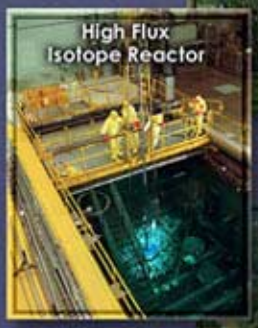
ORNL/TM-2002/1

Oak Ridge National Laboratory

Land and Facilities Plan



August 2002

ORNL/TM-2002/1

OAK RIDGE NATIONAL LABORATORY
LAND AND FACILITIES PLAN

August 2002

Prepared by
OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831-6302
managed by
UT-Battelle, LLC
for the
U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-00OR22725

The information in the *Oak Ridge National Laboratory Land and Facilities Plan* was obtained with the cooperation of the professional staff of the Oak Ridge National Laboratory. For additional information, contact

Reservation Management and
Facilities and Operations Infrastructure Planning Division
Oak Ridge National Laboratory
P.O. Box 2008
Oak Ridge, TN 37831-6302
Telephone: 865-576-4183

Comments on the 2000 *Oak Ridge National Laboratory Land and Facilities Plan* have been addressed and resolved, as appropriate, in this update. Recognizing that land and facilities planning is not a static process, this document will continue to address comments with additional updates electronically published as needed.

An electronic version of this draft document is available on the World Wide Web: http://www.ornl.gov/~dmsi/landUse/

Front cover designed by Brett Hopwood, ORNL Computing, Information, and Networking Division.

CONTENTS

LIST OF FIGURES vii

LIST OF TABLES xi

ACRONYMS AND ABBREVIATIONS xiii

ACKNOWLEDGMENTS xix

1. INTRODUCTION 1-1
- 1.1 LAND USE HISTORY OF THE OAK RIDGE RESERVATION 1-3
- 1.2 SHIFTING OWNERSHIP 1-3
- 1.3 RESERVATION-WIDE PLANNING 1-3
  - 1.3.1 DOE Land Use Planning Process 1-3
  - 1.3.2 ORNL Land and Facilities Planning 1-5
  - 1.3.3 Integrated Safety and Planning 1-5

2. ORNL LAND USE PLAN 2-1
- 2.1 ORNL LAND AND FACILITIES PLAN DEVELOPMENT 2-1
- 2.2 LAND USE DECISION MAKING AND PLANNING 2-1
  - 2.2.1 Guidelines for Land Use Planning 2-1
  - 2.2.2 Land Use Priorities 2-2
  - 2.2.3 Review by Subject Matter Experts 2-2
- 2.3 ORNL LAND AND FACILITIES USE COMMITTEE 2-3
  - 2.3.1 Review Process 2-3
  - 2.3.2 Overlapping Land Use/Management Responsibilities 2-3
- 2.4 DESCRIPTION OF THE OAK RIDGE RESERVATION 2-4
  - 2.4.1 Location 2-4
  - 2.4.2 DOE Facilities 2-4
  - 2.4.3 Physical Characteristics 2-4
    - 2.4.3.1 Topography, Geology, and Hydrology 2-4
    - 2.4.3.2 Vegetation and Wildlife 2-11
    - 2.4.3.3 Caves, Open Sinkholes, and Quarries 2-13
  - 2.4.4 Cultural Resources 2-13
  - 2.4.5 Environmental Designations 2-13
    - 2.4.5.1 State Natural Areas 2-15
    - 2.4.5.2 Oak Ridge Wildlife Management Area 2-15
    - 2.4.5.3 Wetlands 2-17
    - 2.4.5.4 Nature Conservancy Biodiversity Ranked Areas 2-17
    - 2.4.5.5 Nature Conservancy Landscape Complexes 2-19
    - 2.4.5.6 Research Park Endangered Species Habitats (Natural Areas) 2-19
    - 2.4.5.7 Research Park Endangered Species Potential Habitats (Reference Areas) 2-19
    - 2.4.5.8 Biosphere Reserve 2-19
  - 2.4.6 Maps - Physical Characteristics and Natural Resources of the Oak Ridge Reservation 2-19

2.5 CURRENT LAND USE ON THE OAK RIDGE RESERVATION 2-21
2.5.1 National Environmental Research Park 2-21
2.5.2 Safety 2-33
2.5.2.1 Security 2-33
2.5.2.2 Training Facilities with Surface Danger Zones 2-33
2.5.2.3 Emergency Planning Zones 2-33
2.5.3 Compliance and Monitoring 2-35
2.5.3.1 Environmental Monitoring 2-35
2.5.3.2 Air Monitoring 2-35
2.5.3.3 Surface Water Monitoring 2-37
2.5.3.4 Groundwater Monitoring 2-37
2.5.3.5 Terrestrial Vegetation Monitoring 2-39
2.5.3.6 Biological Monitoring and Abatement Program 2-39
2.5.4 Contaminated Areas 2-39
2.5.5 Land Application of Biosolids 2-41
2.5.6 Reservation Infrastructure (Gas, Communication Lines, Power) 2-41
2.5.7 Oak Ridge Wildlife Management Area 2-43
2.5.8 Public Opportunities 2-43
2.5.8.1 Public Greenways 2-43
2.5.8.2 Tennessee Wildlife Resources Agency Wildlife Management Area 2-43
2.5.8.3 New Bethel Baptist Church and Interpretive Center 2-44
2.5.8.4 Walks/Tours 2-44
2.5.8.5 Ecological and Physical Sciences Study Center 2-44
2.5.8.6 ORNL Graphite Reactor 2-44
2.5.8.7 Other Public Facilities and Educational Programs 2-44
2.5.9 Facilities 2-44
2.5.10 Other 2-44
2.5.11 Maps - Current Land Use on the Oak Ridge Reservation 2-45
2.6 FUTURE LAND USE ON THE OAK RIDGE RESERVATION 2-46
2.6.1 Ecosystem Research 2-46
2.6.2 Identified New Future Land Uses 2-46
2.6.2.1 Research Facilities 2-47
2.6.2.1.1 Spallation Neutron Source 2-47
2.6.2.1.2 Center for Nanophase Materials Science 2-47
2.6.2.1.3 West Campus 2-47
2.6.2.1.4 East Campus 2-50
2.6.2.1.5 Development in the 7600 and 7900 Areas 2-50
2.6.2.1.6 Research and Development Facilities 2-50
2.6.2.2 Environmental Field Research Areas 2-50
2.6.2.3 Environmental Partnership Areas 2-54
2.6.2.3.1 State Natural Areas 2-54
2.6.2.3.2 Wetland Mitigation Areas 2-54
2.6.2.3.3 Wildlife Habitat Restoration 2-56
2.6.2.4 Waste Management Facility 2-56
2.6.2.5 Future Initiatives 2-56
2.6.2.6 Transportation Improvements 2-57
2.6.2.7 Education and Recreation 2-57
2.6.2.8 Land Transfers/Lease Areas 2-57
2.6.2.9 Oak Ridge Institute for Science and Education 2-58
2.6.3 Maps - Future Land Use on the Oak Ridge Reservation 2-58

2.7 STAKEHOLDER INPUT 2-58
2.7.1 Stakeholder Definition 2-58
2.7.2 Process for Input 2-58
2.7.3 Use of Input 2-59

3. ORNL INTEGRATED FACILITIES PLAN 3-1
3.1 PURPOSE 3-1
3.2 SITE AND PROGRAM DESCRIPTION 3-1
3.2.1 Current Facilities and Uses 3-3
3.2.2 General Infrastructure Conditions 3-9
3.2.3 ORNL's Programmatic Direction and Needs 3-12
3.2.3.1 Science Programs 3-12
3.2.3.1.1 Physical Sciences 3-12
3.2.3.1.2 Spallation Neutron Source 3-14
3.2.3.1.3 Biological and Environmental Sciences 3-16
3.2.3.1.4 Computing and Computational Sciences 3-19
3.2.3.1.5 Energy and Engineering Sciences 3-20
3.2.3.1.6 University Partnerships 3-20
3.2.3.1.7 User Research Facilities 3-20
3.2.3.2 Support Programs 3-21
3.2.3.2.1 Environment, Safety, Health, and Quality 3-21
3.2.3.2.2 FEVA Recommendations for Improvement 3-21
3.2.3.2.3 Sustainable Designs 3-21
3.2.3.2.4 Waste Management and Environmental Restoration 3-22
3.2.3.2.5 Facilities and Operations Management 3-23
3.3 RESOURCE PLANNING, PRIORITIZATION, AND ALLOCATION PROCESS 3-42
3.4 ORNL MASTER PLAN 3-44
3.4.1 Master Plan Vision/goals 3-44
3.4.2 Master Plan for ORNL Site Development 3-45
3.4.2.1 East Campus Design Features 3-48
3.4.2.2 West Campus Design Features 3-49
3.4.2.3 Central Campus Design Features 3-49
3.4.3 Master Plan Phase I: FY 2002–06 3-49
3.4.4 Master Plan Phase II: FY 2007–11 3-52
3.4.5 Master Plan Phase III: Beyond 2011 3-58
3.5 MASTER PLAN COST AND SCHEDULE 3-58

4. CONCLUSIONS AND RECOMMENDATIONS 4-1
4.1 LAND AND FACILITIES PLAN CONCLUSIONS 4-1
4.2 LAND AND FACILITIES PLAN RECOMMENDATIONS 4-2
4.2.1 Oak Ridge Reservation 4-2
4.2.2 ORNL Facilities 4-2

5. REFERENCES 5-1

Appendix A. ORNL Stakeholder Responses A-1
Appendix B. Self-Sufficiency Parcels for the City of Oak Ridge B-1
Appendix C. ORR Research Focus C-1
Appendix D. ORNL Stakeholder Plan D-1
Appendix E. DOE/UT-Battelle Contract E-1
Appendix F. Supporting Information F-1
Appendix G. Environment, Safety, Health, and Quality/FEVA G-1
Appendix H. Waste Management and Environmental Restoration H-1
Appendix I. Detailed Descriptions of Utility Improvements I-1
Appendix J. Detailed Description of Security Improvements J-1
Appendix K. Candidates for Disposition and Space Management Plan Summary K-1
Appendix L. Nuclear Facilities L-1
Appendix M. Master Plan Projects M-1
Appendix N. Project Cost Tables N-1

LIST OF FIGURES

1.1 Geographic areas of responsibility 1-2

1.2 Original DOE land purchase and current reservation boundaries 1-4

2.1 Location of the ORR and surrounding region 2-5

2.2 Geographic areas of responsibility 2-6

2.3 Topography with slope 2-8

2.4 Geology with springs and karst features 2-9

2.5 Water, wetlands, floodplains, and watersheds 2-12

2.6 Public, educational, and recreational opportunities 2-14

2.7 Partnership areas 2-16

2.8 The Nature Conservancy biodiversity rankings and landscape complexes 2-18

2.9 Research park confirmed and potential habitats for rare species 2-20

2.10 Use of DOE land for research 2-23

2.11 Use of DOE land for specific types of research 2-25

2.12 Description of ORR research uses 2-26

2.13 Safety 2-34

2.14 Compliance and monitoring 2-36

2.15 Watershed areas with potential release sites 2-40

2.16 Reservation infrastructure 2-42

2.17 New future uses 2-48

3.1 ORNL Bethel Valley area facility uses 3-4

3.2 ORNL Melton Valley area facility uses 3-5

3.3 ORNL Copper Ridge area facility uses 3-6

3.4 ORNL at Y-12 facility uses 3-7

LIST OF FIGURES (cont'd)

