4.019E+09	2.559E+10	1.345E+09	6.982E+09	1.614E+08	3.071E+09	4.031E+09
TE - 125M	5.360+05	2.128E+06	8.863E+07	8.941E+08	1.058E+07	1.073E+08	1.064E+07	4.375E+08
TE - 127M	1.656E+06	1.083E+05	3.420E+08	3.816E+09	6.753E+07	4.580E+08	4.105E+07	2.236E+09
TE - 127	8.080E+04	3.293E+03	9.572E+04	1.689E - 08	0.000E+00	2.027E - 09	1.122E+04	4.180E+05
TE - 129M	1.976E+06	2.312E+07	4.602E+08	3.966E+09	2.500E+07	4.759E+08	5.528E+07	1.514E+09
TE - 129	3.296E+03	3.076E+04	2.834E - 09	0.000E+00	0.000E+00	0.000E+00	3.433E - 10	3.916E-03
TE - 131M	6.208E+05	9.459E+06	2.529E+07	1.447E+04	1.827E - 15	1.736E+03	3.036E+06	3.248E+07
TE - 131	2.336E+03	3.450E+07	2.879E - 32	0.000E+00	0.000E+00	0.000E+00	3.515E - 33	6.099E - 15
TE - 132	4.632E+05	4.968E+06	8.581E+07	2.300E+07	1.371E - 01	2.760E+06	1.033E+07	7.818E+07
I - 130	1.488E+06	6.692E+06	1.742E+08	4.005E - 04	1.416E - 45	4.806E - 05	2.092E+08	8.276E+07
			(PASTURE)	(PASTURE)	(FEED)	(PASTURE)	(PASTURE)	

Units -

Inhalation and all tritium - mrem/yr per $\mu Ci/m^3$

Other pathways for all other radionuclides -m^2 • mrem/yr per $\mu Ci/sec$

TABLE 3.2-5 (continued)

PATHWAY DOSE FACTORS FOR SECTION 3.2.4 (R_i)*

AGE GROUP	(TEENAGER)	(N.A.)	(TEENAGER)	(TEENAGER)	(TEENAGER)	(TEENAGER)	(TEENAGER)	(TEENAGER)
ISOTOPE	INHALATION	GROUND PLANE	GRS/COW/ MILK	GRS/COW/ MEAT	GRS/COW/ MILK	GRS/GOT/ MEAT	GRS/GOT/ MILK	VEGETATION
I - 131	1.464E+07	2.089E+07	2.195E+11	3.645E+09	3.266E+07	4.375E+08	2.634E+11	3.140E+10
I - 132	1.512E+05	1.452E+06	2.242E+01	1.389E - 57	0.000E+00	1.667E - 58	3.092E+01	4.262E+03
I - 133	2.920E+06	2.981E+06	1.674E+09	7.234E+01	3.096E - 23	8.680E+00	2.009E+09	4.587E+08
I - 134	3.952E+04	5.305E+05	1.583E - 10	0.000E+00	0.000E+00	0.000E+00	1.915E - 10	3.854E - 03
I - 135	6.208E+05	2.947E+06	3.777E+06	5.963E - 15	0.000E+00	7.156E - 16	4.538E+06	5.832E + 06
CS - 134	1.126E+06	8.007E+09	2.310E+10	1.231E+09	7.443E+09	1.477E+08	6.931E+10	1.671E+10
CS - 136	1.936E+05	1.710E+08	1.759E+09	3.671E+07	5.249E+06	4.405E+06	5.292E+09	1.708E+08
CS - 137	8.480E+05	1.201E+10	1.781E+10	9.634E+08	6.197E+09	1.156E+08	5.342E+10	1.348E+10
CS - 138	8.560+02	4.102E+05	3.149E - 23	0.000E+00	0.000E+00	0.000E+10	9.576E - 23	6.935E - 11
BA - 139	6.464E+03	1.194E+05	7.741E - 07	0.000E+00	0.000E+00	0.000E+00	8.794E - 08	2.403E - 01
BA - 140	2.032E+06	2.346E+07	7.483E+07	3.663E+07	1.990E+05	4.396E+06	8.981E+06	2.130E+08
BA - 141	3.288E+03	4.734E+04	7.703E - 46	0.000E+00	0.000E+00	0.000E+00	9.244E - 47	8.699E - 22
BA - 142	1.912E+03	5.064E+04	5.010E - 80	0.000E+00	0.000E+00	0.000E+00	6.012E - 81	5.613E - 39
LA - 140	4.872E+05	2.180E+07	2.291E+05	8.689E+02	5.560E - 12	1.043E+02	2.745E+04	5.104E+07
LA - 142	1.200E+04	9.117E+05	4.611E - 07	0.000E+00	0.000E+00	0.000E+00	5.465E - 08	2.529E+00
CE - 141	6.136E+05	1.540E+07	1.696E+07	2.252E+07	8.700E+05	2.703E+06	2.036E+06	5.404E+08
CE - 143	2.552+05	2.627E+06	1.671E+06	3.695E+02	1.130E - 14	4.434E+01	2.006E+05	2.040E+07
CE - 144	1.336E+07	8.042E+07	1.655E+08	3.089E+08	4.650E+07	3.706E+07	1.986E+07	1.326E+10
PR - 143	4.832E+05	0.000E+00	9.553E+05	5.817E+07	3.374E+03	6.980E+06	1.146E+05	2.310E+08
PR - 144	1.752E+03	2.112E+03	1.238E - 53	0.000E+00	0.000E+00	0.000E+00	1.331E - 54	3.097E - 26
ND - 147	3.720E+05	1.009E+07	7.116E+05	2.453E+07	8.552E+02	2.942E+06	8.530E+04	1.424E+08
W-187	1.768E+05	2.740E+06	2.646E+06	3.989E+00	5.579E - 22	4.787E - 01	3.155E+05	7.839E+06
NP - 239	1.320E+05	1.976E+06	1.060E+05	3.387E+03	1.083E - 07	4.064E+02	1.276E+04	2.097E+07
			(PASTURE)	(PASTURE)	(FEED)	(PASTURE)	(PASTURE)	

Units -

Inhalation and all tritium - mrem/yr per $\mu Ci/m^3$

Other pathways for all other radionuclides -m^2 • mrem/yr per $\mu Ci/sec$

TABLE 3.2-6

PATHWAY DOSE FACTORS FOR SECTION 3.2.4 (R_i)*

AGE GROUP	(ADULT)	(N.A.)	(ADULT)	(ADULT)	(ADULT)	(ADULT)	(ADULT)	(ADULT)
ISOTOPE	INHALATION	GROUND PLANE	GRS/COW/ MILK	GRS/COW/ MEAT	GRS/COW/ MILK	GRS/GOT/ MEAT	GRS/GOT/ MILK	VEGETATION
H-3	1.264E+03	0.000E+00	6.904E+02	2.940E+02	6.904E+02	3.528E+01	1.408E+03	2.845E+03
C-14	1.816E+04	0.000E+00	2.634E+08	2.414E+08	9.219E+07	2.897E+07	2.634E+08	2.276E+08
NA-24	1.024E+04	1.385E+07	2.438E+06	1.356E - 03	3.636E - 38	1.628E - 04	2.926E+05	2.690E+05
P-32	1.320E+06	0.000E+00	1.709E+10	4.651E+09	7.559E+07	5.582E+08	2.052E+10	1.403E+09
CR-51	1.440E+04	5.506E+06	7.187E+06	1.772E+06	2.644E+05	2.127E+05	8.624E+05	1.168E+07
MN-54	1.400E+06	1.625E+09	2.578E+07	2.812E+07	7.389E+06	3.375E+06	3.091E+06	9.585E+08
MN-56	2.024E+04	1.068E+06	1.328E - 01	4.958E - 52	0.000E+00	5.949E - 53	1.594E - 02	5.082E+02
FE-55	7.208E+04	0.000E+00	2.511E+07	2.933E+08	8.250E+06	3.519E+07	3.265E+05	2.096E+08
FE-59	1.016E+06	3.204E+08	2.327E+08	2.080E+09	2.009E+07	2.495E+08	3.024E+06	9.875E+08
CO-58	9.280E+05	4.464E+08	9.565E+07	3.703E+08	1.394E+07	4.443E+07	1.147E+07	6.252E+08
CO-60	5.968E+06	2.532E+10	3.082E+08	1.413E+09	1.044E+08	1.695E+08	3.7E+06	3.139E+09
NI-63	4.320E+05	0.000E+00	6.729E+09	1.888E+10	2.351E+09	2.266E+09	8.075E+08	1.040E+10
NI-65	1.232E+04	3.451E+05	1.219E+00	7.405E - 52	0.000E+00	8.886E - 53	1.464E - 01	2.026E+02
CU-64	4.896E+04	6.876E+05	2.031E+06	2.307E - 05	4.233E - 46	2.769E - 06	2.415E+05	7.841E+05
ZN-65	8.640E+05	8.583E+08	3.798E+09	1.132E+09	1.183E+09	1.358E+08	4.588E+08	1.009E+09
ZN-69	9.200E+02	0.000E+00	4.031E - 12	0.000E+00	0.000E+00	0.000E+00	4.837E - 13	1.202E - 05
BR-83	2.408E+02	7.079E+03	1.399E - 01	8.648E - 57	0.000E+00	1.038E - 57	1.698E - 02	4.475E+00
BR-84	3.128E+02	2.363E+05	1.69E - 23	0.000E+00	0.000E+00	0.000E+00	2.029E - 24	2.475E - 11
BR-85	1.280E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	1.352E+05	1.027E+07	2.595E+09	4.870E+00	3.201E+07	5.845E+07	3.113E+08	2.194E+08
RB-88	3.872E+02	3.779E+04	2.139E - 45	0.000E+00	0.000E+00	0.000E+00	2.573E - 46	3.428E - 22
RB-89	2.560E+02	1.476E+05	4.496E - 53	0.000E+00	0.000E+00	0.000E+00	5.396E - 54	3.961E - 26
SR-89	1.400E+06	2.509E+04	1.451E+09	3.014E+08	1.475E+08	3.617E+07	3.046E+09	9.961E+09
SR-90	9.920E+07	0.000E+00	4.680E+10	1.244E+10	1.628E+10	1.493E+09	9.828E+10	6.846E+11
SR-91	1.912E+05	2.511E+06	1.377E+05	7.233E-10	0.000E+00	8.680E - 11	2.872E+05	1.451E+06
			(PASTURE)	(PASTURE)	(FEED)	(PASTURE)	(PASTURE)	

*See note, page 3.0-36

Units -

Inhalation and all tritium - mrem/yr per $\mu Ci/m^3$

Other pathways for all other radionuclides -m^2 • mrem/yr per $\mu Ci/sec$

TABLE 3.2-6 (continued)

PATHWAY DOSE FACTORS FOR SECTION 3.2.4 (R_i)*

AGE GROUP	(ADULT)	(N.A.)	(ADULT)	(ADULT)	(ADULT)	(ADULT)	(ADULT)	(ADULT)
ISOTOPE	INHALATION	GROUND PLANE	GRS/COW/ MILK	GRS/COW/ MEAT	GRS/COW/ MILK	GRS/GOT/ MEAT	GRS/GOT/ MILK	VEGETATION
SR - 92	4.304E+04	8.631E+05	9.675E+00	2.334E - 48	0.000E+00	2.801E - 49	2.05E+01	8.452E+03
Y - 90	5.056E+05	5.308E+03	7.511E+05	1.141E+06	1.865E - 05	1.369E+05	9.028E+04	1.410E+08
Y - 91M	1.920E+03	1.161E+05	1.883E - 19	0.000E+00	0.000E+00	0.000E+00	2.262E - 20	1.527E - 08
Y - 91	1.704E+06	1.207E+06	4.726E+06	6.231E+08	5.691E+05	7.477E+07	5.672E+05	2.814E+09
Y - 92	7.352E+04	2.142E+05	9.772E - 01	2.657E - 35	0.000E+00	3.188E - 36	1.17E - 01	1.603E+04
Y - 93	4.216E+05	2.534E+05	7.091E+03	2.075E - 07	4.290E - 61	2.490E - 08	8.43E+02	5.517E+06
ZR - 95	1.768E+06	2.837E+08	9.587E+05	1.903E+09	1.265E+05	2.284E+08	1.151E+05	1.194E+09
ZR - 97	5.232E+05	3.445E+06	2.707E+04	1.292E+00	3.032E - 35	1.550E - 01	3.24E+03	2.108E+07
NB -95	5.048E+05	1.605E+08	2.787E+08	7.748E+09	1.639E+07	9.297+08	3.344E+07	4.798+08
MO - 99	2.480E+05	4.626E+06	5.741E+07	2.318E+05	2.813E - 03	2.781E+04	6.878E+06	1.426E+07
TC - 99M	4.160E+03	2.109E+05	5.553E+03	7.439E - 18	0.000E+00	8.927E - 19	6.641E+02	5.187E+03
TC - 101	3.992E+02	2.277E+04	7.406E - 59	0.000E+00	0.000E+00	0.000E+00	8.888E - 60	3.502E - 29
RU - 103	5.048E+05	1.265E+08	1.189E+05	1.229E+10	8.537E+03	1.475E+09	1.426E+04	5.577E+08
RU - 105	4.816E+04	7.212E+05	5.240E - 01	3.533E - 25	0.000E+00	4.239E - 26	6.245E - 02	3.294E+04
RU - 106	9.360E+06	5.049E+08	1.320E+06	1.811E+11	3.898E+05	2.173E+10	1.584E+05	1.247E+10
AG - 110M	4.632E+06	4.019E+09	2.198E+10	2.523E+09	5.996E+09	3.028E+08	2.638E+09	3.979E+09
TE - 125M	3.136E+05	2.128E+06	6.626E+07	1.460E+09	7.906E+06	1.751E+08	7.955E+06	3.927E+08
TE - 127M	9.600E+05	1.083E+05	1.860E+08	4.531E+09	3.671E+07	5.437E+08	2.223E+07	1.418E+09
TE - 127	5.736E+04	3.293E+03	5.278E+04	2.034E - 08	0.000E+00	2.441E - 09	6.172E+03	4.532E+09
TE - 129M	1.160E+06	2.312E+07	3.028E+08	5.698E+09	1.645E+07	6.838E+08	3.636E+07	1.261E+09
TE - 129	1.936E+03	3.076E+04	1.183E - 09	0.000E+00	0.000E+00	0.000E+00	1.42E - 10	2.80E-03
TE - 131M	5.560E+05	9.459E+06	1.753E+07	2.190E+04	1.266E - 15	2.628E+03	2.102E+06	4.428E+07
TE - 131	1.392E+03	3.450E+07	1.578E - 32	0.000E+00	0.000E+00	0.000E+00	1.927E - 33	6.575E - 15
TE - 132	5.096E+05	4.968E+06	7.356E+07	4.287E+07	1.170E - 01	5.144E+06	8.827E+06	1.312E+08
I - 130	1.136E+06	6.692E+06	1.050E+08	5.272E - 04	8.535E - 46	6.326E - 05	1.254E+08	9.809+07
			(PASTURE)	(PASTURE)	(FEED)	(PASTURE)	(PASTURE)	

Units -

Inhalation and all tritium - mrem/yr per $\mu Ci/m^3$

Other pathways for all other radionuclides -m^2 • mrem/yr per $\mu Ci/sec$

TABLE 3.2-6 (continued)

PATHWAY DOSE FACTORS FOR SECTION 3.2.4 (R_i)*

AGE GROUP	(ADULT)	(N.A.)	(ADULT)	(ADULT)	(ADULT)	(ADULT)	(ADULT)	(ADULT)
ISOTOPE	INHALATION	GROUND PLANE	GRS/COW/ MILK	GRS/COW/ MEAT	GRS/COW/ MILK	GRS/GOT/ MEAT	GRS/GOT/ MILK	VEGETATION
I - 131	1.192E+07	2.089E+07	1.388E+11	5.034E+09	2.065E+07	6.040E+08	1.665E+11	3.785E+10
I - 132	1.144E+05	1.452E+06	1.541E+01	1.816E - 57	0.000E+00	2.179E - 58	1.849E+01	5.016E+03
I - 133	2.152E+06	2.981E+06	9.891E+08	9.336E+01	1.830E - 23	1.120E+01	1.189E+09	5.331E+08
I - 134	2.984E+04	5.305E+05	8.886E - 11	0.000E+00	0.000E+00	0.000E+00	1.066E-10	4.563E-03
I - 135	4.480E+05	2.947E+06	2.217E+06	7.644E - 15	0.000E+00	9.172E - 16	2.676E+06	6.731E+06
CS - 134	8.480+05	8.007E+09	1.345E+10	1.565E+09	4.333E+09	1.878E+08	4.035E+10	1.110E+10
CS - 136	1.464E+05	1.710E+08	1.039E+09	4.724E+07	3.093E+06	5.669E+06	3.117E+09	1.675E+08
CS - 137	6.208E+05	1.201E+10	1.010E+10	1.193E+09	3.513E+09	1.431E+08	3.03E+10	8.696E+09
CS - 138	6.208E+02	4.102E+05	1.786E - 23	0.000E+00	0.000E+00	0.000E+00	5.146E-23	7.730E - 11
BA - 139	3.760E+03	1.194E+05	7.863E - 08	0.000E+00	0.000E+00	0.000E+00	9.435E-09	5.225E - 02
BA - 140	1.272E+06	2.346E+07	5.535E+07	5.917E+07	1.472E+05	7.100E+06	6.643E+06	2.646E+08
BA - 141	1.936E+03	4.734E+04	4.327E - 46	0.000E+00	0.000E+00	0.000E+00	5.193E-47	9.463E - 22
BA - 142	1.192E+03	5.064E+04	2.509E-80	0.000E+00	0.000E+00	0.000E+00	3.011E-81	2.463E - 39
LA - 140	4.584E+05	2.180E+07	1.672E+05	1.385E+03	4.059E - 12	1.662E+02	2.006E+04	7.319E+07
LA - 142	6.328E+03	9.117E+05	6.273E - 08	0.000E+00	0.000E+00	0.000E+00	7.531E-09	6.768E - 01
CE - 141	3.616E+05	1.540E+07	1.25E+07	3.632E+07	6.424E+05	4.358E+06	1.503E+06	5.097E+08
CE - 143	2.264E+05	2.627E+06	1.15E+06	5.547E+02	7.768E - 15	6.656E+01	1.38E+05	2.758E+07
CE - 144	7.776E+06	8.042E+07	1.21E+08	4.928E+08	3.398E+07	5.914E+07	1.451E+07	1.112E+10
PR - 143	2.808E+05	0.000E+00	6.918E+05	9.204E+07	2.445E+03	1.104E+07	8.297E+04	2.748E+08
PR - 144	1.016E+03	2.112E+03	6.716E - 54	0.000E+00	0.000E+00	0.000E+00	7.745E-55	3.303E - 26
ND - 147	2.208E+05	1.009E+07	5.231E+05	3.935E+07	6.286E+02	4.722E+06	6.273E+04	1.853E+08
W - 187	1.552E+05	2.740E+06	1.796E+06	5.912E+00	3.787E - 22	7.094E - 01	2.14E+05	1.046E+07
NP - 239	1.192E+05	1.976E+06	7.409E+04	5.152E+03	7.545E - 08	6.182E+02	8.876E+03	2.872E+07
			(PASTURE)	(PASTURE)	(FEED)	(PASTURE)	(PASTURE)	

Units -

Inhalation and all tritium - mrem/yr per $\mu Ci/m^3$

Other pathways for all other radionuclides -m^2 • mrem/yr per $\mu Ci/sec$

NOTE: The R_i values of Table 3.2-2 through 3.2-6 were calculated in accordance with the methods of Section 5.3.1 of Reference 1. Columns in those tables marked "Pasture" are for freely-grazing animals ($f_p = f_s = 1$). Columns marked "Feed" are for animals fed solely locally-grown stored feed ($f_p = f_s = 0$). The values used for each parameter and the origins of the values are given in Table 3.2-9 and its notes.

Table 3.2-7

CONTROLLING RECEPTORS, LOCATIONS, AND PATHWAYS*

SECTOR	DISTANCE (METERS)	PATHWAY	AGE GROUP	ORIGIN (FOR INFORMATION ONLY
N**	6,100	Vegetation	Child	-Vegetable Garden
NNE**	5,300	Vegetation	Child	-Vegetable Garden
NE	4,500	Vegetation	Child	-Vegetable Garden
	4,500	Grass/Cow/Meat	Child	Grazing Beef Cattle
ENE	2,600	Vegetation	Child	-Vegetable Garden
	2,600	Grass/Cow/Meat		Grazing Beef Cattle
E	1,800	Vegetation	Child	-Vegetable Garden
ESE	1,800	Vegetation	Child	-Vegetable Garden
SE	2,400	Vegetation	Child	-Vegetable Garden
SSE	4,300	Vegetation	Child	-Vegetable Garden
S**	6,300	Vegetation	Child	-Vegetable Garden
SSW**	5,500	Vegetation	Child	-Vegetable Garden
SW**	5,300	Vegetation	Child	-Vegetable Garden
WSW	3,100	Grass/Cow/Meat	Child	-Grazing Beef Cattle
W	4,300	Vegetation	Child	-Vegetable Garden
	3,500	Grass/Cow/Meat	Child	Grazing Beef Cattle
WNW**	7,700	Vegetation	Child	-Vegetable Garden
NW**	6,600	Vegetation	Child	-Vegetable Garden
	6,600	Grass/Cow/Meat	Child	Grazing Beef Cattle
NNW	4,800	Vegetation	Child	-Vegetable Garden
	4,800	Grass/Cow/Meat	Child	Grazing Beef Cattle

* See note on the following page for the method used to identify these controlling receptors.

** If a cow were located at 5.0 miles (8,000 meters) in this sector, an infant consuming only its milk would receive a greater total radiation dose than would the real receptor listed. However, such an infant would not be the Maximum Exposed Individual for the site.

NOTE: The controlling receptor in each sector was identified in the following way. Receptor locations and associated pathways were obtained from the August 1991 field survey. A child was assumed at each location, except that where a milk cow was listed, an infant was assumed. X/Q' and D/Q' for each candidate receptor was calculated using five year averaged meteorological data. XOQDOQ[82] software was used to analyze the meteorological data. Expected annual releases of each nuclide were taken from Table 5.2-2 of Reference 5. The specific dispersion values for each candidate are used with the methodology of ODCM section 3.2.3.2 to calculate a hypothetical dose. The controlling receptor for each sector was then chosen as the candidate receptor with the highest total annual dose of any candidate receptor in the given sector. All listed pathways are in addition to inhalation and ground plane exposure.

Table 3.2-8

ATMOSPHERIC DISPERSION PARAMETERS FOR CONTROLLING RECEPTOR LOCATIONS*

SECTOR	$\overline{X}/Q'$	$\overline{D}/Q'$	DISTANCE (MILES/METERS)
N	2.3 E-7	6.3 E-10	3.8 / 6,100
NNE	2.9 E-7	8.5 E-10	3.3 / 5,300
NE	5.4 E-7	1.5 E-9	2.8 / 4,500
ENE	1.8 E-6	5.4 E-9	1.6 / 2,600
E	3.5 E-6	1.1 E-8	1.1 / 1,800
ESE	2.1 E-6	6.8 E-9	1.1 / 1,800
SE	6.5 E-7	2.4 E-9	1.5 / 2,400
SSE	1.2 E-7	5.3 E-10	2.7 / 4,300
S	7.6 E-8	3.5 E-10	3.9 / 6,300
SSW	1.2 E-7	7.0 E-10	3.4 / 5,500
SW	1.3 E-7	9.6 E-10	3.3 / 5,300
WSW	3.6 E-7	2.5 E-9	1.9 / 3,100
W	1.8 E-7	7.7 E-10	2.7 / 4,300
W	2.8 E-7	1.3 E-9	2.2 / 3,500
WNW	3.8 E-8	1.3 E-10	4.8 / 7,700
NW	9.8 E-8	2.8 E-10	4.1 / 6,600
NNW	3.3 E-7	9.0 E-10	3.0 / 4,800

* Annual average relative dispersion and deposition values for the receptor locations in Table 3.2-7. Values were calculated from 5 year averaged meteorological data using the XOQDOQ-82 software. Dispersion values were calculated assuming ground-level release, open terrain recirculation, dry depletion, and using decay with a half-life of 8.0 days. As a result of the analysis described in the note to Table 3.2-7, the location of the maximum exposed individual for the site is assumed to be the vegetable garden at 1.1 miles in the E sector. Therefore, the site X/Q' and D/Q' (Section 3.2.3.2 and following) are those from this table for that location.

Table 3.2-9

PARAMETERS USED IN DOSE FACTOR CALCULATIONS

Parameter	Value	Origin of Value		
		Table in R.G. 1.109	Section of NUREG-0133	Site-Specific
	For P_i			
DFA_i	Each radionuclide	E-9		Note 2
BR	3700 m^3/yr	E-5		
	For Ri (Vegetation)			
r	Each element type	E-1		
Y_v	2.0 kg/m^2	E-15		
λw	5.83 E-7 sec^{-1}		5.3.1.3	
DFL_i	Each age group and radio-nuclide	E-11 thru E-14		Note 2
U_a^L	Each age group	E-5		
f_L	1.0		5.3.1.5	
t_L	8.6 E + 4 seconds	E-15		
U_a^S	Each age group	E-5		
f_g	0.76		5.3.1.5	
t_h	5.18 E + 6 seconds	E-15		
H	8.84 gm/m^3			Note 1
	For Ri (Inhalation)			
BR	Each age group	E-5		
DFA_i	Each age group and nuclide	E-7 thru E-10		Note 2

Table 3.2-9

Page 2 of 4

PARAMETERS USED IN DOSE FACTOR CALCULATIONS

Parameter	Value	Origin of Value		
		Table in R.G. 1.109	Section of NUREG-0133	Site-Specific
	*****For R_i (Ground Plane)*****			
SF	0.7	E-15		
DFG_i	Each radionuclide	E-6		
t	4.73 E + 8 sec		5.3.1.2	
	*****For Ri (Grass/Animal/Meat)*****			
Q_F (Cow)	50 kg/day	E-3		
Q_F (Goat)	6 kg/day	E-3		
U_{ap}	Each age group	E-5		
λw	5.73 E-7 sec^{-1}		5.3.1.3	
F_f (Both)	Each element	E-1		
r	Each element type	E-15		
DFL_i	Each age group and nuclide	E-11 thru E-14		Note 2
f_p	1.0			Note 3
f_s	1.0			Note 3
Y_p	0.7 kg/m^3	E-15		
t_h	7.78 E + 6 sec	E-15		
Y_s	2.0 kg/m^2	E-15		
t_f	1.73 E + 6 sec	E-15		
H	8.84 gm/m^3			Note 1

Table 3.2-9

PARAMETERS USED IN DOSE FACTOR CALCULATIONS

Parameter	Value	Origin of Value		
		Table in R.G. 1.109	Section of NUREG-0133	Site-Specific
	For R_i (Grass/Animal/Milk)			Note 4
Q_F (Cow)	50 kg/day	E-3		
Q_F (Goat)	6 kg/day	E-3		
U_{ap}	Each age group	E-5		
λw	5.73 E-7 sec^{-1}		5.3.1.3	
F_m	Each element	E-1 & E-2		
r	Each element type	E-15		
DFL_i	Each age group and nuclide	E-11 thru E-14		Note 2
Y_p	0.7 kg/m^2	E-15		
t_h	7.78 E + 6 sec	E-15		
Y_s	2.0 kg/m^2	E-15		
t_f	1.73 E + 5 sec	E-15		
f_p	1.0			Note 5
f_s	1.0			Note 5
f_p	0.0			Note 5
f_s	0.0			Note 5
H	8.84 gm/m^3			Note 1

Table 3.2-9 (Continued)

Page 4 of 4

NOTES

1. Site-specific annual average absolute humidity. For each month, an average absolute humidity was calculated from the 7 years of monthly average temperatures in Table 2.3-49 of Reference 4 and 5 years of monthly average dew points in Table 2.3-64 of Reference 4. The 12 monthly values were averaged to obtain the annual average of 8.84 gm/m^3. (Section 5.2.1.3 of Reference 1 gives a default value of 8 gm/m^3.)