3.5 Use of ORNL space 3-8

3.6 Condition of space at ORNL 3-9

3.7 Condition of ORNL space at Y-12 3-9

3.8 Building 2001 (constructed in 1948) 3-10

3.9 Building 3550 (constructed in 1943) 3-10

3.10 The "new" ORNL Cafeteria (constructed in 1951) 3-10

3.11 Bricks falling off Building 9207 at Y-12 3-10

3.12 Age of ORNL buildings 3-11

3.13 Advanced Materials Characterization Laboratory 3-15

3.14 Spallation Neutron Source 3-17

3.15 West End Campus view 3-18

3.16 Environmental Management facilities at the ORNL main site, Bethel Valley 3-24

3.17 Environmental Management facilities at the ORNL main site, Melton Valley 3-25

3.18 Locations of Environmental Management watershed areas 3-26

3.19 Effect of adequate and timely maintenance and repairs on the service life of a building 3-32

3.20 Facilities at the main ORNL site 3-35

3.21 ORNL facilities at Y-12 3-36

3.22 Private-sector funded facilities 3-41

3.23 ORNL site planning methodology 3-43

3.24 Property/facility lease flow diagram 3-46

3.25 ORNL Master Plan for site development 3-47

3.26 Planned new facilities in the 7600 Area 3-53

3.27 Planned new facilities in the 7900 Area 3-54

LIST OF FIGURES (cont'd)

3.28 Spallation Neutron Source and associated facilities 3-55

3.29 ORNL projects for Bethel Valley, Phase I, FY 2002–06 3-56

3.30 ORNL projects for Melton Valley, Phase I, FY 2002–06 3-57

3.31 ORNL projects for Bethel Valley, Phase II, FY 2007–11 3-59

3.32 ORNL projects for Melton Valley, Phase II, FY 2007–11 3-60

3.33 Needs chart for ORNL landlord-funded infrastructure modernizaation 3-63

3.34 Preliminary schedule for ORNL site development 3-64

B.1 Oak Ridge Reservation self-sufficiency parcels B-4

H.1 Environmental sampling locations H-12

I.1 Primary electrical distribution system I-4

I.2 Natural gas and compressed air distribution systems I-8

I.3 Water distribution system I-15

I.4 Chilled water system I-20

I.5 Steam distribution system I-24

I.6 Sanitary and process sewage system I-30

LIST OF TABLES

2.1 Physical characteristics and natural resources of the ORR 2-21

2.2 Current land use on the ORR 2-45

2.3 Oak Ridge Reservation infrastructure needs 2-57

2.4 ORNL future land use map 2-59

3.1 List of organizational contacts for documents/databases 3-2

3.2 ORNL building summary 3-3

3.3 Estimated replacement plant value 3-11

3.4 Funding profile for the Center for Nanophase Materials Sciences 3-14

3.5 Future mission facility needs 3-38

3.6 Projected funding requirements for ORNL site development 3-61

H.1 ORNL facilities located within the 500-year floodplain H-19

H.2 Management and Integration (M&I) contractor facilities H-21

K.1 Candidates for disposition K-3

K.2 Space Management Plan summary K-7

N.1 Landlord Line Item list N-3

N.2 Landlord GPP list N-5

N.3 Institutional GPP list N-7

N.4 Landlord GPE list N-9

N.5 Programmatic Line Item list N-11

N.6 Programmatic GPP list N-13

N.7 Programmatic GPE list N-15

ACRONYMS AND ABBREVIATIONS

ACM	asbestos-containing material
ADS	Activity Data Sheet
AEC	U.S. Atomic Energy Commission
AMCL	Advanced Materials Characterization Laboratory
AMSE	American Museum of Science and Energy (Oak Ridge)
ARIMs	Accelerator and Reactor Improvement and Modifications
ATDD	Atmospheric Turbulence Diffusion Division
BES	Basic Energy Sciences
BIO	Basis for Interim Operation
BMAP	Biological Monitoring and Abatement Program
BSR	biological significance ranking
BTC	Building Technology Center
BV	Bethel Valley
BVEST	Bethel Valley Evaporator Service Tank
CAIS	Condition Assessment Information System
CCII	Computational Center for Industrial Innovation
CCS	Center for Computational Science
CCTV	closed-circuit television
CCWS	Central Chilled Water System
CDR	conceptual design report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESAR	Center for Engineering Systems Advanced Research
CFC	chlorofluorocarbon
CFM	Complex Facility Manager
CFR	*Code of Federal Regulations*
CH8	Corehole 8
CIP	Comprehensive Integrated Plan
CNMS	Center for Nanophase Materials Sciences
CRADA	cooperative research and development agreement
CROET	Community Reuse Organization of East Tennessee
CSB	Computational Sciences Building
CSMB	Center for Structural Molecular Biology
CTD	Chemical Technology Division
CTF	Central Training Facility
CWA	Clean Water Act
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
DOE-EE	U.S. Department of Energy Office of Energy Efficiency and Renewable Energy
DOE-EM	U.S. Department of Energy Environmental Management
DOE-ORO	U.S. Department of Energy, Oak Ridge Operations Office
DOE-SC	U.S. Department of Energy Office of Science
DOELAP	Department of Energy Laboratory Accreditation Program
DOSAR	Dosimetry Applications Research Facility
DOT	U.S. Department of Transportation
DP	Office of Defense Programs (DOE)
DX	direct expansion

ACRONYMS AND ABBREVIATIONS (cont'd)

E^2SF	Energy and Environmental Systems of the Future
ED&C	Engineering Design and Construction
EM	Environmental Management
EREL	Energy Reliability and Efficiency Laboratory
ESD	Environmental Sciences Division
EPA	U.S. Environmental Protection Agency
ES&H	environment, safety, and health
ESH&Q	environment, safety, health, and quality
ESHQ&I	environment, safety, health, quality, and infrastructure
ET	evapotranspiration
ETF	Engineering Technology Facility
ETMC	East Tennessee Mechanical Contractors
ETNGC	East Tennessee Natural Gas Company
ETTP	East Tennessee Technology Park
EUWG	End Use Working Group
FAB	Facility Authorization Basis
FACE	Free Air CO_2 Enrichment
FAMMIS	Facility and Maintenance Management Information System
FDDI	Fiber Distributed Data Interface
FED	Fusion Energy Division
FEVA	Facility Environmental Vulnerability Assessment
FEVARI	Facility Environmental Vulnerability Assessment Recommendation Implementation
FFA	Federal Facilities Agreement
FIMS	Facility Information Management System
FMD	Facilities Management Division
FRC	Field Research Center
FRP	Facilities Revitalization Project
FSSD	Fabrication and Site Services Division
FTS	Federal Telecommunications System
FUA	Facility Use Agreement
FY	fiscal year
GAAT	Gunite and Associated Tank
GJC	Grand Junction Colorado
GPE	general-purpose equipment
GPP	general plant project
HEPA	high-efficiency particulate air
HFIR	High Flux Isotope Reactor
HPRR	Health Physics Research Reactor
HRIBF	Holifield Radioactive Ion Beam Facility
HSWA	Hazardous and Solid Waste Amendments of 1984
HTML	High Temperature Materials Laboratory
HVAC	heating, ventilation, and air conditioning systems

ACRONYMS AND ABBREVIATIONS (cont'd)

I&C	Instrumentation and Controls
IGPP	Institutional general plant project
IHEM	In-House Energy Management
IRA	interim remedial action
ISOL	Isotope Separator On-Line
IT&M	Inspection, Testing, and Maintenance
IWMF	Interim Waste Management Facility
JIBS	Joint Institute for Biological Sciences
JICS	Joint Institute for Computational Sciences
JINS	Joint Institute for Neutron Sciences
LAN	local area network
LCB	Life Cycle Baseline
LCFG	Laboratory for Comparative and Functional Genomics
LDRD	Laboratory Directed Research and Development
LEED™	Leadership in Energy and Environmental Design
LGWOP	Liquid and Gaseous Waste Operations Project
LI	Line Item
LINAC	linear accelerator
LLLW	liquid low-level (radioactive) waste
LSD	Life Sciences Division
LWS	Laboratory Waste Services
M&I	management and integration
M&O	management and operating
MAA	Material Access Area
MAB	Man and the Biosphere
MEL-FS	Multiprogram Energy Laboratory Facility Support
MFAB	master fire alarm box
MOU	Memorandum of Understanding
MS&E	Materials Science and Engineering
MSRE	Molten Salt Reactor Experiment
MV	Melton Valley
MVST	Melton Valley Storage Tanks
NABIR	Natural and Accelerated Bioremediation Research
NEON	National Ecological Observation Network
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NNSA	National Nuclear Security Administration
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
NRWTP	Nonradiological Wastewater Treatment Plant
NSAC	Nuclear Science Advisory Committee
NTRC	National Transportation Research Center

ACRONYMS AND ABBREVIATIONS (cont'd)

OCB	oil circuit breakers
ORAU	Oak Ridge Associated Universities
ORCAS	Oak Ridge Center for Advanced Studies
ORELA	Oak Ridge Electron Linear Accelerator
ORFICN	Oak Ridge Federal Integrated Communications Network
ORIC	Oak Ridge Isochronous Cyclotron
ORISE	Oak Ridge Institute for Science and Education
ORLaND	Oak Ridge Laboratory for Neutrino Detectors
ORNL	Oak Ridge National Laboratory
ORO	Oak Ridge Operations Office (DOE)
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Administration
OSR	Operational Safety Requirement
OSTI	Office of Scientific and Technical Information
PCB	polychlorinated biphenyl
PCSD	President's Council on Sustainable Development
PdM	predictive maintenance
PM	preventive maintenance
PMF	probable maximum flood
PVC	polyvinylchloride
PWTC	Process Waste Treatment Complex
PWTP	Process Waste Treatment Plant
R&D	research and development
RCRA	Resource Conservation and Recovery Act
REDC	Radiochemical Engineering Development Center
RIB	radioactive ion beam
RI/FS	Remedial Investigation/Feasibility Study
RMO	Reservation Management Organization
ROD	Record of Decision
RPM	Risk-Based Priority Model
RPSC	Robotics and Process Systems Complex
RPV	replacement plant value
RTBT	Ring to Target Beam Transport
RTS	Radiochemical Technology Section
S&M	surveillance and maintenance
SAMAB	Southern Appalachian Man and the Biosphere
SAMS	Space Allocation Management System
SANS	Small-Angle Neutron Scattering
SAR	Safety Analysis Report
SARUP	Safety Analysis Report Update Program
SC	Office of Science
SciDAC	Scientific Discovery through Advanced Computing
SDI	Shared Data Initiative
SLLW	solid low-level (radioactive) waste
SNF	spent nuclear fuel