2. Inhalation and ingestion dose factors were taken from the indicated source. For each age group, for each nuclide, the organ dose factor used was the highest dose factor for that nuclide and age group in the referenced table.

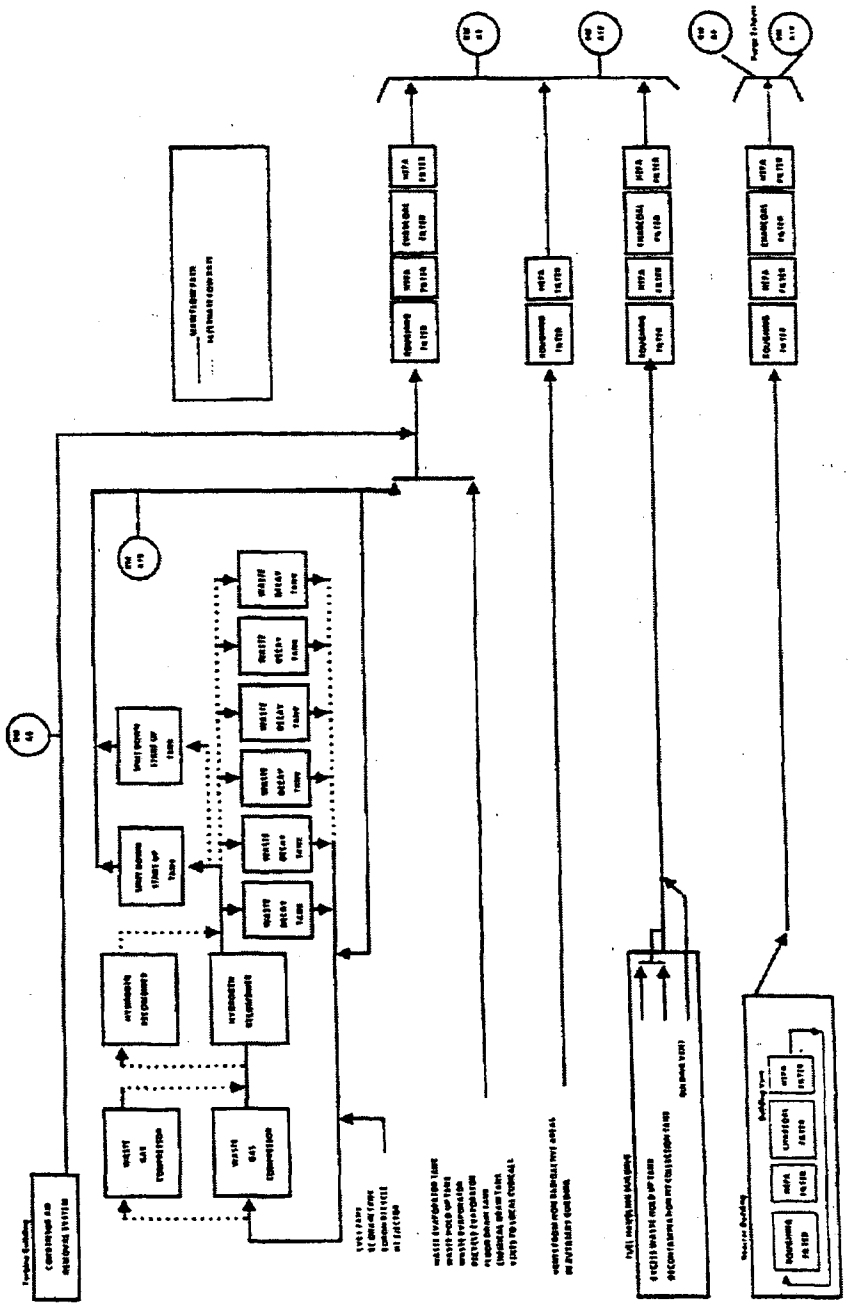
3. Typically beef cattle are raised all year on pasture. Annual land surveys have indicated that the small number of goats raised within 5 miles typically are used for grass control and not food or milk. Nevertheless, the goats were treated as full meat and milk sources where present, despite the fact that their numbers cannot sustain the meat consumption rates of Table E-5 of Reference 3.

4. According to the August 1990 land use census, dairy cattle possibly graze at 4.9 miles in the West sector. If dairy cattle graze at this location, the dose to an infant consuming milk from these animals would be less than the dose received by the critical receptor identified for the sector. No other milking activity within five miles of the plant was identified. These values are included for reference only.

5. Two columns of R_i's were calculated - one for cows kept exclusively on local pasture ($f_p = f_s = 1$), and one for cows kept exclusively on locally grown stored feed ($f_p = f_s = 0$). See the note on page 2.0-37.

GASEOUS RADWASTE TREATMENT SYSTEM

Figure 3.2-1



3.3 Meteorological Model for Dose Calculations

3.3.1 Meteorological Model Parameters

Term		Definition	Section of Initial Use
b	=	height of the containment building.	(3.3.2.1)
D_g	=	deposition rate for ground-level releases relative to the distance from the containment building (from Figure 3.3-3).	(3.3.2.2)
D/Q	=	the sector averaged relative deposition for any distance in a given sector (m^{-2}).	(3.3.2.2)
i	=	wind speed class. The wind speed classes are given in Table 4A of Reference 10 as 1-3, 4-7, 8-12, 13-18, 19-24, and > 24 miles per hour.	(3.3.2.1)
N	=	total hours of valid meteorological data.	(3.3.2.1)
n_{ij}	=	number of hours meteorological conditions are observed to be in a given wind direction, wind speed class i, and atmospheric stability class j.	(3.3.3.1)
n	=	number of hours wind is in given direction.	(3.3.2.1)
r	=	distance from the containment building to the location of interest for dispersion calculations (m).	(3.3.2.1)
$\Delta T/\Delta Z$	=	temperature differential with vertical separation (°K/100m).	(3.3.2.1)
T	=	terrain recirculation factor, Figure 3.3-4.	(3.3.2.1)
u_i	=	wind speed (midpoint of wind speed class i) at ground level (m/sec).	(3.3.2.1)
X/Q	=	the sector average relative concentration at any distance in a given sector. (sec/m^3).	(3.3.2.1)
δ	=	plume depletion factor at distance r from Figure 3.3-1.	(3.3.3.1)

Term		Definition	Section of Initial Use
σ_z	=	vertical standard deviation of the plume (in meters), at distance r for ground level releases under the stability category indicated by $\Delta T/\Delta Z$, from Figure 3.3-2.	(3.3.2.1)
2.032	=	$(2/\pi)^{1/2}$ divided by the width in radians of a 22.5° sector (0.3927 radians).	(3.3.2.1)
2.55	=	the inverse of the number of radians in a 22.5° sector	(3.3.2.2)

$$\frac{1}{(22.5°)\,(0.0175\,Radians/°)}$$

3.3.2 Meteorological Model

3.3.2.1 Atmospheric dispersion for routine venting or other routine gaseous effluent releases is calculated using a ground-level, wake-corrected form of the straight line flow model.

X/Q = the sector-averaged relative concentration at any distance in the given sector (sec/m^3)

$$= 2.032\,\delta\,T \sum_{ij} \frac{n_{ij}}{Nru_i \sum_{ij}} \qquad (52)$$

where:

2.032 = $(2/\pi)^{1/2}$ divided by the width in radians of a 22.5° sector (0.3927 radians).

δ = plume depletion factor at distance r for the appropriate stability class from Figure 3.3-1.

i = wind speed class. The wind speed classes are given in Table 4A of Reference 10 as 1-3, 4-7, 8-12, 13-18, 19-24, and > 24 miles per hour.

$n_{i,j}$ = number of hours meteorological conditions are observed to be in a given wind direction, wind speed class i, and atmospheric stability class j.

N = total hours of valid meteorological data.

r = distance from the containment building to location of interest (m)

u_i = wind speed (midpoint of wind speed class $_i$) at ground level (m/sec).

$$\sum_Z = \textit{the lesser of } (\sigma_z^2 + b^2/2\pi)^{\frac{1}{2}} \textit{ or } \left(\sqrt{3\sigma_z}\right) \qquad (53)$$

where:

σ_Z = vertical standard deviation of the plume (in meters) at distance r for ground level releases under the stability category indicated by $\Delta T/\Delta Z$, from Figure 3.3-2.

T = terrain recirculation factor, from Figure 3.3-4

π = 3.1416

b = height of the containment building (50.9m)

$\Delta T/\Delta Z$ = temperature differential with vertical separation (°K/100m).

Note: For calculation of X/Q using actual meteorological data for a particular release, u_i = the average wind speed for hour $_i$ and n_{ij} = number of hours with wind speed $_i$ and stability class $_j$.

3.3.2.2 Relative deposition per unit area for all releases is calculated for a ground-level release.

D/Q = the sector-averaged relative deposition at any distance in a given sector (m^{-2}).

$$= \frac{2.55\, D_g^{\,n}}{rN} \qquad (54)$$

where,

D_g = deposition rate for ground-level releases relative to distance (r) from the containment building (from Figure 3.3-3).

2.55 = the inverse of the number of radians in a 22.5° sector

$$\frac{1}{(22.5°)\ (0.0175\ Radians/°)}$$

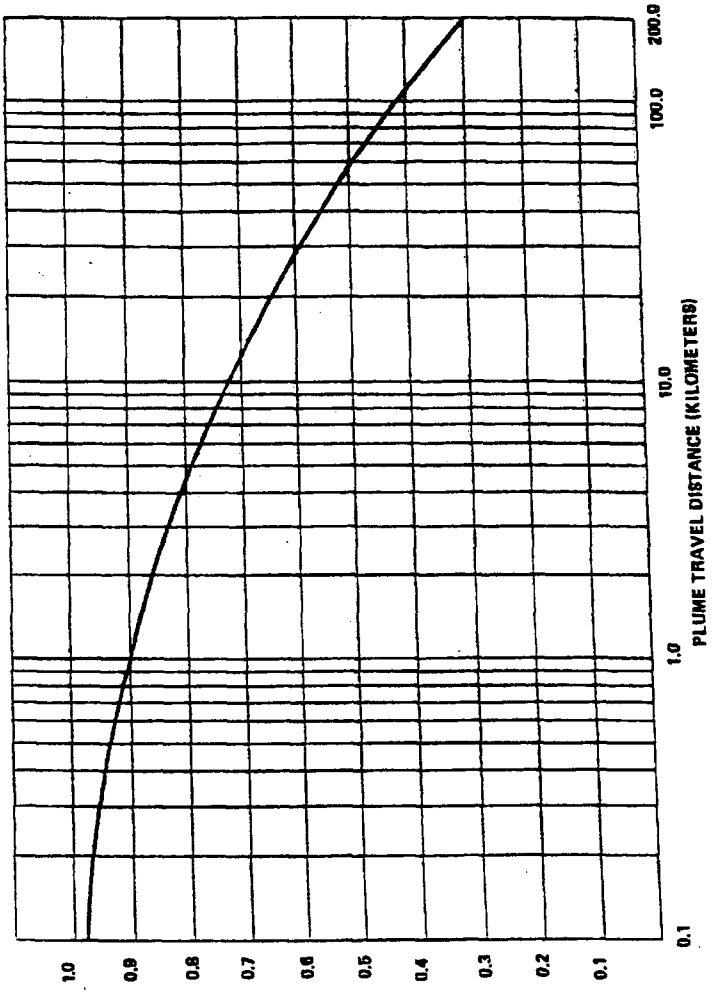
n = number of hours wind is in given direction (sector).

N = total hours of valid meteorological data.