SNS	Spallation Neutron Source
SSD	Solid State Division
SWSA	Solid Waste Storage Area
TDEC	Tennessee Department of Environment and Conservation
TERF	Terrestrial Ecosystem Research Facility
TLD	thermoluminescent dosimeter
TRU	transuranic
TS	Treatability Study
TSC	Technical Support Center
TSCA	Toxic Substances Control Act
TSD	Transportation Safety Document
TSDF	hazardous waste treatment, storage, and disposal facility
TSF	Tower Shielding Facility
TSRs	Technical Safety Requirements
TVA	Tennessee Valley Authority
TWRA	Tennessee Wildlife Resources Agency
UEFPC	Upper East Fork Poplar Creek
UL	Underwriters' Laboratories, Inc.
URL	Uniform Resource Locator
USDA	U.S. Department of Agriculture
USQD	Unreviewed Safety Question Determination
UT	University of Tennessee
VOC	volatile organic compound
WAC	Waste Acceptance Criteria
WM	Waste Management
WOCC	Waste Operations Control Center
WSI-OR	Wackenhut Services, Inc. - Oak Ridge
WSSs	Work Smart Standards

ACKNOWLEDGMENTS

Development of this 2002 update of the *Oak Ridge National Laboratory Land and Facilities Plan* involved coordination with a number of individuals whose input and contributions have helped shape and improve the plan. Although everyone cannot be named, special appreciation is expressed to the following individuals:

Willie Allen
Susan Anderson
Teresa Baer
David Baity
Kelly Beierschmitt
Barry Berven
Bud Brickeen
John Burr
Wayne Camp
Ken Cook
Sherri Cotter
Patty Cox
Nancy Dailey
Danny Davis
Herb Debban
Gary Denton
Karen Downer
Lynn Eberhardt
Greg Eidam
Tom Etheridge
Rick Forbes
Jon Forstrom
Faye Frederick
Stan Frey
Robin Graham
Steve Griffith
Greg Gruzalski
Marianne Heiskell
Tana Helms
Brenda Hembree
Steve Hildebrand
Pete Hoke
Nancy Holcombe
Brett Hopwood
Joan Hughes
Donna Inman
Greg Irby
Katy Kates
Dave Kennard
Dick Ketelle
Mark Kohring
Frank Kornegay
Mack Lakumb
Jim Loar
Pam Love
Jim Mathys
Tony Medley
Carlo Melbihess
Lance Mezga
Kerry Miller
Norman Mulvenon
Tim Myrick
Bonnie Nestor
Dan O'Connor
Greg Palko
Wayne Parker
Pat Parr
John Patterson
Jim Phillips
Bill Rich
Kathy Rosenbalm
Michael Ryon
Carol Scott
Chris Scott
Lorene Sigal
Steve Sims
John Sinclair
David Skipper
Linda Smith
Mark Spann
David Starling
Carl Strawbridge
Jerry Swanks
Charlie Valentine
Dirk Van Hoesen
Hans Vogel
Vicky Wallace
Mike Watkins
Warren Webb
Joe Whedbee
John Wheeler
Allen White
John Yates
numerous reviewers

1. INTRODUCTION

Oak Ridge National Laboratory (ORNL) is the nation's largest and most diverse energy research and development (R&D) institution in the U.S. Department of Energy (DOE) laboratory complex. Its activities are focused on basic and applied R&D to advance the nation's energy resources, environmental quality, and scientific knowledge. This plan has been prepared to assist DOE and contractor personnel in implementing ORNL's land and facility responsibilities for management and planning.

The Secretary of Energy has articulated the Department's overarching mission as national security, broadly construed. The Department's core science, energy, environmental cleanup, and national security programs have been placed in the context of that broad mission. As a nation we are taking urgent measures to increase our safety and security immediately, and the nation's science and technology institutions, including particularly the national laboratories, have been asked to bring today's technology to bear—rapidly and effectively—on urgent security needs. At the same time, the nation's political leadership has recognized homeland defense as an enduring challenge, and one that will require new technical solutions to a broad suite of very demanding problems over the long run.

Major DOE Office of Science (DOE-SC) research programs depend not only on the national laboratory facilities, but also on the land base of the Oak Ridge Reservation (ORR) to meet mission objectives. ORNL is managed by UT-Battelle, LLC, which has the management and planning responsibility for ORNL facilities and for most of the ORR's undeveloped land area. This responsibility includes planning for approximately 18,000 acres of undeveloped and developed land (Fig.1.1).

The ORR includes multiple, overlapping reservation land uses. Details on the various uses are discussed in Sect. 2. With major changes in mission at the East Tennessee Technology Park (ETTP) and the Y-12 National Security Complex, demonstrating current land use (by ORNL as well as other users) and planning for future land use needs by DOE and ORNL are critical. An irreplaceable asset, the reservation is a vital part of ORNL. Decisions on how to use the land area impact not only at local and regional levels but also nationally and internationally.

The ORR is a unique and irreplaceable resource for DOE to use for its national science and technology missions. The DOE ORR vision, as stated in the *ORR Comprehensive Integrated Plan* (CIP) (September 1999), emphasizes that the ORR serves as an integrated science, education, industrial, and technology complex managed by DOE in partnership with the private sector—supporting a dynamic regional and national economy. Future use is to include a mixture of activities that are compatible with and contribute to ongoing and anticipated DOE missions. According to current plans, the reservation will be used to support many of the same programs it currently supports while adapting to changing national goals and interests and reduced federal budgets. Portions of the reservation will be used to promote the development of private-sector enterprises in ways that are consistent with and complementary to DOE missions. DOE's environmental management and reindustrialization initiative is highlighted at the ETTP; defense support, manufacturing, and storage at the Y-12 National Security Complex; and research and development at ORNL.

1.1 LAND USE HISTORY OF THE OAK RIDGE RESERVATION

The land area now known as the ORR was established on September 19, 1942, when General Groves, Commander of the wartime "Manhattan Project," ordered the immediate purchase of a tract of land along the Clinch River between the cities of Kingston and Clinton, Tennessee, to be converted into a government reservation. The 58,575-acre military reservation (17 miles long by 7 miles wide) was to contribute to the manufacture of an atomic bomb within three years. It became the site of rapid construction of three separate production facilities (code named X-10, Y-12, and K-25) and a remote residential Townsite, all of which were managed behind a heavily guarded barbed-wire fence under strict military security (Souza et al. 1997).

1.2 SHIFTING OWNERSHIP

Of the original 58,575 acres of land acquired by the federal government, 24,340 acres were disposed of and 34,235 acres remain, as indicated in Fig. 1.2. Approximately 25% of the disposed land was conveyed to the City of Oak Ridge for developmental purposes (almost 6,000 acres). It includes 2,371 acres of self-sufficiency parcels for residential, commercial, and industrial development; 270 acres for school sites; 1,172 acres for electrical, water, sanitary and storm sewer, drainage, roads and streets; 1,475 acres for municipal properties; and 29 acres for public housing. Land was also conveyed to Anderson County (28 acres), Oliver Springs (9 acres), the Tennessee Valley Authority (2,992 acres), and other federal agencies (63 acres). Land conveyed to the State of Tennessee was for health, forestry, agricultural research, and a biomedical graduate school (2,315 acres). Land conveyed for private entities and homeowners (12,692 acres) includes permanent road easements granted to the city, counties, and State to provide access to the area; 108 acres conveyed for rail service; 123 acres for area churches; 11,000 acres for house lots, country club and golf course development, sportsman's clubs, quarry operations, a cemetery association, Girl and Boy Scout organizations, and the hospital association for the medical complex. Self-sufficiency land requests from the City of Oak Ridge are discussed and identified in Appendix B.

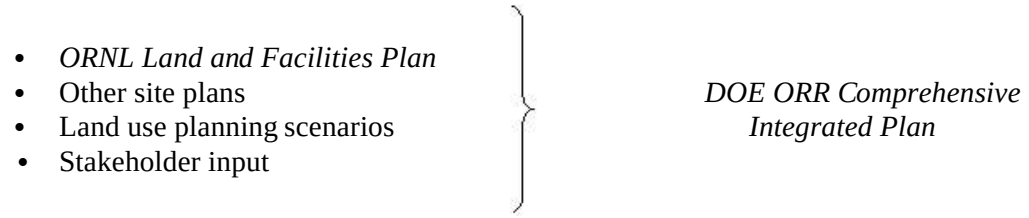
1.3 RESERVATION-WIDE PLANNING

The focus of the *ORNL Land and Facilities Plan* is DOE's ORNL land and facility needs on the ORR. ORNL needs identified in the *ORNL Land and Facilities Plan* are incorporated into a DOE reservation-wide planning document, the *ORR Comprehensive Integrated Plan*, that includes the needs of DOE programs at ETTP, the National Nuclear Security Administration (NNSA), Oak Ridge Associated Universities (ORAU), ORNL, and other ORR land and facility users.

1.3.1 DOE Land Use Planning Process

The DOE Oak Ridge Operations Office (DOE-ORO) has initiated a land use planning process involving extensive public participation regarding the future use of land, which may in the future no longer be needed for mission purposes. The planning process began the end of August 2001 with a time line of approximately one year. DOE program needs for current and future land uses have been reviewed. Discussions indicate that most of the ORR land, except for areas around ETTP, will be needed for future DOE missions during the next 5 to 20 years. Preliminary planning has begun for the northwest portion of the reservation around ETTP. Public participation is through a Land Use Planning Focus Group (monthly working meetings are open to the public); Town Hall meetings and workshops (winter, spring, and summer meetings); comments on draft documents (available at reading rooms); and correspondence by telephone, letters, or E-mail. Planning will take into consideration existing resources and interests

including historic and preservation sites, wetlands and other sensitive habitats, research and monitoring, leased areas, and ongoing environmental remediation. The process will result in the development and analysis of various scenarios of how the land could be used. Site-specific and reservation-wide consequences will be considered for both individual and cumulative effects. The results will be incorporated into the *ORR Comprehensive Integrated Plan.* This process is not intended to replace other requirements such as the Executive Order 12512 Utilization Survey process or appropriate National Environmental Policy Act (NEPA) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) reviews prior to initiating actions.



1.3.2 ORNL Land and Facilities Planning

Updated information on ORNL land and facilities use, revitalization, and planning is contained in this 2002 revision of the 2000 *ORNL Land and Facilities Plan.* Section 2, "ORNL Land Use Plan," provides information on current reservation uses (ORNL and others) and addresses ORNL plans for use of the land outside the ORNL fenced, developed site. Information on planned uses by non-ORNL projects (Bechtel Jacobs Company, LLC, Tennessee Department of Transportation, etc.) is included when known.