FIGURE 3.3-1

Plume Depletion Effect for Ground Level Releases (δ)
(All Atmospheric Stability Classes)

Graph taken from Reference 8, Figure 2

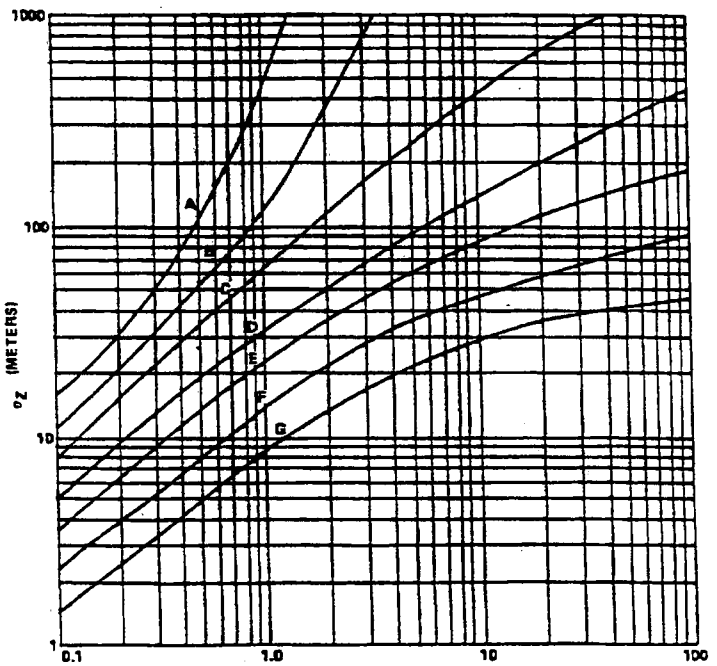


FRACTION REMAINING IN PLUME

FIGURE 3.3-2

Vertical Standard Deviation of Material in a Plume (δ_z)
(Letters denote Pasquill Stability Clases)

Graph taken from Reference 8, Figure 1

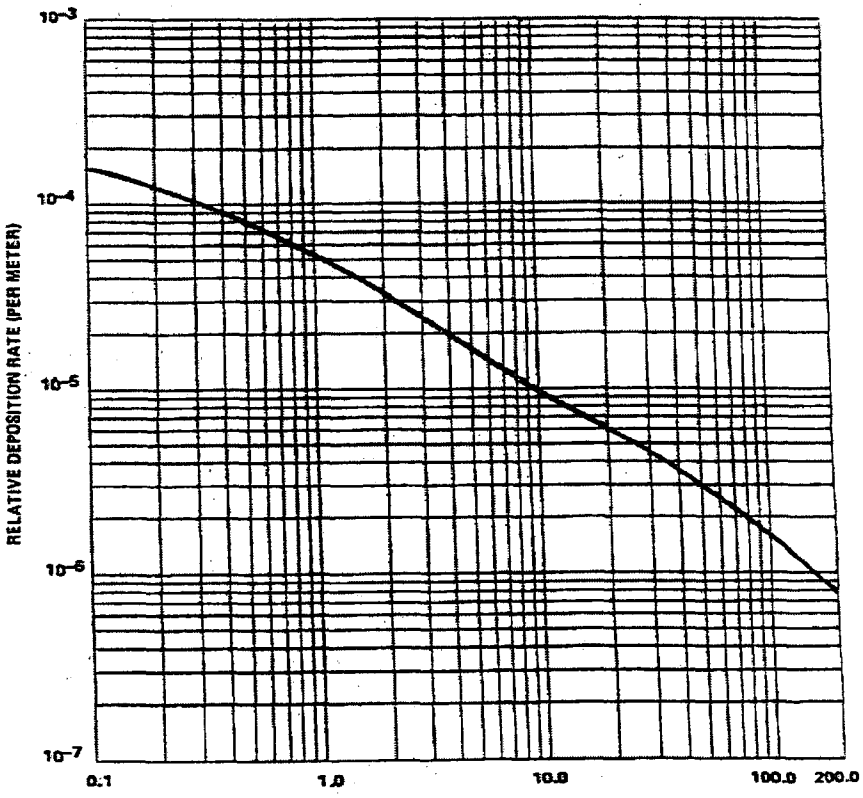


PLUME TRAVEL DISTANCE (KILOMETERS)

Temperature change with Height Δ T/Δ Z (•K/100m)	Pasquill Categories	Stability Classification
<-1.9	A	Extremely Unstable
-1.9 to -1.7	B	Moderately Unstable
-1.7 to 1.5	C	Slightly Unstaable
-1.5 to -0.5	D	Neutral
-0.5 to 1.5	E	Slightly Stable
1.5 to 4.0	F	Moderately Stable
>4.0	G	Extremely Stable

FIGURE 3.3-3
Relative Deposition for Ground Level Releases (D_g)
(All Atmospheric Stability Classes)

Graph taken from Reference 8, Figure 6

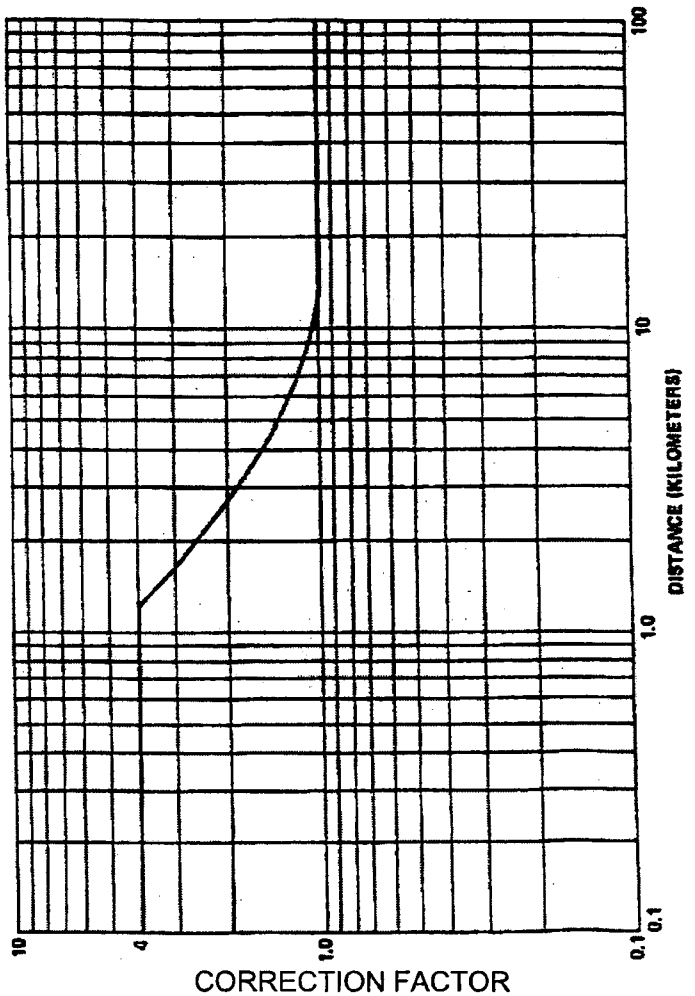


PLUME TRAVEL DISTANCE (KILOMETERS)

FIGURE 3.3-4

Open Terrain Recirculation Factor

Graph taken from Reference 7, Figure 2



4.0 RADIOLOGICAL ENVIRONMENTAL MONITORING

Sampling locations as required in section 1.4.1 of the ODCM Specifications are described in Table 4.0-1 and shown on Figures 4.0-1 and 4.0-2. As indicated by the ditto (") marks in the table, entries in the sampling frequency and analysis frequency columns apply to all samples below the entry until a new entry appears.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
VIRGIL C. SUMMER NUCLEAR STATION
TABLE 4.0-1

Exposure Pathway and/or Sample		Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample[10] Location	Locations Mi/Dir	Type & Frequency of Analysis
AIRBORNE: I. Particulate	A)	3 Indicator samples to be taken at locations (in different sectors) beyond but as close to the exclusion boundary as practicable where the concentrations are anticipated.[9]	Continuous sampler operation with weekly collection.	2 7 30	1.2 SW 1.0 E 1.0 SSW	Gross beta following filter change; Quarterly [6] Composite (by location) for gamma isotopic.
	B)	1 Indicator sample to be taken in the sector beyond but as close to the exclusion boundary as practicable corresponding to the residence having the highest anticipated offsite ground level concentration or dose.[9]	Continuous sampler operation with weekly collection.	6	1.0 ESE	Gross beta following filter change; Quarterly [6] Composite (by location) for gamma isotopic.
	C)	1 Indicator sample to be taken at the location of one of the dairies being sampled meeting the criteria of VII(A). [2,9]	Continuous sampler operation with weekly collection.	N/A	N/A	Gross beta following filter change; Quarterly [6] Composite (by location) for gamma isotopic.
	D)	1 Control samples to be taken at a location at least 10 air miles from the site and not in the most prevalent wind direction.[9]	Continuous sampler operation with weekly collection.	17	25.0 SE	Gross beta following filter change; Quarterly [6] Composite (by location) for gamma isotopic.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
VIRGIL C. SUMMER NUCLEAR STATION
TABLE 4.0-1

Exposure Pathway and/or Sample		Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample[10] Location	Locations Mi/Dir	Type & Frequency of Analysis
II. Radioiodine	A)	3 Indicator samples to be taken at two locations as given in I(A) above.	Continuous sampler operation with weekly canister collection.	2 7 30	1.2 SW 1.0 E 1.0 SSW	Gamma Isotopic for I-131 weekly.
	B)	1 Indicator to be taken at the location as given in I(B) above	Continuous sampler operation with weekly canister collection.	6	1.0 ESE	Gamma Isotopic for I-131 weekly.
	C)	1 Indicator sample to be taken at the location as given in I(C) above	Continuous sampler operation with weekly canister collection.	N/A	N/A	Gamma Isotopic for I-131 weekly.
	D)	1 Control sample to be taken at a location similar in nature to I(D) above.	Continuous sampler operation with weekly canister collection.	17	25.0 SE	Gamma Isotopic for I-131 weekly.
III. Direct	A)	13 Indicator stations to form an inner ring of stations in the 13 accessible sectors within 1 to 2 miles of the plant.	Monthly[5] or quarterly[6]; exchange two or more dosimeters at each location.	1,2 3,4 5,6 7,8 9,10 29 30 47	1.2 S, 1.2 SW 1.2W, 1.2WNW 0.9 SE, 1.0 ESE 1.0 E, 1.5 ENE 2.3 NE, 2.5NNE 1.0 WSW, 1.0 SSW 1.0 NW	Gamma dose monthly[5] or quarterly.[6]

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
VIRGIL C. SUMMER NUCLEAR STATION
TABLE 4.0-1

Exposure Pathway and/or Sample		Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample[10] Location	Locations MI/Dir	Type & Frequency of Analysis
III. Direct (Continued)	B)	16 Indicator stations to form an outer ring of stations in the 16 accessible sectors within 3 to 5 miles of the plant.	Monthly [5] or quarterly [6], exchange two or more dosimeters at each location.	12,13 32,33 34,35 36,37 41,42 43,44 46,60 53,55	4.2 N, 2.9 NNW 4.6 NNE, 4.2 ENE 4.9 ESE, 4.6 SE 3.1 SSE, 4.9 NW 3.8 S, 3.8 SSW 5.2 SW, 2.8 WSW 3.7 WNW, 3.5W 3.0 NE, 2.8 E	Gamma dose monthly[5] or quarterly. [6]
	C)	11 Stations to be placed in special interest areas such as population centers, nearby residences, schools and in 4 or 5 areas to serve as controls.	Monthly [5] or quarterly [6], exchange two or more dosimeters at each location.	16, 17 18, 19 20,31 45,52 54,56 58	28.0 W, 25.0 SE 16.5 S, 21.0 SSW 22.0 NW, 6.6 NNE 5.8 WSW, 3.8 NNE 1.7 ENE, 2.0 SE 2.5 SSE	Gamma dose monthly[5] or quarterly. [6]
WATERBORNE: IV. Surface Water	A)	1 Indicator sample downstream to be taken at a location which allows for mixing and dilution in the ultimate receiving river.	Time composite samples with collection every month.[5]	21 [3,11]	2.7 SSW	Gamma isotopic monthly [5] with quarterly [6] composite (by location) to be analyzed for tritium.
	B)	1 Control sample to be taken at a location on the receiving river, sufficiently far upstream such that no effects of pumped storage operation are anticipated.	Time composite samples with collection every month.[5]	22 [11]	26.0 NNW	Gamma isotopic monthly [5] with quarterly [6] composite (by location) to be analyzed for tritium.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
VIRGIL C. SUMMER NUCLEAR STATION
TABLE 4.0-1

Exposure Pathway and/or Sample		Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample[10] Location	Locations Mi/Dir	Type & Frequency of Analysis
IV. Surface Water (Continued)	C)	1 Indicator sample to be taken in the upper reservoir of the pumped storage facility at the plant discharge canal.	Time composite samples with collection every month.[5]	23 [11]	0.5 ESE	Gamma isotopic monthly [5] with quarterly [6] composite (by location) to be analyzed for tritium.
V. Ground Water	A)	19 Indicators samples to be taken within the exclusion boundary and in the direction of potentially affected ground water supplies.	Quarterly [6] grab sampling	6 26 27 100-110 111 112 113 114 115	1.0 ESE Onsite Onsite Onsite 0.27 SE 0.36 SSE 0.33 SSE 0.39 SE 0.39 SSE	Gamma isotopic and tritium analyses quarterly.[6]
	B)	1 Control sample from unaffected location	Quarterly [6] grab sampling	59	2.6 SSE	Gamma isotopic and tritium analyses quarterly.[6]
VI. Drinking Water	A)	1 Indicator sample from a nearby public ground water supply source.	Monthly [5] grab sampling.	28	2.6 SSE	Monthly [5] gamma isotopic and gross beta analyses and quarterly [6] composite for tritium analyses.
	B)	1 Indicator (finished water) sample from the nearest downstream water supply	Monthly [5] composite sampling	17	25.0 SE	Monthly [5] gamma isotopic and gross beta analyses and quarterly [6] composite for tritium analyses.
	C)	1 Control (finished water) sample from an unaffected water supply.	Monthly [5] composite sampling	39	14.0 SSE	Monthly [5] gamma Isotopic and gross beta analyses and quarterly [6] composite for tritium analyses.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
VIRGIL C. SUMMER NUCLEAR STATION
TABLE 4.0-1

Exposure Pathway and/or Sample		Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample [10] Location	Locations Mi/Dir	Type & Frequency of Analysis
INGESTION: VII. Milk [2]	A)	Samples from milking animals in 3 locations within 5 km having the highest dose potential. If there are none then 1 sample from milking animals in each of 3 areas between 5 to 8 km distance where doses are calculated to be greater than 1 mrem per year.[1]	Semimonthly [4] when animals are on pasture, monthly [5] other times.	To be supplied when milk animals are found in accordance with criteria VII(A).		Gamma isotopic and I-131 analysis semimonthly [4] when animals are on pasture monthly [5] other times.
	B)	1 Control sample to be taken at the location of a dairy > 20 miles distance and not in the most prevalent wind direction.[2]	Semimonthly [4] when animals are on pasture, monthly [5] other times. [6]	16	20.0 W	Gamma isotopic and I-131 analysis semimonthly [4] when animals are on pasture monthly [5] other times.
	C)	1 Indicator grass (forage) sample to be taken at the location of one of the dairies being sampled meeting the criteria of VII(A), above, when animals are on pasture.	Monthly [5] when available. [8]	To be supplied when milk animals are found in accordance with criteria VII(A).		Gamma isotopic.
	D)	1 Control grass (forage) sample to be taken at the location of VII(B) above.	Monthly [5] when available [8]	16	20.0 W	Gamma isotopic.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
VIRGIL C. SUMMER NUCLEAR STATION
TABLE 4.0-1