To accomplish its mission of scientific research, ORNL staff are dependent upon the availability of a wide variety of buildings and equipment, including specialized experimental laboratories, user facilities, hot cells and nuclear reactors, and a large complement of office space and associated utility systems. Section 3, "ORNL Integrated Facilities Plan," incorporates the details of facility conditions and uses and the Master Plan for facility projects. In addition to maintaining current facility infrastructure, the Master Plan includes revitalization projects to ensure that ORNL will meet the needs of a 21st Century Laboratory. Section 4 provides conclusions and recommendations for future land use and facilities at the Laboratory. Several appendices follow Sect. 4 to provide detailed information useful in understanding ORNL land and facilities plans and projects.

This plan complements and draws from recommendations provided in the DOE *Comprehensive Land-Use Planning Process Guide* (DOE 1996a) and feeds into the ORR comprehensive integrated planning document, *Comprehensive Integrated Planning Process for the Oak Ridge Operations Sites*, herein referred to as the *ORR Comprehensive Integrated Plan* (September 1999).

1.3.3 Integrated Safety and Planning

ORNL systematically and fully integrates safety into management and work practices at all levels so that the mission of the Laboratory is successfully accomplished while protecting the public, the worker, and the environment. Operations are conducted in compliance with regulations and in a manner consistent with the hazards associated with the work. Work processes are systematically evaluated by ORNL through an ongoing self-assessment program designed to ensure that the mission of the Laboratory is carried out in a safe and effective manner. ORNL has adopted Integrated Safety Management (ISM) by Contract (DEAR Clause 970.5204-2) and carries out the requirements of ISM by way of an integrated set of management systems that apply controls tailored to all the work being performed.

2. ORNL LAND USE PLAN

The U.S. Department of Energy (DOE) has made the commitment that as it conducts its energy mission on the Oak Ridge Reservation (ORR) on behalf of the nation, DOE will do so in a manner that is respectful of the land and local environment. Land use planning for the Oak Ridge National Laboratory (ORNL) identifies and prioritizes needs for preservation of reservation land to meet the requirements of existing and future scientific facilities, environmental research, education, and other compatible uses.

2.1 ORNL LAND AND FACILITIES PLAN DEVELOPMENT

The ORR is vital because the ability and/or opportunity to acquire another land area such as this is not feasible. In November 1996, an ORNL land use planning team was charged with developing a land use plan and a process for reviewing and evaluating proposed land uses. The ORNL Land and Facilities Use Committee, chartered August 1998, now has the responsibility of updating the plan. In addition, input to the plan was solicited from external stakeholders. This revision updates the 2000 *ORNL Land and Facilities Plan* (ORNL 2000).

The land uses identified in the plan include

- land for future DOE mission initiatives,
- areas for maintaining DOE mission objectives,
- diverse areas for pursuing new DOE initiatives for ORNL,
- areas for regulatory compliance,
- areas for protection of biological diversity,
- areas for historic preservation,
- areas for educational and recreational activities, and
- controlled-access areas for public recreation.

2.2 LAND USE DECISION MAKING AND PLANNING

Prerequisites to any decision include ensuring the health and safety of ORR employees and the public. Beyond health and safety and regulatory compliance, land use decision making and planning reflect the vision for land use. Recommendations on land use are made through the process described in Sect. 2.3.1 based on the land use vision statement and on guidelines for wise land use planning, land use priorities, and input by subject matter experts through a review process.

2.2.1 Guidelines for Land Use Planning

The following guidelines (not prioritized) are used in planning and evaluating land uses:

- ensure compatibility with DOE mission and vision for land use;
- cluster like uses;
- preserve clean areas;
- reuse disturbed areas;
- prevent pollution;
- protect natural, historic, and cultural resources;
- balance costs and benefits;
- create economic development opportunities;

- consider future generations;
- optimize appropriate recreational use;
- ensure compatibility with surrounding landscape;
- consider regional context;
- ensure consistency with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remediation agreements; and
- consider stakeholder input.

2.2.2 Land Use Priorities

For any parcel of land that will be used to support DOE's ORNL mission, potentially competing uses may or may not be compatible with each other. The following ORNL priorities for land use were developed by the ORNL Land and Facilities Use Committee for screening proposed projects prior to submission to the RMO (see Sect. 2.3.1). They have been established so that conflicts between competing uses, particularly those that are not compatible, can be resolved:

1. Preserve and protect land to meet the requirements of existing and future scientific facilities and research programs so that DOE can continue to address its national science and technology missions.

2. Preserve and protect land to meet the requirements of environmental research by ensuring that adequate areas within the ORR are protected and preserved for their biological, historical, and physical diversity.

3. Preserve and protect land to meet the requirements of scientific and technical education by ensuring that suitable land is available for facilities and research areas needed to support educational opportunities on the ORR.

4. Allow for land uses that are compatible with DOE mission uses and do not preclude future options. Decisions concerning these other uses are made on a case-by-case basis to ensure compatibility with higher-priority uses.

2.2.3 Review by Subject Matter Experts

The decision-making process includes review and evaluation of proposed land uses by subject matter experts. Reviews are conducted to determine the potential to impact the following (not prioritized) and work out acceptable alternatives to avoid or minimize impacts, if needed:

- current land uses;
- opportunities to pursue future initiatives;
- natural, historic, and cultural resources;
- health and safety;
- emergency preparedness;
- regulatory compliance;
- access control/security;
- real estate agreements;
- neighboring lands;
- utilities;
- public relations;
- changes to dose receptors;
- transportation;
- remediation and cleanup activities; and
- maintenance activities.

2.3 ORNL LAND AND FACILITIES USE COMMITTEE

The ORNL Land and Facilities Use Committee plans, reviews, and approves for recommendation to DOE all (ORNL and non-ORNL) proposed changes in the use of land and facilities within the ORNL developed area and ORNL projects proposed for the ORR outside the ORNL developed area (see Fig. 1.1). The committee, chaired by the ORNL Area Manager, is composed of representatives of various ORNL research and operations expertise and a representative of Bechtel Jacobs Company, LLC. Areas of expertise represented on the committee include security, research, safety, facilities, compliance, utilities, database management, remediation, and infrastructure planning. Review of proposed projects includes evaluation by appropriate subject matter experts. All projects are assessed to ensure compatibility with this revised *ORNL Land and Facilities Plan* and the *ORR Comprehensive Integrated Plan* (September 1999). Review through the ORNL Land and Facilities Use Committee ensures coordination of the site planning process described in Sect. 3.3. Planning goals and projects approved by the ORNL Land and Facilities Use Committee are incorporated into the *ORNL Land and Facilities Plan* and the *ORR Comprehensive Integrated Plan* updates. Approved ORNL projects for areas outside the ORNL developed area are submitted to the Reservation Management Organization (RMO) for review and concurrence and to the DOE ORR Management Team as described in the *ORR Comprehensive Integrated Plan.*

2.3.1 Review Process

Proposals for changes in land and facility use are submitted first to the ORNL Land and Facilities Use Committee for screening. This includes proposals from anyone planning activities within the ORNL developed area, as well as proposals initiated by ORNL projects or activities for areas outside the ORNL developed area.

Proposed actions within the ORNL developed area. Once approved by the ORNL Land and Facilities Use Committee, the proposed changes in land or facility use are then discussed with the DOE ORNL Site Office. If approved, an ORNL project review (i.e., National Environmental Policy Act) and other required reviews are initiated.

Proposed actions by ORNL outside the ORNL developed area. Once approved by the ORNL Land and Facilities Use Committee, the proposals are submitted to the RMO. If approved by the RMO, the proposals are submitted to the DOE ORR Management Team as described in the *ORR Comprehensive Integrated Plan* (September 1999).

Actions proposed within ORNL developed area	➥	ORNL Land and Facilities Use Committee	➥	DOE ORNL Site Office		
Actions proposed by ORNL outside ORNL developed area	➥	ORNL Land and Facilities Use Committee and DOE ORNL Site Office	➥	RMO	➥	Process in CIP

2.3.2 Overlapping Land Use/Management Responsibilities

Some land areas for which ORNL has responsibility (e.g., the National Environmental Research Park) overlap the Y-12 National Security Complex or Oak Ridge Associated Universities (ORAU) areas of responsibility. Within the overlap areas, the DOE contractors have day-to-day responsibility for management, operation, and maintenance as described in the *Oak Ridge Reservation Management Plan* (February 1999). Any proposed changes in land use within these overlap areas are reviewed by the RMO.

2.4 DESCRIPTION OF THE OAK RIDGE RESERVATION

2.4.1 Location

The ORR consists of 34,235 acres of federally owned lands within Anderson and Roane counties, Tennessee (Fig. 2.1). Most of the ORR is within the corporate limits of the City of Oak Ridge, Tennessee, and is located approximately 2 miles southwest of the population center of Oak Ridge. The ORR is bordered on the north and east by the population center of the City of Oak Ridge and on the south and west by the Clinch River/Melton Hill Lake impoundment. Knoxville, the largest city in east Tennessee, is located approximately 15 miles east of the ORR (Fig. 2.1).

2.4.2 DOE Facilities

About one-third of the ORR is occupied by the three major DOE facilities: ORNL, ETTP (formerly the K-25 Site), and the Y-12 National Security Complex. Figure 2.2 is a detailed map depicting areas of responsibility. About 3500 acres are waste sites or remediation areas. The large land area surrounding the developed areas and waste sites serves as a buffer between the City of Oak Ridge and DOE activities. Use of this buffer area has been primarily for environmental research, remediation, education, compliance monitoring, utilities, security, protection of natural and cultural resources, wildlife management, and limited recreation. There are additional miscellaneous DOE land parcels not shown on the map.

2.4.3 Physical Characteristics

2.4.3.1 Topography, Geology, and Hydrology

The ORR is the most complex geologically and hydrologically of all the DOE sites. Located in the Valley and Ridge Physiographic Province, the ORR is characterized by a series of narrow, elongated ridges and slightly broader intervening valleys that follow a northeast to southwest trend (ORNL 1992). Major valleys within the ORR include East Fork Valley, Bear Creek Valley, Bethel Valley, and Melton Valley. Major ridges within the ORR include Blackoak Ridge, East Fork Ridge, Pine Ridge, Chestnut Ridge, Haw Ridge, and Copper Ridge.

Topography is shown in Fig. 2.3. Elevation within the ORR ranges from a low of 750 feet mean sea level (MSL) along the Clinch River to a high of 1260 feet MSL along Pine Ridge (DOE 1989). Topographic relief between valley floors and ridge crests within the ORR is generally about 300 to 350 feet (ORNL 1992).