Exposure Pathway and/or Sample		Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample Location [10]	Locations Mi/Dir	Type & Frequency of Analysis
VIII.	Food Products	A) 2 samples of broadleaf vegetation grown in the 2 nearest offsite locations of highest calculated annual average ground level D/Q if milk sampling is not performed within 3 km or if milk sampling is not performed at a location within 5 to 8 km where the doses are calculated to be greater than 1 mrem/yr.[1]	Monthly [5] when available.	6 7	1.0 ESE 1.0 E	Gamma isotopic on edible portion.
		B) 1 Control sample for the same foods taken at a location at least 10 miles distance and not in the most prevalent wind direction if milk sampling is not performed within 3 km or if milk sampling is not performed at a location within 5 to 8 km where the doses are calculated to be greater than 1 mrem/yr.[1]	Monthly [5] when available.	18	16.5 S	Gamma isotopic on edible portion.
IX.	Fish	A) 1 Indicator sample to be taken at a location in the upper reservoir.	Seminannual [7] collection of the following specie types if available: bass; bream, crappie; catfish, carp.	23 [11]	0.3-5	Gamma isotopic on edible portions seminannually.[7]
		B) 1 Indicator sample to be taken at a location in the lower reservoir.	Seminannual [7] collection of the following specie types if available: bass; bream, crappie; catfish, carp.	21 [11]	1-3	Gamma isotopic on edible portions seminannually.[7]

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
VIRGIL C. SUMMER NUCLEAR STATION
TABLE 4.0-1

Exposure Pathway and/or Sample	Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample Location [10]	Locations Mi/Dir	Type & Frequency of Analysis
IX. Fish (Continued)	C) 1 Control sample to be taken at a location on the receiving river sufficiently far upstream such that no effects of pumped storage operation are anticipated.	Semiannual [7] collection of the following specie types if available: bass; bream, crappie; catfish, carp.	22 [11]	26.0 NNW	Gamma Isotopic on edible portions semiannually. [7]
AQUATIC: X. Sediment	A) 1 Indicator sample to be taken at a location in the upper reservoir.	Semiannual [7] grab sample.	23 [11]	0.5 ESE	Gamma isotopic.
	B) 1 Indicator sample to be taken on or near the shoreline of the lower reservoir.	Semiannual [7] grab sample.	21 [11]	2.7 SSW	Gamma isotopic.
	C) 1 Control sample to be taken at a location on the receiving river sufficiently far upstream such that no effects of pumped storage operation are anticipated.	Semiannual [7] grab sample.	22 [11]	26.0 NNW	Gamma isotopic.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
VIRGIL C. SUMMER NUCLEAR STATION
TABLE 4.0-1
TABLE NOTATION

1. The dose shall be calculated for the maximum organ and age group, using the guidance/methodology contained in Regulatory Guide 1.109, Revision 1 and the parameters particular to the Site. The locations are selected based on the potential for the highest exposure.

2. Milking animal and garden survey results will be analyzed annually. Should the survey indicate new dairying activity the owners shall be contacted with regard to a contract for supplying sufficient samples. If contractual arrangements can be made, Site(s) will be added for additional milk sampling up to a total of 3 Indicator Locations.

3. Time composite samples are samples which are collected with equipment capable of collecting an aliquot at time intervals which are short (e.g. hourly) relative to the compositing period.

4. At least once per 18 days.

5. Not to exceed 35 days.

6. At least once per 100 days.

7. At least once per 200 days

8. Milk and forage sampling at the control location is only required when locations meeting the criteria of VII(A) are being sampled.

9. Sample site locations are based on 5 year average meteorological analysis.

10. Location numbers refer to Figures 4.0-1 and 4.0-2.

11. Though generalized areas are noted for simplicity of sample site enumeration, airborne, water and sediment sampling is done at the same location whereas biological sampling sites are generalized areas in order to reasonably assure availability of samples.

FIGURE 4.0-1
Radiological Environmental Sampling Locations (Remote)

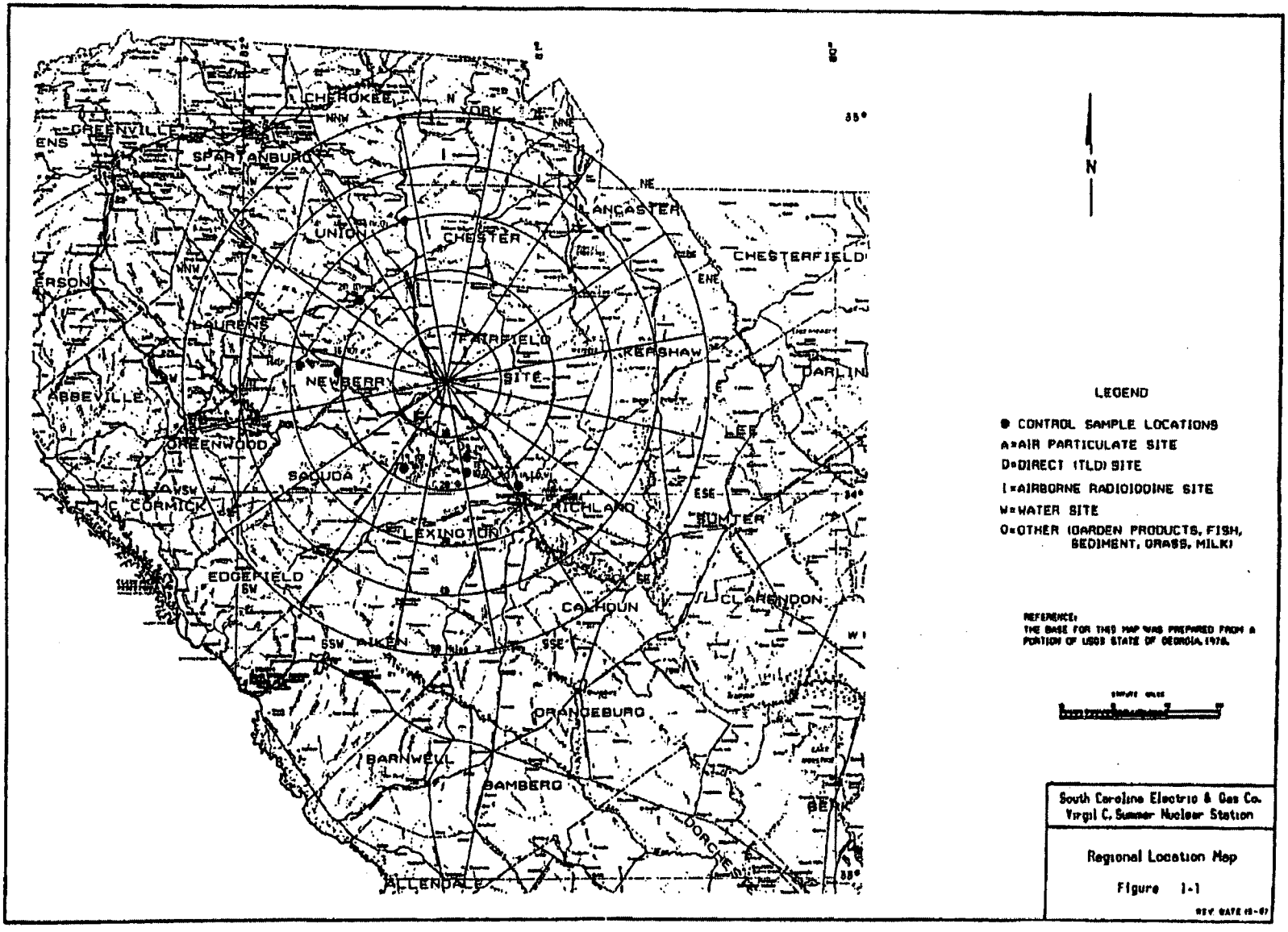


FIGURE 4.0-2
Radiological Environmental Sampling Locations (Local)

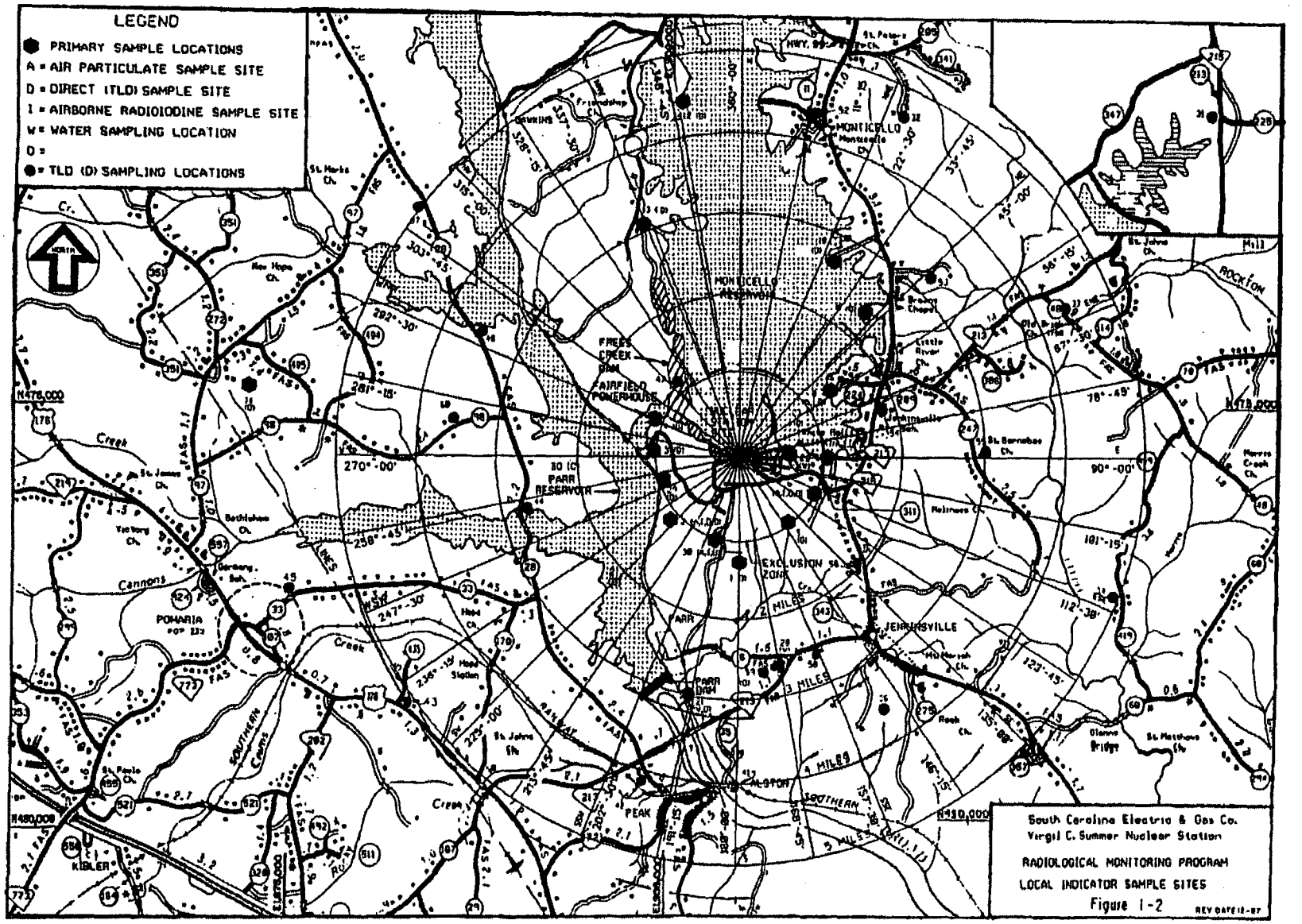


FIGURE 4.0-3
Radiological Environmental Sampling Locations (Local)