Bedrock geology is shown on Fig. 2.4. Valleys within the ORR are underlain by bedrock formations predominated by calcareous siltstones and limestones, including the Conasauga Group and the Chickamauga Group. The Conasauga Group, consisting primarily of calcareous shale interbedded with shaly to silty limestone, underlies Melton and Bear Creek Valleys. The Chickamauga Group, which underlies Bethel Valley and East Fork Valley, consists primarily of limestone, with interlayers of siltstone and other clastic material. Ridges within the ORR are underlain by two different types of bedrock: (1) formations predominated by weathering-resistant sandstones, siliceous shales and siltstones (Rome Formation and Post-Chickamauga rocks) and (2) siliceous dolostones of the Knox Group (ORNL 1992). The Rome Formation underlies Haw Ridge, Pine Ridge, and a smaller ridge northwest of Pine Ridge, while Post-Chickamauga rocks occur in one ridge on the northwestern perimeter of the ORR. These rock units are typified by steep slopes and shallow depths to bedrock. Together with the Conasauga and Chickamauga Groups, they are generally characterized as aquitards, meaning that they have limited capacity to transmit or store groundwater. The Cambro-Ordovician age Knox Group

underlies Copper Ridge, Chestnut Ridge, McKinney Ridge at the ETTP, and Blackoak Ridge. It consists of a thick sequence of silica-rich carbonate rocks that weather to form silty clay soils rich in chert and resistant to erosion. Depth to bedrock is highly variable, but in many locations there is an extremely thick mantle of silty clay residual soil over solid rock. The Knox Group, together with the Maynardville Limestone in the Conasauga Group, is the principal aquifer (groundwater-bearing rock unit) on the ORR. The width of valleys and ridges is determined by geologic factors such as the dip angle and formation thickening due to thrust faulting of underlying geologic formations. Weathering and erosion processes, coupled with the general dipping attitude of bedrock underlying the area, result in rather steep (commonly steeper than 45°) northwest-facing slopes, while southeast-facing slopes are commonly gentler, with inclinations of 5 to 25% (Fig. 2.3) (ORNL 1992).

The topographical features of the ORR reflect geological structures and processes beneath the surface. While groundwater flow in bedrock and, to some degree, surface water flow are controlled by widespread fractures in all bedrock formations on the ORR, the carbonate bedrock also displays dissolutional features and landforms collectively referred to as karst. Karst features represent a spectrum ranging from minor solutional enlargement of fractures to conduit flowpaths to enterable caves. All of these are evidenced on the ORR, associated with the carbonate strike belts along ridge lines and valley bottoms.

All three ORR facilities are situated on carbonate bedrock to some extent such that groundwater flow and contaminant transport are at least in part controlled by solution conduits in the bedrock.

A recent inventory of karst features on the reservation has identified numerous indications of karst development which vary from site to site. Karst features are displayed on Fig. 2.4. Surface evidence of karst development includes sinking streams (swallets) and overflow swallets, karst springs and overflow springs, enterable caves, and numerous sinkholes of varying size. Additional karst-related topographic features may once have been present on the sites of the ORR facilities but were obscured or obliterated by construction activities. Not all springs on the ORR are associated with karst.

In general terms, karst appears most developed in association with the Knox Group carbonate bedrock. The highest density of sinkholes occurs in the Knox Group, and drilling data suggest the largest solution cavities are associated with these formations, ranging up to 22 feet in height at the ETTP. Enterable caves on the reservation are almost exclusively restricted to the Knox Group bedrock. Large springs in the Knox typically occur along the base of the ridges underlain by the Knox. Many appear to have been used for water supply purposes prior to DOE presence.

In contrast with the Knox, karst is less developed in the Chickamauga Group carbonates that underlie the ORNL facilities area and much of the ETTP facilities area in a valley-bottom topographic position. Cavities encountered in drilling are typically smaller and often clay-filled. Caves developed in the Chickamauga regionally, as well as on the ORR, are sparse and typically small.

Problems in recent years related to property damage to residential homes on neighboring properties due to settlement have highlighted the potential for collapse in areas underlain by cavernous limestone. While it is not possible to quantify the risk of collapse on the ORR, it should be considered a potential condition but not necessarily an imminent one. Considering that the karst features are best developed in the Knox Group carbonates, it stands to reason that collapse potential would be greatest in areas underlain by these formations.

The Clinch River is believed to represent the base level to which all groundwater in carbonate bedrock on the ORR would ultimately discharge, if not to surface water features on the ORR. The Tennessee Valley Authority (TVA) has performed probable maximum flood (PMF) studies along the Clinch River, which is the southern boundary of the ORR. PMF is the flood that can be expected from the most severe combination of critical hydrometeorological conditions that are reasonably possible over the entire watershed (ORNL 1992).

The PMF level along the Clinch River at the mouth of Bearden Creek occurred at elevation 814.7 feet, while the PMF level at the mouth of White Oak Creek occurred at elevation 779.3 feet (ORNL 1992). Most of the ORR is located above the PMF elevation along the Clinch River.

Surface water hydrology on the ORR is characterized by a network of small streams that are tributary to the Clinch River (Fig. 2.5). Water levels in the Clinch River are regulated by TVA, and fluctuations in the river have an effect on tributary creeks and streams draining the ORR. The three DOE facilities on the ORR affect different subbasins of the Clinch River. Drainage from the ETTP enters Poplar Creek, which has a total drainage area of 136 square miles. Drainage from ORNL has its greatest effect on White Oak Creek, which has a total drainage area of 6.0 to 6.4 square miles. Drainage from the Y-12 National Security Complex enters both Bear Creek and East Fork Poplar Creek, which have total drainage areas of 7.4 and 30 square miles, respectively (DOE 1989).

2.4.3.2 Vegetation and Wildlife

The ORR is mostly contiguous native eastern deciduous forest. Prior to government acquisition as a security buffer for military activities, the ORR's approximately 1000 individual farmsteads consisted of forest, woodlots, open grazed woodlands, and fields. Results of remote-sensing analyses show that in 1994 about 70% of the ORR was in forest cover and about 20% was transitional, consisting of old fields, agricultural areas, cutover forest lands, roadsides, and utility corridors (Washington-Allen et al. 1995). Forested (hardwood and pine) areas (many in blocks greater than 100 acres) are found throughout the reservation. Cutover forest land includes about 1100 acres of pine plantations killed in 1994 by southern pine beetles (now regenerating or replanted). Additional areas are being cut to salvage timber as a result of the 1999-2000 pine beetle outbreak. Less than 2% of the reservation remains as open agricultural fields (Mann et al. 1996). The forests are mostly oak-hickory, pine-hardwood, or pine. Minor areas of other hardwood forest cover types are found throughout the ORR, including northern hardwoods, a few small natural stands of hemlock or white pine, and floodplain forests.

This large, relatively unfragmented area of mature eastern deciduous hardwood forest provides habitat for numerous wildlife species. Such blocks of forested area are increasingly uncommon in the Ridge and Valley Province and nationwide. In addition to the forested habitats and pine plantations, the ORR contains seminatural grasslands (hay) and forest edge (e. g., transmission line corridors through forest) which provide diversity of habitats suitable for a great variety of wildlife. Other wildlife habitats on the ORR include, but are not limited to, the following: old-field successional areas; unique or important vegetational communities; seminatural corridors; planted hardwoods and pines; bottomlands and wetlands, including an increasing number of beaver ponds; caves; and developed and semideveloped areas and roads.

The resulting diversity of wildlife species ranges from common species found in urban and suburban areas of eastern Tennessee to species with more restrictive requirements, such as interior forest bird species. The ORR hosts about 63 species of fish; 59 species of reptiles and amphibians; up to 260 species of migratory, transient, and resident birds; and 38 species of mammals, as well as innumerable invertebrate species. Among these, 20 species of federal- or state-protected vertebrate species have been confirmed in recent surveys (Mitchell et al. 1996). Furthermore, appropriate habitat for approximately 20 additional species has been identified.

Most of the ORR is relatively pristine when compared with the surrounding region, especially in the Ridge and Valley Province (Mann et al. 1996). Viewed from the air, the ORR is clearly a large and nearly continuous island of forest within a landscape fragmented by urban development and agriculture. Many ecological communities (e.g., cedar barrens, river bluffs, and wetlands) with unique biota, often including rare species, are known to exist within the larger framework of mixed hardwood and pine forest on the ORR (Pounds et al. 1993).

2.4.3.3 Caves, Open Sinkholes, and Quarries

Caves, sinkholes, and quarries are found on the ORR. In addition to providing important habitat for some plants and animals, including sensitive species, these features are often attractive to people, yet can be hazardous. The numerous caves on the reservation are not open to the public, and access has been restricted to research and monitoring uses (Fig. 2.4). A large, open sinkhole is located near the Tower Shielding Facility Highway 95 entrance in an area maintained by periodic mowing. The sinkhole is fenced, and access is restricted. The area is not open to the public (Fig. 2.4).The three inactive quarries (Lambert, Kerr Hollow, and Rogers) are all in restricted areas and are not open to the public (Fig. 2.4).

2.4.4 Cultural Resources

Cultural resources on the ORR include (1) surface and buried archeological materials (artifacts) and sites dating to the Prehistoric, Historic, and Ethnohistoric periods; (2) standing structures that are over 50 years of age or are important because they represent a major historical theme or era; (3) cultural and natural places, selected natural resources, and objects with importance for Native Americans; and (4) American folk life traditions and arts. Figure 2.6 shows general locations of cemeteries, churches, national historic landmarks, and old home structures. Six properties on the ORR are included in the National Register of Historic Places: New Bethel Baptist Church and Cemetery (includes church and two grave houses), George Jones Memorial Baptist Church, and Freels Cabin (includes dwelling and one outbuilding). Thirty-five other properties were identified in a 1996 evaluation (DuVall and Souza 1996). Additional information that may be considered sensitive is available in the cultural resource database for planning and evaluation purposes. A resource management plan for the ORR has been prepared (Souza et al. 2001).

2.4.5 Environmental Designations

The ORR has evolved into a biologically rich resource over the last 60 years. When acquired in 1942, aerial photos indicate that about half of the land was cleared. These cleared and cultivated areas have returned to forest through planted seedlings and natural succession, with about 70% of the ORR now in mature or maturing native forest. Ecological communities found within the larger framework of mixed hardwood and pine forests on the ORR include cedar barrens, river bluffs, and wetlands. As a result of urbanization, these communities are now absent or uncommon in areas surrounding the reservation.

Over 1100 vascular plant species are found on the ORR (compare this to The Great Smoky Mountains National Park, the most biologically diverse with respect to vascular plants of all the national parks in the contiguous U.S., which lists approximately 1650 species). Twenty-one plants listed by the State as rare (endangered, threatened, or special concern) are found on the ORR (Awl et al. 1996). The

population of tall larkspur on the ORR is one of the largest populations known to occur anywhere in the world. The species is listed as "globally rare" by The Nature Conservancy and as "endangered" by the State of Tennessee.

Over 315 wildlife species are known to occur on the ORR. Twenty of the species listed as rare by the State have been verified as occurring on the ORR, with an additional 20 that may be here because the habitat is appropriate (Mitchell et al. 1996). The Tennessee Dace (listed by the State as in need of management) is found in numerous streams and tributaries on the reservation in contrast to declining or absent populations in streams outside the ORR. Listed rare species occur across the ORR in over 50 different locations which are protected as Research Park Natural Areas. Seven of these special areas are also registered State Natural Areas.

The combination of long-term protection for the land area and the biological richness of the ORR with the available research capability and proximity of diverse scientific expertise has resulted in the following state, regional, national, and international associations:

- DOE National Environmental Research Park
- member of ParkNet (network of seven DOE National Environmental Research Parks)
- National Environmental Research Park Biosphere Reserve
- unit of the Southern Appalachian Biosphere (with Great Smoky Mountains National Park, Coweeta Hydrologic Laboratory, and others)
- member of Southern Appalachian Man and the Biosphere Cooperative [with U.S. Department of Agriculture (USDA), Forest Service, TVA, Economic Development Administration, U.S. Environmental Protection Agency (EPA), U.S. Fish and Wildlife Service, U.S. Geological Survey, National Park Service, U.S. Forest Service, Appalachian Regional Commission, and others]
- Oak Ridge Wildlife Management Area managed by the Tennessee Wildlife Resources Agency (TWRA)
- Three Bend Scenic and Wildlife Management Refuge Area
- State Natural Areas (registered)
- ORNL User Facility

2.4.5.1 State Natural Areas

Seven State Natural Areas were noted on the ORR in 1985 through a letter agreement between DOE and the Tennessee Department of Environment and Conservation (TDEC) (see Fig. 2.7). These areas qualified as State Natural Areas because of rare plant or animal species or community types. In June 2001, TDEC submitted a request to DOE for expanded areas of designation. This request is being considered in the overall approach to comprehensive land-use management and the mission objectives of DOE.

2.4.5.2 Oak Ridge Wildlife Management Area

The ORR is a Tennessee Wildlife Management Area through an agreement between DOE and TWRA. The agreement provides for protection of wildlife habitat and species (including several threatened and endangered species) and restoration of other wildlife habitat and species. Management of the ORR for wildlife is also a type of land use (see Sect. 2.5.7).

About 2920 acres of the Wildlife Management Area are specifically managed by TWRA under a separate agreement with DOE. This area is known as the Three Bend Scenic and Wildlife Management Refuge Area and includes most of Solway, Freels, and Gallaher bends along the Clinch River on the southern boundary of the ORR.

2.4.5.3 Wetlands

The ecological functioning of approximately 580 acres of wetlands known to date on the ORR provides water quality benefits, stormwater control, wildlife habitat, rare species habitat, and landscape and biological diversity (Fig. 2.5).

Wetlands occur across the ORR in low-elevation positions primarily in the riparian zones of headwater streams and their receiving streams, as well as in Clinch River embayments. Most of the wetlands on the ORR are classified as palustrine forested, scrub-shrub, and emergent wetlands (Cowardin et al. 1979). Wetlands identified to date range in size from several square yards at small seeps and springs to approximately 25 acres at White Oak Lake. A high percentage of the wetlands on the ORR are less than one acre in size and occur in headwater areas. Wetlands greater than one acre are typically associated with river embayments, other areas affected by the fluctuating water levels of the Clinch River reservoirs (e.g., Poplar Creek), areas in which water has been artificially impounded (e.g., White Oak Lake), and beaver ponds.

Activities that affect wetlands are regulated under federal law [Sect. 404 of the Clean Water Act (CWA), Federal Water Pollution Control Act, 33 USC1251] and State law (Tennessee Water Quality Control Act, TN Code Annotated 70-324). Federal and State permits are required to conduct dredge and fill activities in a jurisdictional wetland. Impacts to wetlands are avoided whenever possible. However, if impacts are unavoidable, they are minimized through steps such as project design changes or the implementation of Best Management Practices. Compensatory mitigation in the form of wetland restoration, creation, or enhancement is a required permit condition under certain circumstances. Potential pre-impacted wetland mitigation areas are discussed in Sect. 2.6.2.3.2, “Wetland Mitigation Areas.”

2.4.5.4 Nature Conservancy Biodiversity Ranked Areas

Over 270 occurrences of significant plant and animal species were recognized by The Nature Conservancy in its preliminary report of biodiversity on the ORR as part of Common Ground, the DOE Future Land Use Initiative (The Nature Conservancy 1995).

In addition, using a national ranking system, over 69 preliminary conservation sites were identified with occurrences of rare species and communities and other important features (e.g., caves, springs). These sites generally had clusters of important species or communities, with special emphasis placed on those species and elements designated as globally imperiled, rare, or uncommon in The Nature Conservancy and Natural Heritage Network ranking system. The sites also include the landscape features and ecological processes (i.e., watersheds) believed to be important for sustaining the occurrences of important species and communities. The sites were evaluated and given a biological significance ranking (BSR) based on their conservation significance. Sites on the ORR were rated BSR-2 (very high significance), BSR-3 (high significance), and BSR-4 (moderate significance). The BSR-5 category (of general biodiversity interest) was not used in The Nature Conservancy’s report, although it notes that "forested land on ORR would fit in this or an above category." The Nature Conservancy areas of biological significance are identified in Fig. 2.8. The Nature Conservancy maintains ORR records of rare plant and animal species in the Biological and Conservation Database.

2.4.5.5 Nature Conservancy Landscape Complexes

The Nature Conservancy report also recommended protection of three large land areas on which are found many highly ranked conservation sites [i.e., those with rare communities and rare species, hardwood forests greater than 100 acres, and critical watersheds (The Nature Conservancy 1995) (Fig. 2.8)].

2.4.5.6 Research Park Endangered Species Habitats (Natural Areas)

Rare plant and animal species (State and/or federal candidate, and/or listed) are provided protection through preservation of the habitat that is required for their survival. Such critical habitat is established on the best available information about the need of the rare species and is protected through Research Park Natural Area designations. Figure 2.9 shows the ORR areas designated as habitat for rare species.

2.4.5.7 Research Park Endangered Species Potential Habitats (Reference Areas)

Reference areas serve two functions. They provide protection to habitat with high potential for rare plant or animal species, and they provide protection for common or representative plant or animal communities that can serve as baseline areas for research and monitoring. Many of the areas originally designated as Research Park Reference Areas have been found to contain rare plant or animal species and have been changed to a Research Park Natural Area designation. Figure 2.9 shows these areas as potential habitat for rare species.

2.4.5.8 Biosphere Reserve

In 1988, the Oak Ridge National Environmental Research Park Biosphere Reserve (Fig. 2.7) was designated (Soles, letter to Van Hook, 1988). Biosphere reserves are areas of terrestrial and coastal ecosystems that are internationally recognized within the framework of the United Nations Educational, Scientific, and Cultural Organization Man and the Biosphere (MAB) Program. Collectively, they constitute a World Network. Each Biosphere Reserve is encouraged to fulfill three functions as appropriate within their management framework: a conservation function (contributing to the conservation of landscapes, ecosystems, species, and genetic variation); a development function (fostering economic and human development which is socioculturally and ecologically sustainable); and a logistic function (providing support for research, monitoring, education, and information exchange related to local, national, and global issues of conservation and development). The Oak Ridge Biosphere Reserve is managed by ORNL for DOE.

In addition, the Oak Ridge National Environmental Research Park Biosphere Reserve is a core protected area within the regional zone of the Southern Appalachian Biosphere Reserve. The MAB World Network now comprises 368 biosphere reserves. The Southern Appalachian Man and the Biosphere (SAMAB) is one of the most active of 47 biosphere reserves in the U.S. and is regarded as an international model.

2.4.6 Maps - Physical Characteristics and Natural Resources of the Oak Ridge Reservation

Maps included in this document were prepared on MapInfo software using data from the ORNL Shared Data Initiative (SDI). The SDI database is updated as data are available from ORNL projects as well as other ORR projects. Table 2.1 lists maps showing physical characteristics and natural resources on the ORR.

Table 2.1. Physical characteristics and natural resources of the ORR

Fig. no.	Map type	Main components
	Physical	
2.1		Location of Oak Ridge Reservation
2.2		Geographic areas of responsibility
2.3		Topography with slope
2.4		Geology with karst features including sinks, springs, caves, source water protection area, and quarries
2.5		Hydrologic features including water, wetlands, floodplains, and watersheds
	Environmental	
2.8		The Nature Conservancy Biodiversity Rankings and Landscape Complexes
2.9		Research Park confirmed and potential habitats for rare species
2.10		Research areas
2.11		Use of DOE land for specific types of research
2.12		ORR research uses

2.5 CURRENT LAND USE ON THE OAK RIDGE RESERVATION

2.5.1 National Environmental Research Park

Major DOE Office of Science (DOE-SC) scientific research programs use the ORR land base to meet mission objectives. The Office of Science considers the research and science values of the ORR to be critical. In 1980, DOE established the Oak Ridge National Environmental Research Park. Consisting of approximately 20,000 acres, the Research Park serves as an outdoor laboratory for studying the nature of present and future environmental consequences from energy-related issues such as global and regional change, environmental stresses, and resource use (Fig. 1.1). It provides a protected land area for research and education in environmental sciences and is used to demonstrate that environmental quality can be compatible with energy technology development. Furthermore, the ORR is one of the few sites in the nation where large-scale ecological research, environmental technology, and measurement science intersect against a backdrop of 30 years of environmental monitoring and research. The Research Park boundaries also form those of the Biosphere Reserve (Soles, letter to Van Hook, 1988).

The availability of the ORR protected lands and field research sites allows DOE [and its predecessor agencies, the U.S. Atomic Energy Commission (AEC) and the Energy Research and Development Administration] to support major field experiments that could not be done if the lands and associated ecological systems had not been protected and secured for such long-term studies. This research addresses fundamental questions about the effects of energy-related activities on ecological systems and compares such effects to the natural variation of ecological systems.

In addition, the Environmental Management (EM) Program supports a variety of monitoring programs on the ORR to assess the effectiveness of remedial actions for reducing the release and transport of radiological and chemical contaminants from waste disposal sites. Remote-sensing information, current and historical aerial photography, and natural resource inventories developed in the EM Program provide broad-scale information needed to characterize ecosystem status and dynamics over time. In the mid-1980s, long-term ecological monitoring programs were implemented for five ORR watersheds to comply with the Clean Water Act and/or CERCLA by assessing the health and monitoring the recovery of streams. Conventional monitoring

approaches (laboratory toxicity tests, biota contaminant analyses, and benthic invertebrate and fish surveys) are combined with innovative, state-of-the-art techniques (e.g., biochemical indicators of fish health, in situ bioassays with endemic mollusks).

The National Environmental Research Park is an ORNL User Facility with more than 700 users from colleges, universities, industries, ORNL, and other State and federal government agencies over the past five years. The National Environmental Research Park also serves as the umbrella for coordinating natural resource management on the entire ORR.

Environmental Field Research Areas. Lands of the ORR are used for research to meet the mission goals and objectives of DOE in many substantive ways. The research addresses major national issues and contributes to national and international collaborative initiatives on global climate change, tropospheric air quality, sustainable development, and biodiversity. These uses require protected blocks of land ranging from a few acres to more than 250 acres. Use of the land area for research is shown in Fig. 2.10. Areas with active research have been identified. Many of these active areas also include sites where research has been proposed (identified for specific projects for proposal submittals or pending actions) or is planned (areas with high potential for studying research issues of interest to DOE and other Research Park users).