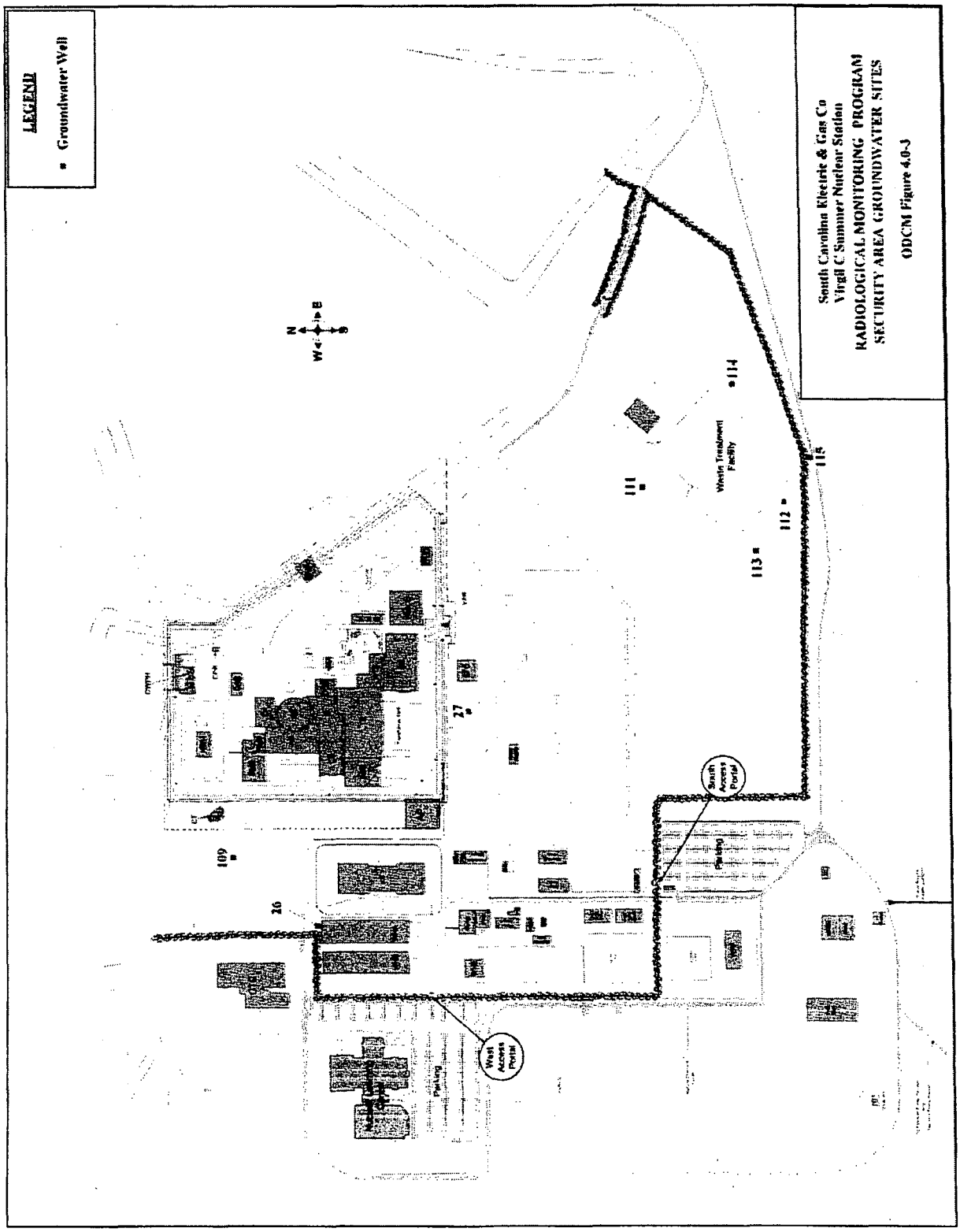
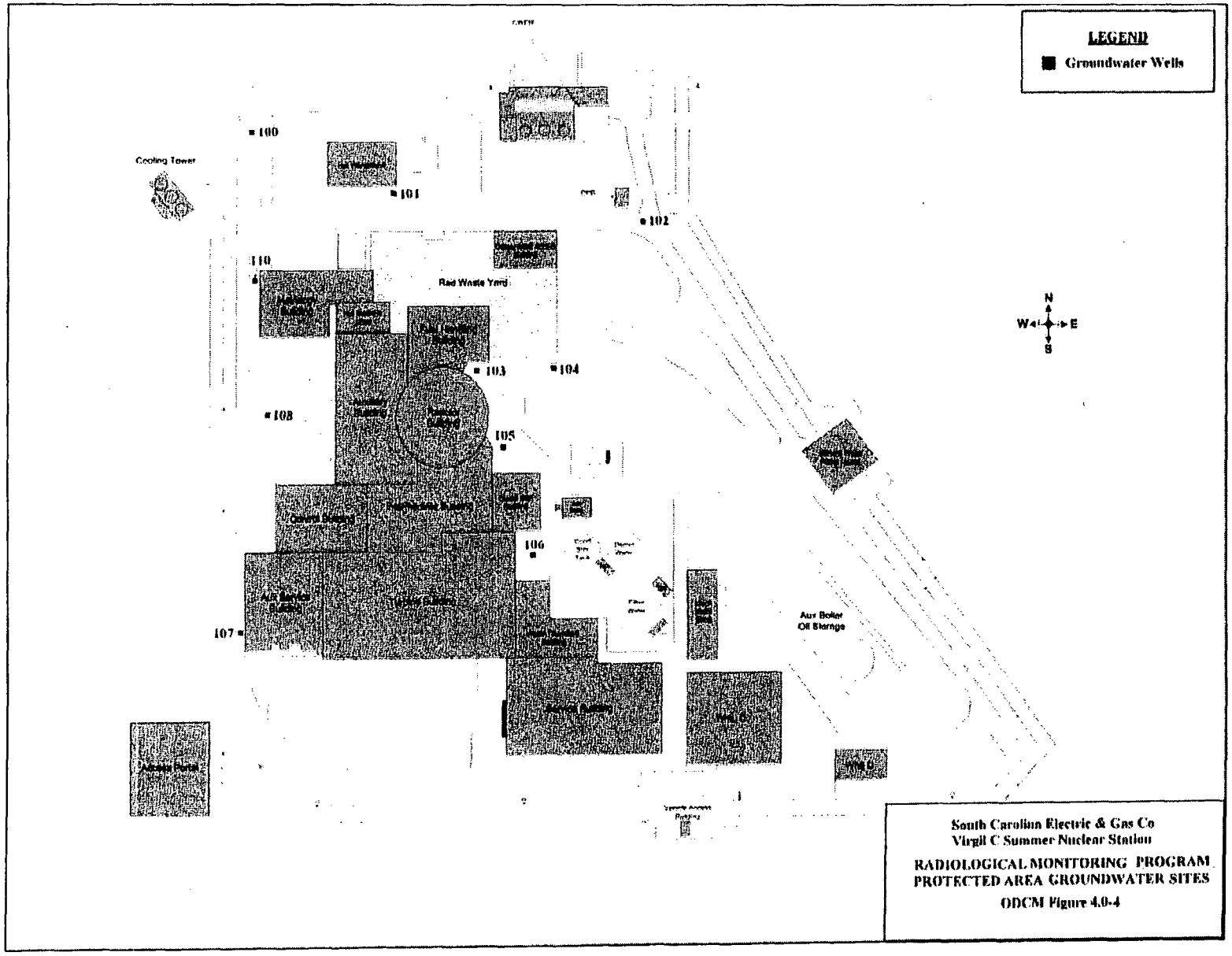


FIGURE 4.0-4
Radiological Environmental Sampling Locations (Local)



Section 4.6 References

NO REFERNCES

Section 4.7 References

1. BLS (Bureau of Labor Statistics) 2006a. Table 1. *Incidence Rates of Nonfatal Occupational Injuries and Illnesses by Industry and Case Types, 2005.* Available at http://www.bls.gov/iif, accessed April 26, 2007.

2. BLS 2006b. Table 6. *Incidence Rates of Nonfatal Occupational Injuries and Illnesses by Industry and Case Types, 2005, South Carolina.* Available at http://www.bls.gov/iif, accessed April 26, 2007.

3. BLS 2006c. Table A-1. *Fatal Occupational Injuries by Industry and Event or Exposure, All United States, 2005.* Available at http://www.bls.gov/iif, accessed April 26, 2007.

U.S. Department of Labor
Bureau of Labor Statistics
Injuries, Illnesses, and Fatalities

www.bls.gov

The **Injuries, Illnesses, and Fatalities (IIF)** program provides data on illnesses and injuries on the job and data on worker fatalities.

- Current Injury, Illness, and Fatality Data
- Economic News Releases and Announcements
- Special Notices
- Get Detailed IIF Statistics
- Publications
- Overviews, Descriptions, and Documentation
- Definitions
- Record keeping, Standards, and Forms
- Related Links
- Frequently Asked Questions
- Contact Us

Back to Top

SCEG-147

CURRENT INJURY, ILLNESS, AND FATALITY DATA:

Select a subject area

- OSHA recordable case rates (TXT) (PDF 95K) - latest incidence rates, by industry, for nonfatal work-related injuries and illnesses.
- REVISED Fatal injuries - 2004 revised data now available
- Nonfatal (OSHA recordable) injuries and illnesses
  - Industry incidence rates and counts
  - NEW Case and demographic characteristics

Back to Top

ECONOMIC NEWS RELEASES AND ANNOUNCEMENTS:

- Census of Fatal Occupational Injuries (HTML) (PDF 75K)
- Nonfatal occupational injuries and illnesses from the Survey of Occupational Injuries and Illnesses
  - Industry counts and frequency rates (HTML) (PDF 62K)
  - NEW Lost-Worktime Injuries and Illnesses: Characteristics and resulting days away from work (HTML) (PDF)
- Survey of Respirator Use and Practices (TXT) (PDF)
- Time of Lost-Workday Injuries and Illnesses, 2002 - First Results Announced By BLS (PDF)
- Schedule of upcoming releases and access to archived news releases

Back to Top

SPECIAL NOTICES:

- Survey of Occupational Injuries and Illnesses 2003 - Revised Published Employment Data
- Census of Fatal Occupational Injuries Revised Data
- State data included in nonfatal injury and illness data series II and CH.
- Recordkeeping changes affect the Occupational Injury and Illness data
- Occupational Safety and Health Statistics Changes to NAICS

Latest Numbers

Nonfatal injuries and illnesses, private industry

Total recordable cases:
4,257,300 in 2004

Cases involving days away from work:
1,259,300 in 2004

Cases involving sprains, strains, tears:
525,390 in 2004

Cases involving injuries to the back:
282,240 in 2004

Cases involving falls:
255,600 in 2004

Fatal work-related injuries

Total fatalities (all sectors):
5,764 in 2004

Total fatalities (private industry):
5,229 in 2004

Highway incidents (private industry):
1,229 in 2004

Falls (private industry):
783 in 2004

Homicides (private industry):
489 in 2004

» p- preliminary
» Click on the icon for 10 years of historical data.

People Are Asking...

1. How many Hispanic workers have been fatally injured on the job?
2. Which occupations have the highest fatality rates?
3. How can I evaluate our safety record?
4. How widespread is violence in the workplace? Homicides?
5. Where can I find another company's injury rates?
6. What information do the survey data provide about injury and illness severity?
7. What kind of ergonomics numbers exist?

TABLE 1. **Incidence rates[1] of nonfatal occupational injuries and illnesses by industry and case types, 2004**

Industry[2]	NAICS code[3]	2004 Annual average employment[4] (thousands)	Total recordable cases	Cases with days away from work, job transfer, or restriction			Other recordable cases
				Total	Cases with days away from work[5]	Cases with job transfer or restriction	
Private industry[6]		107,551.8	4.8	2.5	1.4	1.1	2.3
Goods producing[6]		22,655.5	6.5	3.5	1.9	1.7	2.9
Natural resources and mining[6,7]		1,481.7	5.3	3.1	2.0	1.1	2.2
Agriculture, forestry, fishing and hunting[6]	11	961.8	6.4	3.7	2.3	1.4	2.7
Crop production[6]	111	429.8	5.6	3.3	1.7	1.5	2.3
Oilseed and grain farming[6]	1111	11.7	5.7	1.8	.5	1.3	3.9
Greenhouse, nursery, and floriculture production[6]	1114	150.8	6.0	3.7	1.6	2.1	2.4
Animal production[6]	112	141.1	8.5	4.7	2.9	1.9	3.8
Cattle ranching and farming[6]	1121	72.0	6.9	3.5	2.6	.9	3.4
Beef cattle ranching and farming, including feedlots[6]	11211	22.4	7.4	3.7	2.5	1.2	3.7
Dairy cattle and milk production[6]	11212	49.6	6.7	3.4	2.7	.7	3.3
Hog and pig farming[6]	1122	16.0	16.9	10.6	4.4	6.1	6.3
Poultry and egg production[6]	1123	38.5	8.4	4.7	2.4	2.3	3.7
Other animal production[6]	1129	10.6	9.4	6.3	4.2	2.1	3.1
Support activities for agriculture and forestry	115	309.2	5.9	3.3	2.2	1.2	2.6
Support activities for crop production	1151	268.1	5.7	3.2	2.1	1.2	2.5
Support activities for crop production	11511	268.1	5.7	3.2	2.1	1.2	2.5
Soil preparation, planting, and cultivating	115112	22.5	3.0	.9	.7	.1	2.1
Crop harvesting, primarily by machine	115113	10.5	8.7	4.6	2.7	1.9	4.1
Postharvest crop activities (except cotton ginning)	115114	69.9	8.5	5.4	2.8	2.7	3.1
Farm labor contractors and crew leaders	115115	140.1	4.1	2.0	1.4	.6	2.1
Farm management services	115116	15.5	6.6	4.8	4.1	.8	1.8
Support activities for animal production	1152	25.6	6.5	3.8	2.5	1.4	2.7
Support activities for forestry	1153	15.5	7.6	3.8	2.9	.8	3.8
Mining[7]	21	519.9	3.8	2.3	1.6	.6	1.5
Oil and gas extraction	211	121.3	2.6	1.2	.9	.3	1.4
Oil and gas extraction	2111	121.3	2.6	1.2	.9	.3	1.4
Oil and gas extraction	21111	121.3	2.6	1.2	.9	.3	1.4
Crude petroleum and natural gas extraction	211111	117.1	2.6	1.2	.9	.3	1.4
Mining (except oil and gas)[8]	212	204.2	4.3	2.9	2.2	.7	1.4
Coal mining[8]	2121	70.0	5.6	3.9	3.6	.3	1.7
Coal mining[8]	21211	70.0	5.6	3.9	3.6	.3	1.7
Bituminous coal and lignite surface mining[8]	212111	32.7	2.7	1.8	1.6	.2	.9
Bituminous coal underground mining[8]	212112	36.7	8.3	5.9	5.4	.4	2.5
Anthracite mining[8]	212113	.6	5.6	3.9	3.8	([9])	1.7

See footnotes at end of table.