The Oak Ridge National Environmental Research Park contains intensive, long-term ecological research areas, most notably Walker Branch Watershed, which is a gauged, 250-acre deciduous forest catchment with a 30-year record of forest and stream ecosystem experiments and monitoring. This research includes studies of hydrology, atmospheric chemical deposition, forest biogeochemical cycling, plant physiology and community dynamics, and stream ecology and nutrient cycling. Ongoing research includes (1) the Throughfall Displacement Experiment, a large-scale ecosystem-level manipulation designed to assess the effects of climate-related changes in precipitation on forest growth and productivity; (2) continuous measurements of trace gas fluxes between the forest and the atmosphere; (3) an experimental study of the rates and pathways of nitrogen cycling in the stream; and (4) National Oceanic and Atmospheric Administration/Atmospheric Turbulence Diffusion Division (NOAA/ATDD) air pollutant dry deposition monitoring. (NOAA has the longest record of air pollutant dry deposition measurements in the world at Walker Branch Watershed.) NOAA/ATDD has a similar long record of measuring solar radiation in various wavelengths, and the Walker Branch Solar Station is part of the Integrated Surface Irradiance Study, NOAA's national solar radiation observing network. Walker Branch is also a site in several national research networks, including the National Atmospheric Deposition Program. Several other streams on the ORR have been used for manipulative experiments to investigate the limitation of primary productivity and the ecological effects of ultraviolet-B radiation.

Three field facilities located at Source Area A in Waste Area Group 5 (WAG 5), West Bear Creek Valley, and Melton Branch Subwatershed are extensively instrumented to monitor storm-driven unsaturated flow and saturated groundwater flow. The hydrologic and geochemical processes have been well characterized at each site, and instrumentation is available for performing sustained tracer injection studies. Investigations at the various sites have focused on quantifying the mechanisms of preferential flow and matrix diffusion in fractured saprolites and shale bedrock. Research findings have significantly improved decision-making strategies with regard to contaminant remediation in complex heterogeneous subsurface media.

In addition, several large lysimeters located west of the Y-12 National Security Complex in Bear Creek Valley are the site of manipulative, ecosystem-level experiments that use Genetically Engineered Microorganisms to investigate contaminant biodegradation in soil. While currently not in active use, these lysimeters provide a unique facility for safely evaluating the efficacy of such organisms.

One of the major facets of the ORR Bioenergy and Carbon Sequestration Initiative regards the forests and their ability to sequester carbon. A description is included in the *ORNL Institutional Plan* (ORNL 2002).

The thousands of acres of eastern hardwood forests on the ORR also support several large-scale ecological manipulation experiments that have established ORNL's national leadership role in global change impacts research. Diverse, complex, and large-scale experimental approaches are used to understand how forest ecosystems respond to the changes in temperature, precipitation, and atmospheric carbon dioxide (CO_2) concentrations expected from global climate change. For example, the Free Air CO_2 Enrichment (FACE) Facility in the 0800 Area was completed in 1997 to investigate the response of a forest ecosystem to increased CO_2 concentrations. This unique global change research facility is providing an opportunity for researchers from all over the U.S. to increase collaborative research on the effects that changes in precipitation or CO_2 may have on the long-term development of these forest communities.

Research use on the reservation has been categorized under four main research types. Figure 2.11 shows the areas with active, proposed, and planned research for carbon cycling and management research, ecosystem dynamics research, global climate change research, and remediation research and monitoring. Specific research within these categories is described below and numbered corresponding to the research compartments shown in Fig. 2.12.

Carbon Cycling and Management Research. Carbon cycling research investigates the flows of carbon through ecosystems and the factors that control that flow, while carbon management research examines the mechanisms by which carbon is stored in ecosystems. Primary production and decomposition and soil carbon are key components of these studies. This work encompasses both terrestrial (forests and agriculture) and aquatic systems. Information garnered from this work will lead to better approaches for enhancing carbon uptake thereby slowing the buildup of carbon dioxide in the atmosphere or conversely reducing the loss of fixed carbon to the atmosphere.

- Control Area for Walker Branch Watershed and Chestnut Ridge Experimental Catchments - 14, proposed
- Bethel Valley Agricultural Land Use Impacts and Carbon Sequestration Research Area - 21, 22, planned (currently active in 19, 29)
- Bethel Valley Agricultural Land Use Impacts and Carbon Sequestration Research Area - 19, 29, active (also planned for 21, 22)
- Carbon Biogeochemistry in High-Fertility, Hydric Environments - 4, 7, 14, 21, planned
- Carbon Experimental Site - planned
    - Bethel Valley Replicated Limestone - 19, 22
    - Blackoak Ridge Replicated Dolomite - 2
    - Bottomland Forest Communities - 4
    - East Fork Poplar Creek - 5
    - Pine Ridge Replicate Experimental Catchments - 9
    - Replicated Controls for Chestnut Ridge - 25
    - Valley Bottom - 21
    - Wetland - 7
- Carbon Experimental Site - 37, active
- Pine Ridge Replicate Experimental Catchments - 37
- Carbon Sequestration Research - 30, planned
- Control Areas for Research on Impacts of Urban Fragmentation with Respect to (a) Plant and Soil Carbon Sequestration Rates, (b) Forest Successional Dynamics on Biodiversity, (c) Wildlife and Neotropical Migrants, (d) Invasive Exotic Species, and (e) Geneflow and Genetic Isolation - 2, planned

- C Site for Ecosystem and Landscape Studies - 2, 5, 8, 9, 10, 11, 14, 17, 19, 21, 23, 24, 26, 28, 30, 36, active
- Ecosystem Processes (Carbon Sequestration, Biodiversity, Wildlife, Non-Native Invasive Species) in High-Contrast Landscapes (Dry Ridges, Wet Valley Bottoms) - 8, 9, planned
- Effects of Current Land Management Practices on Soil and Plant Carbon Storage - 23, planned
- Enriched Background Isotope Study, C-14 - 3, 9, 17, 22, active
- Forest Succession Experimental Sites for Wildlife, Carbon Sequestration, Invasive Species, Biodiversity - 19, 21, 22, planned
- Partnership with City of Oak Ridge, Bechtel Jacobs Company, LLC, and DOE on Biosolid Landfarming for Carbon Research - 4, 5, 14, 17, 20, planned
- Partnership with the Y-12 National Security Complex, Carbon Sequestration Demonstration Site, Biomass and Soil Carbon Experimental Facility - 20, planned
- Recovery of Soil Carbon and Biodiversity on Ash Fields - 20, planned
- Walker Branch Watershed Nitrogen and Carbon Transect Study - 17, active
- Walker Branch Watershed Long-Term Research Area and Buffer - 17, active

Ecosystem Dynamics Research. These studies focus on an improved understanding of ecosystem function and dynamics. Much of the work addresses the complex response of ecosystems to natural and human perturbations such as drought, elevated ozone, forest fragmentation and isolation, and exotic invasive species. Included among these field studies is the world's largest multiyear ecosystem manipulation experiment to examine the response of mature forest to rainfall shifts. The factors which control biodiversity of ecosystems are also a topic of several studies. These studies will improve the ability to predict ecosystem responses to change and to better manage ecosystems to safeguard the resources they provide.

- Biofuels Research and Demonstration Site - 24, active (planned for 14, 19, 21, 23)
- Carbon Experimental Site - 37, active
- Pine Ridge Replicate Experimental Catchments - 37
- Enriched Background Isotope Study, C-14 - 3, 17, 22, 36, active
- Forest Succession Experimental Sites for Invasive Species - 22, active
- Invasive Plant Control Research - Oriental Bittersweet - 8, active
- Exotic, Invasive Plant Research - 8, 17, 25, 26, 29, 30, active (13, 23, 25, 26, 29, 30, proposed)
- Long-Term Agricultural Impacts Research Plots - 32, 33, 34, active
- Long-Term Recovery from Agricultural Impacts - active
  - Complex Terrains - 17, 25, active (14, 26, planned)
  - Level Terrains - 19, active (22, planned)
- NOAA Partnership Area, NOAA Tower No. 2 and Footprint Area - 14, active
- NOAA Partnership Area, NOAA Tower No. 1 and Footprint Area - 17, active
- Partners in Flight Monitoring Route - 4, 5, 7, 8, 9, 11, 13, 14, 17, 21, 23, 25, 26, 30, area north of ETTP, ED-1, active
- Partnership with TWRA Wildlife Management Area on Wildlife Research, Monitoring, and Restoration - entire reservation, active
- Partnership with TWRA for biodiversity, educational, and research initiatives - 23, active
- Rare Plant Population Long-Term Monitoring - 29, active
- Throughfall Displacement Experiment - 17, active
- Tree Nutrition Study - 13, active
- Vascular Plant Monitoring Site - 28, 38, 39, 40, 41, 42, active
- Walker Branch Watershed Nitrogen and Carbon Transect Study - 17, active
- Walker Branch Watershed Long-Term Research Area and Buffer - 17, active
- Whole Tree Harvest Research - 28, active
- Biodiversity of Productive Riparian Areas - 4, 7, proposed
- Control Areas for Research on Impacts of Urban Fragmentation with Respect to Invasive Exotic Species - 2, proposed