TABLE 1. **Incidence rates[1] of nonfatal occupational injuries and illnesses by industry and case types, 2004** — Continued

Industry[2]	NAICS code[3]	2004 Annual average employment[4] (thousands)	Total recordable cases	Cases with days away from work, job transfer, or restriction			Other recordable cases
				Total	Cases with days away from work[5]	Cases with job transfer or restriction	
Utility system construction	2371	373.4	6.0	3.2	2.2	1.0	2.8
Land subdivision	2372	86.7	3.6	1.6	.9	.7	2.0
Highway, street, and bridge construction	2373	336.1	6.4	3.4	2.1	1.2	3.1
Other heavy and civil engineering construction	2379	98.8	5.8	3.8	–	1.0	2.1
Specialty trade contractors	238	4,402.9	6.8	3.6	2.6	1.0	3.2
Foundation, structure, and building exterior contractors	2381	1,004.6	8.0	4.6	3.3	1.3	3.4
Poured concrete foundation and structure contractors	23811	214.9	6.9	4.1	3.0	1.1	2.8
Structural steel and precast concrete contractors	23812	83.1	10.5	–	–	1.3	4.6
Framing contractors	23813	157.1	11.2	6.3	4.5	1.8	5.0
Masonry contractors	23814	230.9	6.6	3.8	3.0	.9	2.7
Glass and glazing contractors	23815	53.3	6.7	3.5	2.2	1.3	3.2
Roofing contractors	23816	182.8	8.1	4.9	3.3	1.6	3.2
Siding contractors	23817	43.3	–	5.0	3.7	1.3	3.2
Other foundation, structure, and building exterior contractors	23819	39.1	5.5	2.8	1.6	1.2	2.7
Building equipment contractors	2382	1,848.2	6.8	3.3	2.4	.9	3.5
Electrical contractors	23821	850.9	5.8	2.8	2.1	.6	3.0
Plumbing, heating, and air-conditioning contractors	23822	891.2	8.1	3.9	2.7	1.2	4.2
Other building equipment contractors	23829	106.0	4.5	2.5	1.7	.8	2.0
Building finishing contractors	2383	928.1	6.4	3.5	2.5	1.0	2.9
Drywall and insulation contractors	23831	339.5	7.5	3.8	2.5	1.3	3.7
Painting and wall covering contractors	23832	221.5	3.6	2.2	1.7	.5	1.4
Flooring contractors	23833	82.5	6.7	3.9	3.0	.9	2.8
Tile and terrazzo contractors	23834	64.5	7.4	3.4	2.5	.9	–
Finish carpentry contractors	23835	155.5	6.9	4.3	3.2	1.1	2.6
Other building finishing contractors	23839	64.6	7.4	4.0	3.3	.7	3.4
Other specialty trade contractors	2389	622.0	5.3	3.0	2.1	.9	2.4
Site preparation contractors	23891	326.0	5.6	2.8	2.1	.7	2.8
All other special trade contractors	23899	296.1	5.1	3.2	2.1	1.1	1.9
Manufacturing		14,257.4	6.6	3.6	1.6	2.1	3.0
Manufacturing	31-33	14,257.4	6.6	3.6	1.6	2.1	3.0
Food manufacturing	311	1,490.4	8.2	5.3	1.9	3.4	3.0
Animal food manufacturing	3111	49.1	7.1	4.5	1.5	3.0	2.6
Animal food manufacturing	31111	49.1	7.1	4.5	1.5	3.0	2.6
Dog and cat food manufacturing	311111	17.6	7.1	4.1	1.6	2.5	3.0
Other animal food manufacturing	311119	31.5	7.1	4.7	1.5	3.2	2.4
Grain and oilseed milling	3112	60.9	5.6	2.8	1.5	1.3	2.9
Flour milling and malt manufacturing	31121	19.7	6.1	3.5	2.0	1.5	2.6
Flour milling	311211	14.4	5.1	3.0	1.5	1.5	2.1

See footnotes at end of table.

TABLE 1. **Incidence rates[1] of nonfatal occupational injuries and illnesses by industry and case types, 2004** — Continued

Industry[2]	NAICS code[3]	2004 Annual average employment[4] (thousands)	Total recordable cases	Cases with days away from work, job transfer, or restriction			Other recordable cases
				Total	Cases with days away from work[5]	Cases with job transfer or restriction	
Taxi and limousine service	4853	65.7	5.7	4.0	3.4	0.6	1.7
Taxi service	48531	29.8	6.7	4.9	4.6	.3	1.8
Limousine service	48532	35.9	4.7	3.1	2.3	.8	1.6
School and employee bus transportation	4854	166.5	5.6	2.6	2.0	.6	2.9
Charter bus industry	4855	32.5	5.2	2.8	1.8	1.0	2.4
Other transit and ground passenger transportation	4859	58.0	5.7	3.1	2.2	.9	2.6
Pipeline transportation	486	37.6	2.5	1.4	1.0	.4	1.1
Pipeline transportation of natural gas	4862	25.5	2.6	1.6	1.1	.5	1.0
Scenic and sightseeing transportation	487	27.0	4.7	2.8	2.4	.5	1.9
Support activities for transportation	488	530.6	5.3	3.5	2.2	1.3	1.9
Support activities for rail transportation	4882	20.9	7.2	4.5	3.3	1.2	2.7
Support activities for water transportation	4883	93.4	7.1	4.6	3.8	.7	2.6
Support activities for road transportation	4884	77.1	4.7	3.2	2.4	.8	1.4
Motor vehicle towing	48841	45.8	3.9	3.1	2.6	.5	.7
Freight transportation arrangement	4885	169.5	3.0	1.8	.9	.8	1.2
Other support activities for transportation	4889	29.5	6.6	4.3	1.8	2.5	2.3
Couriers and messengers	492	557.5	12.4	8.8	4.1	4.7	3.7
Couriers	4921	510.0	13.1	9.2	4.2	5.0	3.9
Local messengers and local delivery	4922	47.5	5.6	4.0	2.8	1.2	1.6
Warehousing and storage	493	555.8	9.3	5.8	2.8	3.0	3.4
Warehousing and storage	4931	555.8	9.3	5.8	2.8	3.0	3.4
General warehousing and storage	49311	463.0	9.3	5.6	2.6	3.1	3.7
Other warehousing and storage	49319	41.2	6.2	4.6	1.9	2.7	1.6
Utilities	22	563.9	5.2	2.5	1.4	1.1	2.7
Utilities	221	563.9	5.2	2.5	1.4	1.1	2.7
Electric power generation, transmission and distribution	2211	408.2	4.5	2.1	1.1	1.0	2.5
Electric power generation	22111	247.5	3.5	1.9	.9	1.0	1.6
Electric power transmission, control, and distribution	22112	160.7	6.2	2.3	1.4	.9	3.9
Natural gas distribution	2212	109.5	7.3	4.2	2.4	1.7	3.2
Water, sewage and other systems	2213	46.2	6.0	2.8	1.6	1.2	3.2
Water supply and irrigation systems	22131	35.8	6.1	3.0	1.8	1.2	3.1
Information		3,099.6	2.0	1.1	.8	.4	.9
Information	51	3,099.6	2.0	1.1	.8	.4	.9
Publishing industries (except Internet)	511	907.5	2.1	1.1	.7	.4	1.0
Newspaper, periodical, book, and directory publishers	5111	672.2	2.8	1.5	.9	.6	1.4
Newspaper publishers	51111	375.1	3.5	1.7	1.1	.6	1.9
Periodical publishers	51112	141.2	1.7	1.0	.8	.3	.6

See footnotes at end of table.

TABLE 1. **Incidence rates[1] of nonfatal occupational injuries and illnesses by industry and case types, 2004** — Continued

Industry[2]	NAICS code[3]	2004 Annual average employment[4] (thousands)	Total recordable cases	Cases with days away from work, job transfer, or restriction			Other recordable cases
				Total	Cases with days away from work[5]	Cases with job transfer or restriction	
Special food services	7223	531.3	6.2	2.8	1.6	–	3.4
Other services		3,785.2	3.2	1.6	1.1	0.5	1.6
Other services, except public administration	81	3,785.2	3.2	1.6	1.1	.5	1.6
Repair and maintenance	811	1,222.0	3.9	1.9	1.4	.5	2.0
Automotive repair and maintenance	8111	884.7	3.8	1.8	1.3	.5	2.0
Electronic and precision equipment repair and maintenance	8112	101.2	2.6	1.3	.8	.5	1.3
Commercial and industrial machinery and equipment (except automotive and electronic) repair and maintenance	8113	157.7	5.4	3.0	2.2	.7	2.5
Personal and household goods repair and maintenance	8114	78.4	–	1.2	.8	.5	–
Personal and laundry services	812	1,266.1	2.8	1.6	1.0	.7	1.2
Personal care services	8121	560.0	1.0	.5	.4	.1	.6
Death care services	8122	137.0	2.6	1.7	1.2	.6	.8
Drycleaning and laundry services	8123	349.7	5.3	3.0	1.4	1.6	2.3
Other personal services	8129	219.3	2.8	1.8	1.3	.4	1.0
Religious, grantmaking, civic, professional, and similar organizations	813	1,297.2	2.7	1.2	.8	.4	1.6

[1] The incidence rates represent the number of injuries and illnesses per 100 full-time workers and were calculated as: (N/EH) x 200,000, where

N = *number of injuries and illnesses*
EH = total hours worked by all employees during the calendar year
200,000 = base for 100 equivalent full-time workers (working 40 hours per week, 50 weeks per year)

[2] Totals include data for industries not shown separately.
[3] *North American Industry Classification System* — United States, 2002
[4] Employment is expressed as an annual average and is derived primarily from the BLS-Quarterly Census of Employment and Wages (QCEW) program.
[5] Days-away-from-work cases include those that result in days away from work with or without job transfer or restriction.
[6] Excludes farms with fewer than 11 employees.
[7] Data for Mining (Sector 21 in the *North American Industry Classification System*– United States, 2002) include establishments not governed by the Mine Safety and Health Administration rules and reporting, such as those in Oil and Gas Extraction and related support activities. Data for mining operators in coal, metal, and nonmetal mining are provided to BLS by the Mine Safety and Health Administration, U.S. Department of Labor. Independent mining contractors are excluded from the coal, metal, and nonmetal mining industries. These data do not reflect the changes the Occupational Safety and Health Administration made to its recordkeeping requirements effective January 1, 2002; therefore, estimates for these industries are not comparable to estimates in other industries.
[8] Data for mining operators in this industry are provided to BLS by the Mine Safety and Health Administration, U.S. Department of Labor. Independent mining contractors are excluded. These data do not reflect the changes the Occupational Safety and Health Administration made to its recordkeeping requirements effective January 1, 2002; therefore, estimates for these industries are not comparable to estimates in other industries.
[9] *Fewer than 15 cases.*
[10] Data for employers in railroad transportation are provided to BLS by the Federal Railroad Administration, U.S. Department of Transportation.
[11] Incidence rate less than 0.05.

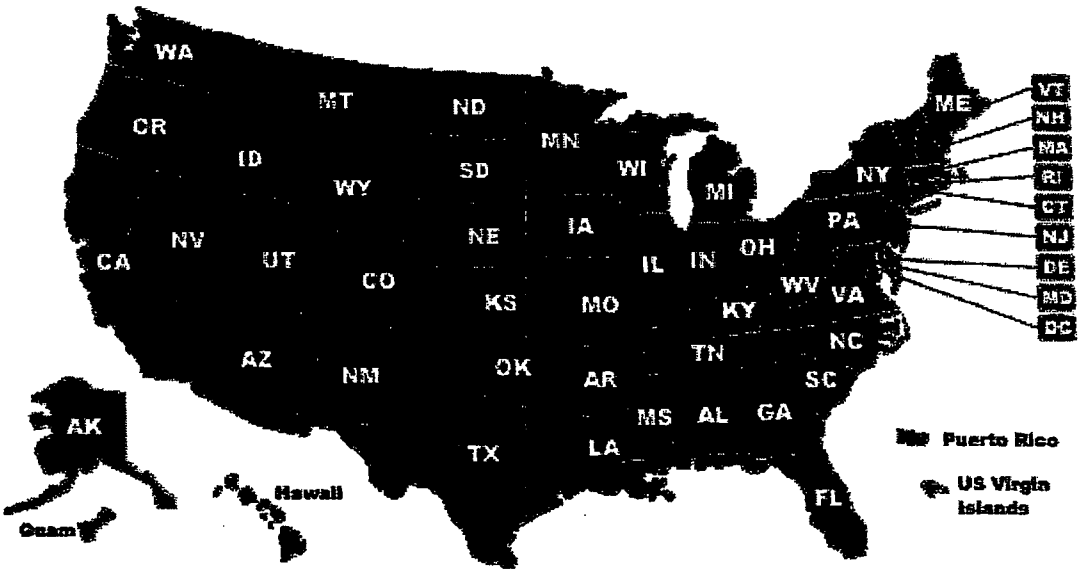
NOTE: Because of rounding, components may not add to totals. Dash indicates data not available.
SOURCE: *Bureau of Labor Statistics*, U.S. Department of Labor
November 2005

U.S. Department of Labor
Bureau of Labor Statistics
Injuries, Illnesses, and Fatalities

www.bls.gov

State Occupational Injuries, Illnesses, and Fatalities

SCEG-148



Overview of State data available

State data presenting the number and frequency of work-related injuries, illnesses, and fatalities are available fr two BLS programs: nonfatal cases of work-related injuries and illnesses that are recorded by employers under t Occupational safety and Health Administration's (OSHA's) recordkeeping guidelines are available for 44 States a Territories from the BLS Survey of Occupational Injuires and Illnesses (SOII); fatal cases of work-related injuire are available for all States, Territories, and New York City under a separate program, the BLS Census of Fatal Occupational Injuries (CFOI).

Note: The number of States for which SOII data are available varies from year to year because not all States h survey sample sizes sufficient to generate State specific estimates of workplace injuries and illnesses. Among th States that do generate State estimates, the sample sizes often are not sufficient to generate estimates at the same level of detail as are available from the national estimates. The industries for which data are available als vary among States, primarily due to the differences in industry concentration and sample size from one State to next. An asterisk (*) indicates that State estimates are available for both public and private industry.

Many of these tables are available as **PDF files only**. Please see information regarding **how to read a PDF fi**

Go to State information -> A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

State	Program	Contact	State da
ALABAMA	**SOII/CFOI**	Peggie Fryer Phone: 334-242-3460	**SOII** data (Please cont

SOUTH CAROLINA	**SOII/CFOI**	Felecia Busby Phone: 803-896-7673 FAX: 803-896-7670 Mailing address: South Carolina Department of Labor, Licensing and Regulation P.O. Box 11329 Columbia, SC 29211-1329 Internet: **http://www.llr.state.sc.us/osha.asp**	**SOII** data (Please contact the State for additional data.) - *2004 Incidence rates (**PDF**) Case counts (**PDF**) - *2003 Incidence rates (**PDF**) Case counts (**PDF**) - *2002 Incidence rates (**PDF**) Case counts (**PDF**) - *2001 Incidence rates (**PDF**) Case counts (**PDF**) - *2000 Incidence rates (**PDF**) Case counts (**PDF**) - *1999 Incidence rates (**PDF**) Case counts (**PDF**) - *1998 Incidence rates (**PDF**) Case counts (**PDF**) - *1997 Incidence rates (**PDF**) Case counts (**PDF**) - *1996 Incidence rates (**PDF**) Case counts (**PDF**) **CFOI** data (Please contact the State for additional data.) - **2004 Profile of occupational fatalities** - **2003 Profile of occupational fatalities**

Table 6. Incidence rates [1] of nonfatal occupational injuries and illnesses by industry and case types, 2004

South Carolina

Industry[2]	NAICS code[3]	2004 Average annual employment[4] (000's)	Total recordable cases	Cases with days away from work, job transfer, or restriction			Other recordable cases
				Total	Cases with days away from work [5]	Cases with job transfer or restriction	
All industries including State and local government [6]		1,749.7	4.3	2.1	1.2	0.9	2.2
Private industry [6]		1,465.0	4.1	2.0	1.2	0.9	2.0
Goods producing[6]		395.4	4.5	2.3	1.2	1.1	2.2
Natural resources and mining[6,7]		13.0	3.2	1.3	0.8	0.5	1.9
Agriculture, forestry, fishing and hunting[6]	11	11.5	3.3	1.1	0.7	0.4	2.2
Forestry and logging	113	3.8	3.4	0.6	0.6	(11)	2.8
Logging	1133	3.6	3.6	0.6	0.6	(11)	3.0
Mining[7]	21	1.6	2.7	2.1	(11)	1.2	(11)
Construction		114.9	4.3	2.3	1.6	0.8	2.0
Construction	23	114.9	4.3	2.3	1.6	0.8	2.0
Construction of buildings	236	30.0	3.1	1.9	1.4	0.6	1.2
Residential building construction	2361	13.6	3.3	3.2	2.5	0.7	–
Nonresidential building construction	2362	16.3	3.0	0.9	0.4	0.5	2.1
Heavy and civil engineering construction	237	17.2	6.0	3.7	2.4	1.3	2.2
Utility system construction	2371	5.8	3.7	3.1	2.1	1.0	0.6
Land subdivision	2372	2.8	3.6	1.5	0.8	(11)	2.2
Highway, street, and bridge construction	2373	6.4	7.6	3.5	1.4	2.1	4.1
Specialty trade contractors	238	67.7	4.4	2.1	1.4	0.7	2.3
Foundation, structure, and building exterior contractors	2381	16.1	2.1	1.1	0.9	0.2	1.0
Poured concrete foundation and structure contractors	23811	2.7	3.2	2.2	2.1	(11)	1.1
Masonry contractors	23814	4.7	2.0	0.9	0.9	(11)	1.2
Roofing contractors	23816	2.8	3.0	1.2	(11)	1.0	1.8
Building equipment contractors	2382	30.1	6.2	2.8	2.1	0.7	3.4
Electrical contractors	23821	14.6	5.6	2.4	1.2	1.1	3.3

See footnotes at end of table.

Table 6. Incidence rates [1] of nonfatal occupational injuries and illnesses by industry and case types, 2004 – Continued

South Carolina

Industry[2]	NAICS code[3]	2004 Average annual employment[4] (000's)	Total recordable cases	Cases with days away from work, job transfer, or restriction			Other recordable cases
				Total	Cases with days away from work [5]	Cases with job transfer or restriction	
Transportation and warehousing[9]	48-49	47.8	9.1	5.8	3.2	2.6	3.3
Support activities for transportation	488	10.2	7.2	4.0	2.0	2.0	3.2
Couriers and messengers	492	5.5	13.1	10.1	3.7	6.5	3.0
Warehousing and storage	493	7.9	9.6	6.7	1.0	5.7	2.9
Utilities	22	11.7	2.6	1.2	1.0	0.2	1.4
Utilities	221	11.7	2.6	1.2	1.0	0.2	1.4
Electric power generation, transmission and distribution	2211	10.5	2.5	1.2	1.0	0.2	1.2
Information		–	–	–	–	–	–
Information	51	–	–	–	–	–	–
Publishing industries (except internet)	511	6.8	3.0	1.5	0.8	0.7	1.5
Newspaper, periodical, book, and directory publishers	5111	5.9	3.4	1.6	0.9	0.8	1.7
Newspaper publishers	51111	4.8	4.3	2.1	1.1	1.0	2.2
Financial activities		90.5	1.1	0.4	0.4	([10])	0.7
Finance and insurance	52	64.8	0.9	0.1	0.1	([11])	0.8
Real estate and rental and leasing	53	25.7	1.9	1.2	1.1	0.2	–
Professional and business services		195.9	1.6	1.0	0.6	0.3	0.7
Professional, scientific, and technical services	54	63.6	1.1	0.3	0.2	0.2	0.7
Professional, scientific, and technical services	541	63.6	1.1	0.3	0.2	0.2	0.7
Architectural, engineering, and related services	5413	15.2	1.7	0.9	0.4	0.5	0.8
Management, scientific, and technical consulting services	5416	7.5	0.9	0.7	0.3	0.3	0.2
Other professional, scientific, and technical services	5419	4.8	4.0	([11])	([11])	([11])	3.9
Management of companies and enterprises	55	9.4	7.4	6.0	3.5	2.5	1.4

See footnotes at end of table.

U.S. Department of Labor
Bureau of Labor Statistics
Injuries, Illnesses, and Fatalities

www.bls.gov

The **Injuries, Illnesses, and Fatalities (IIF)** program provides data on illnesses and injuries on the job and data on worker fatalities.

- Current Injury, Illness, and Fatality Data
- Economic News Releases and Announcements
- Special Notices
- Get Detailed IIF Statistics
- Publications
- Overviews, Descriptions, and Documentation
- Definitions
- Record keeping, Standards, and Forms
- Related Links
- Frequently Asked Questions
- Contact Us

Back to Top

CURRENT INJURY, ILLNESS, AND FATALITY DATA:

Select a subject area

- OSHA recordable case rates (TXT) (PDF 95K) - latest incidence rates, by industry, for nonfatal work-related injuries and illnesses.
- REVISED Fatal injuries - 2004 revised data now available
- Nonfatal (OSHA recordable) injuries and illnesses
  - Industry incidence rates and counts
  - NEW Case and demographic characteristics

Back to Top

ECONOMIC NEWS RELEASES AND ANNOUNCEMENTS:

- Census of Fatal Occupational Injuries (HTML) (PDF 75K)
- Nonfatal occupational injuries and illnesses from the Survey of Occupational Injuries and Illnesses
  - Industry counts and frequency rates (HTML) (PDF 62K)
  - NEW Lost-Worktime Injuries and Illnesses: Characteristics and resulting days away from work (HTML) (PDF)
- Survey of Respirator Use and Practices (TXT) (PDF)
- Time of Lost-Workday Injuries and Illnesses, 2002 - First Results Announced By BLS (PDF)
- Schedule of upcoming releases and access to archived news releases

Back to Top

SPECIAL NOTICES:

- Survey of Occupational Injuries and Illnesses 2003 - Revised Published Employment Data
- Census of Fatal Occupational Injuries Revised Data
- State data included in nonfatal injury and illness data series II and CH.
- Recordkeeping changes affect the Occupational Injury and Illness data
- Occupational Safety and Health Statistics Changes to NAICS

Latest Numbers

Nonfatal injuries and illnesses, private industry

Total recordable cases:
4,257,300 in 2004

Cases involving days away from work:
1,259,300 in 2004

Cases involving sprains, strains, tears:
525,390 in 2004

Cases involving injuries to the back:
282,240 in 2004

Cases involving falls:
255,600 in 2004

Fatal work-related injuries

Total fatalities (all sectors):
5,764 in 2004

Total fatalities (private industry):
5,229 in 2004

Highway incidents (private industry):
1,229 in 2004

Falls (private industry):
783 in 2004

Homicides (private industry):
489 in 2004

» p- preliminary
» Click on the icon for 10 years of historical data.

People Are Asking...

1. How many Hispanic workers have been fatally injured on the job?
2. Which occupations have the highest fatality rates?
3. How can I evaluate our safety record?
4. How widespread is violence in the workplace? Homicides?
5. Where can I find another company's injury rates?
6. What information do the survey data provide about injury and illness severity?
7. What kind of ergonomics numbers exist?

TABLE A-1. Fatal occupational injuries by industry and event or exposure, All United States, 2004 - continued

Industry[1]	NAICS code[1]	Total fatalities (number)	Event or exposure[2]					
			Transportation incidents[3]	Assaults and violent acts[4]	Contact with objects and equipment	Falls	Exposure to harmful substances or environments	Fires and explosions
Coal Mining	21211	26	8	--	14	--	--	--
Bituminous Coal and Lignite Surface Mining	212111	3	3	--	--	--	--	--
Bituminous Coal Underground Mining	212112	14	--	--	10	--	--	--
Metal Ore Mining	2122	5	--	--	--	--	--	--
Nonmetallic Mineral Mining and Quarrying	2123	19	5	--	9	4	--	--
Stone Mining and Quarrying	21231	6	--	--	3	--	--	--
Crushed and Broken Limestone Mining and Quarrying	212312	3	--	--	--	--	--	--
Sand, Gravel, Clay, and Ceramic and Refractory Minerals Mining and Quarrying	21232	12	4	--	5	--	--	--
Construction Sand and Gravel Mining	212321	9	--	--	4	--	--	--
Support Activities for Mining	213	71	28	--	21	7	5	9
Support Activities for Mining	2131	71	28	--	21	7	5	9
Support Activities for Mining	21311	71	28	--	21	7	5	9
Drilling Oil and Gas Wells	213111	30	6	--	11	6	3	--
Support Activities for Oil and Gas Operations	213112	39	22	--	10	--	--	5
Construction		1,234	287	31	267	445	170	34
Construction	23	1,234	287	31	267	445	170	34
Construction of buildings	236	225	43	6	52	106	17	--
Residential Building Construction	2361	118	13	4	24	64	12	--
Residential Building Construction	23611	118	13	4	24	64	12	--
New Single-family Housing Construction (except operative builders)	236115	41	5	--	9	24	3	--
New Multi-family Housing Construction (except operative builders)	236116	9	--	--	--	6	--	--
New Housing Operative Builders	236117	5	--	--	--	--	--	--
Residential Remodelers	236118	31	--	4	3	16	5	--
Nonresidential Building Construction	2362	81	24	--	23	29	4	--
Industrial Building Construction	23621	24	8	--	8	8	--	--
Commercial and Institutional Building Construction	23622	49	12	--	13	19	4	--
Heavy and Civil Engineering Construction	237	220	90	--	73	18	27	11
Utility System Construction	2371	95	20	--	41	11	19	4
Water and Sewer Line and Related Structures Construction	23711	53	12	--	31	--	7	--
Oil and Gas Pipeline and Related Structures Construction	23712	9	--	--	4	--	--	--
Power and Communication Line and Related Structures Construction	23713	30	4	--	6	10	9	--
Highway, Street, and Bridge Construction	2373	100	59	--	29	5	5	--
Highway, Street, and Bridge Construction	23731	100	59	--	29	5	5	--
Other Heavy and Civil Engineering Construction	2379	23	9	--	3	--	--	6
Other Heavy and Civil Engineering Construction	23799	23	9	--	3	--	--	6
Specialty Trade Contractors	238	759	142	20	136	316	124	21
Foundation, Structure, and Building Exterior Contractors	2381	301	44	7	48	170	27	5

See footnotes at end of table.

TABLE A-1. Fatal occupational injuries by industry and event or exposure, All United States, 2004 - continued

Industry[1]	NAICS code[1]	Total fatalities (number)	Event or exposure[2]					
			Transportation incidents[3]	Assaults and violent acts[4]	Contact with objects and equipment	Falls	Exposure to harmful substances or environments	Fires and explosions
Utilities	22	51	13	--	4	9	14	9
Utilities	221	51	13	--	4	9	14	9
Electric Power Generation, Transmission and Distribution	2211	40	7	--	4	8	13	8
Electric Power Generation	22111	13	--	--	3	3	--	5
Fossil Fuel Electric Power Generation	221112	7	--	--	--	--	--	--
Electric Power Transmission, Control, and Distribution	22112	25	6	--	--	4	11	--
Electric Bulk Power Transmission and Control	221121	7	--	--	--	--	--	--
Electric Power Distribution	221122	15	4	--	--	3	8	--
Natural Gas Distribution	2212	4	3	--	--	--	--	--
Natural Gas Distribution	22121	4	3	--	--	--	--	--
Water, Sewage and Other Systems	2213	7	3	--	--	--	--	--
Water Supply and Irrigation Systems	22131	7	3	--	--	--	--	--
Information	--	55	37	6	--	3	8	--
Information	51	55	37	6	--	3	8	--
Publishing Industries (Except Internet)	511	33	26	3	--	--	--	--
Newspaper, Periodical, Book, and Directory Publishers	5111	33	26	3	--	--	--	--
Newspaper Publishers	51111	31	24	3	--	--	--	--
Motion Picture and Sound Recording Industries	512	5	3	--	--	--	--	--
Sound Recording Industries	5122	3	--	--	--	--	--	--
Broadcasting (except Internet)	515	3	--	--	--	--	--	--
Radio and Television Broadcasting	5151	3	--	--	--	--	--	--
Television Broadcasting	51512	3	--	--	--	--	--	--
Telecommunications	517	13	6	--	--	--	5	--
Wired Telecommunications Carriers	5171	4	--	--	--	--	--	--
Wired Telecommunications Carriers	51711	4	--	--	--	--	--	--
Wireless Telecommunications Carriers (except Satellite)	5172	4	4	--	--	--	--	--
Wireless Telecommunications Carriers (except Satellite)	51721	4	4	--	--	--	--	--
Cellular and Other Wireless Telecommunications	517212	4	4	--	--	--	--	--
Cable and Other Program Distribution	5175	3	--	--	--	--	--	--
Cable and Other Program Distribution	51751	3	--	--	--	--	--	--
Financial Activities		116	37	48	4	15	7	5
Finance and Insurance	52	46	16	22	--	4	--	--
Credit Intermediation and Related Activities	522	26	7	13	--	--	--	--
Depository Credit Intermediation	5221	12	4	3	--	--	--	--
Commercial Banking	52211	6	3	--	--	--	--	--

See footnotes at end of table.