- Control Area for Walker Branch Watershed and Chestnut Ridge Experimental Catchments - 14, proposed
- Forest Succession Experimental Sites for Invasive Species - 22, proposed
- Exotic, Invasive Plant Research - 13, 23, 25, 26, 29, 30, proposed (8, 17, 25, 26, 29, 30, active)
- Ecosystem Processes of Exotic, Invasive Plants in High-Contrast Landscapes - 9, proposed
- Large-Scale Catchment Study Area - 22, proposed
- Terrestrial Ecosystem Research Facility (TERF) - entire Research Park, proposed
- Biodiversity of Productive Riparian Areas - 14, 21, planned
- Biofuels Research and Demonstration Site - 14, 19, 21, 23, planned (active in 24)
- Biomass Recovery Plots - 9, planned
- Carbon Biogeochemistry in High-Fertility, Hydric Environments - 4, 7, 14, 21, planned
- Carbon Experimental Site - planned
  - Bethel Valley Replicated Limestone - 19, 22
  - Blackoak Ridge Replicated Dolomite - 2
  - Bottomland Forest Communities - 4
  - East Fork Poplar Creek - 5
  - Pine Ridge Replicate Experimental Catchments - 9
  - Replicated Controls for Chestnut Ridge - 25
  - Valley Bottom - 21
  - Wetland - 7
- Control Areas for Research on Impacts of Urban Fragmentation with Respect to (a) Plant and Soil Carbon Sequestration Rates, (b) Forest Successional Dynamics on Biodiversity, (c) Wildlife and Neotropical Migrants, (d) Invasive Exotic Species, and (e) Geneflow and Genetic Isolation - 1, 2, planned
- Ecosystem Processes (Carbon Sequestration, Biodiversity, Wildlife, Non-Native Invasive Species) in High-Contrast Landscapes (Dry Ridges, Wet Valley Bottoms) - 8, 9, planned
- Ecosystem Consequences of High Geological Complexity - 5, planned
- Effects of Current Land Management Practices on Soil and Plant Carbon Storage - 23, planned
- Forest Succession Experimental Sites for Wildlife, Carbon Sequestration, Invasive Species, Biodiversity - 19, 21, 22, planned
- High-Complexity Shoreline Effects on Wildlife, Biodiversity, Biogeochemical Flux Rates - 26, planned
- Long-Term Recovery from Agricultural Impacts - planned
  - Complex Terrains - 14, 26, planned (17, 25, active)
  - Level Terrains - 22, planned
- National Ecological Observation Network (NEON) - entire Research Park, planned
- Partnership with City of Oak Ridge, Bechtel Jacobs Company, LLC, and DOE on Biosolid Landfarming for Carbon Research - 4, 5, 14, 17, 20, planned
- Experimental Facility - 20, planned
- Pine Bark Beetle Recovery Area Research - 19, 21, 22, 29, planned
- Recovery of Soil Carbon and Biodiversity on Ash Fields - 20, planned
- Replicated Controls for Chestnut Ridge - 14, 17, 26, planned
- Role of High-Productivity Habitats in Wildlife Conservation - 4, 7, 14, 21, planned
- Urban/Industrial Impacts on Isolated Natural Areas - 30, planned

Global Climate Change Research. These studies examine the response of ecosystems to atmospheric and climatic changes and the ability to monitor those changes. Joint studies with NOAA evaluate the ability to measure gas fluxes (e.g., CO_2, H_2O) over whole watersheds and thereby infer watershed productivity and water flux. The Free Air CO_2 Enrichment (FACE) experiment, in which a closed-canopy sweetgum plantation is exposed to elevated carbon dioxide, examines long-term forest ecosystem response to elevated carbon dioxide. This study builds upon open-topped chamber experiments on the reservation in which tree seedlings are grown for multiple years under natural rainfall and light but altered carbon dioxide. Tree and grass crops for energy production are also the subject of field studies.

These crops could provide an alternative energy source to fossil fuels. This suite of studies is aimed towards improving (1) the understanding of the impact of climate and the atmosphere on ecosystems and (2) the ability to manipulate ecosystems to mitigate negative effects of those changes.

- Biofuels Research and Demonstration Site - 24, active (planned for 14, 19, 21, 23)
- Free Air CO_2 Enrichment (FACE) - 24, active
- Global Carbon Cycle Studies - 24, active
- Global Climate Change Field Research Facility - 24, active
- NOAA Partnership Area, NOAA Tower No. 2 and Footprint Area - 14, active
- NOAA Partnership Area, NOAA Tower No. 1 and Footprint Area - 17, active
- Throughfall Displacement Experiment - 17, active
- Walker Branch Watershed Long-Term Research Area and Buffer - 17, active
- Control Area for Walker Branch Watershed and Chestnut Ridge Experimental Catchments - 14, proposed
- Large-Scale Catchment Study Area - 22, proposed
- Terrestrial Ecosystem Research Facility (TERF) - entire Research Park, proposed
- Biofuels Research and Demonstration Site - 14, 19, 21, 23, planned (active in 24)

Remediation Research and Monitoring. Like many other locations, production and research activities in the past have left the ORR with many sites contaminated with toxic chemicals and/or radionuclides. Scientists have taken advantage of on-site contamination to conduct in situ studies of the pathways by which contaminants move through the sites (soils, air, groundwater), the chemical and physical changes that occur to contaminants, and approaches that could be used to remediate or clean up such sites. Long-term monitoring of such sites is an important component of understanding the fate of contaminants. Site characterization of hydrologic flow (the chief means of contaminant movement) is key to many field remediation studies; consequently, such study sites are often heavily instrumented. Oak Ridge was recently selected by DOE to be the Field Research Center (FRC) for DOE's Natural Acceleration Bioremediation Investigation Research (NABIR) program. The FRC provides a site to conduct research and obtain samples related to in situ bioremediation of metals and radionuclides. The FRC includes a contaminated area for experiments on a plume of contaminated groundwater, a background area that provides for comparison studies in an uncontaminated area, and ancillary structures located within a 3.2-mile radius of each other on the ORR. These studies will lead to an improved understanding of the fate of contaminated sites at Oak Ridge and elsewhere and the most effective approaches to their cleanup.

- Biological Monitoring and Abatement Site - 14, 19, 25, Upper Mitchell Branch east of ETTP, ED-1, active
- Hydrology Field Sites - 10, 11, active
- Natural Acceleration Bioremediation Investigation Research (NABIR) Field Research Center - 11, active
- Natural Acceleration Bioremediation Investigation Research Reference Area - 10, active
- Partnership with City of Oak Ridge, Bechtel Jacobs Company, LLC, and DOE on Biosolid Landfarming for Carbon Research - 4, 5, 14, 17, 20, planned

Compartment identifications for research areas are shown in Fig. 2.12. Many research projects include most of the reservation land area, excluding facilities.

Entire Research Park and Other Land Areas Outside of Facilities.

- Center for Bioenergy Research
- Partnership with TWRA Wildlife Management Area on Wildlife Research, Monitoring, and Restoration
- C Site for Ecosystem and Landscape Studies
- Partners in Flight Cooperative Study Site
- ORR Bioenergy and Carbon Sequestration Initiative

Specific active research projects within each compartment or area are described below. Proposed and planned research within these areas is described in Sect. 2.6.1, “Ecosystem Research.”

Area 2
- C Site for Ecosystem and Landscape Scale Studies

Proposed research areas:
- Control Area for Impacts of Urban Fragmentation on Invasive Exotic Species

Area 3
- Enriched Background Isotope Study, C-14

Area 4
- Partners in Flight Monitoring Route

Area 5
- C Site for Ecosystem and Landscape Scale Studies
- Partners in Flight Monitoring Route

Area 7
- Partners in Flight Monitoring Route

Proposed research areas:
- Biodiversity of Productive Riparian Areas, Invasive Plant Species

Area 8
- C Site for Ecosystem and Landscape Scale Studies
- Partners in Flight Monitoring Route
- Invasive Exotic Plant Species Research
- Invasive Plant Control Research - Oriental Bittersweet

Area 9
- C Site for Ecosystem and Landscape Scale Studies
- Enriched Background Isotope Enrichment Site
- Partners in Flight Monitoring Route

Area 10
- C Site for Ecosystem and Landscape Scale Studies
- Hydrology Field Sites
- Natural Acceleration Bioremediation Investigation Research Reference Area

Area 11
- C Site for Ecosystem and Landscape Scale Studies
- Partners in Flight Monitoring Route

Area 12
- Natural Acceleration Bioremediation Investigation Research (NABIR) Field Research Center

Area 13
- Tree Nutrition Study Partners in Flight Monitoring Route

Area 14
- C Site for Ecosystem and Landscape Scale Studies
- Partners in Flight Monitoring Route

- NOAA Partnership Area, NOAA Tower No. 2 Footprint Area
- Control Area for Walker Branch Watershed and Chestnut Ridge Experimental Catchments
- NOAA Partnership Area, NOAA Tower No. 2
- Biological Monitoring and Abatement Site
- Invasive Exotic Plant Species Research

Area 17
- C Site for Ecosystem and Landscape Scale Studies
- Walker Branch Watershed Long-Term Research Area and Buffer
- Enriched Background Isotope Study, C-14
- Invasive Exotic Plant Species Research
- Partners in Flight Monitoring Route
- NOAA Partnership Area, NOAA Tower No. 1 and Footprint
- Walker Branch Watershed Nitrogen and Carbon Transect Study
- Long-Term Recovery from Agricultural Impacts in Complex Terrains

Area 19
- C Site for Ecosystem and Landscape Scale Studies
- Biological Monitoring and Abatement Site
- Long-Term Recovery from Agricultural Impacts in Level Terrains
- Bethel Valley Agricultural Land Use Impacts and Carbon Sequestration Research Area

Area 21
- C Site for Ecosystem and Landscape Scale Studies
- Partners in Flight Monitoring Route

Area 22
- Enriched Background Isotope Study, C-14
- Forest Succession Experimental Sites for Invasive Plant Species

Area 23
- C Site for Ecosystem and Landscape Scale Studies
- Partnership with TWRA, Ecological and Physical Sciences Study Center
- Partners in Flight Monitoring Route

Area 24
- C Site for Ecosystem and Landscape Scale Studies
- Global Climate Change Field Research Facility
- Invasive Exotic Plant Species Research
- Free Air CO_2 Enrichment (FACE)
- Global Carbon Cycle Studies
- Biofuels Research and Demonstration Site

Area 25
- Biological Monitoring and Abatement Site
- Partners in Flight Monitoring Route
- Long-Term Recovery from Agricultural Impacts in Complex Terrain

Area 26
- C Site for Ecosystem and Landscape Scale Studies
- Partners in Flight Monitoring Route

Area 28
- C Site for Ecosystem and Landscape Scale Studies
- Whole Tree Harvest Research
- Vascular Plant Monitoring Site - experimental

Area 29
- Rare Plant Population Long-Term Monitoring
- Invasive Exotic Plant Species Research

Area 30
- C Site for Ecosystem and Landscape Scale Studies
- Partners in Flight Monitoring Route

Area 32
- Ongoing Long-Term Agricultural Impacts Research Plots

Area 33
- Ongoing Long-Term Agricultural Impacts Research Plots

Area 34
- Ongoing Long-Term Agricultural Impacts Research Plots

Area 36
- Enriched Isotope Background Study Area

Area 37
- Carbon Experimental Site, Pine Ridge Replicate Experimental Catchments

Area 38
- Vascular Plant Monitoring - Reference Site

Area 39
- Vascular Plant Monitoring - Reference Site

Area 40
- Vascular Plant Monitoring - Reference Site

Area 41
- Vascular Plant Monitoring - Reference Site

Area 42
- Vascular Plant Monitoring - Reference Site

ED-1 Area
- Partners in Flight Monitoring Routes
- Biological Monitoring and Abatement site

ETTP Area
- Partners in Flight Monitoring Route
- Biological Monitoring and Abatement sites

More detailed information on environmental research is found in *Environmental Sciences: Research, Assessment, and Technology to Understand and Meet the Challenges of the Future* (Environmental Sciences Division 1998) and on the Environmental Sciences Division (ESD) World Wide Web site at http://www.esd.ornl.gov/. In addition to DOE, past and present sponsors of research on the site include the National Science Foundation, the Department of Defense, the EPA, the USDA, the Forest Service, the Nuclear Regulatory Commission, and the Electric Power Research Institute. Ongoing research collaborations also exist with NOAA and TVA.

2.5.2 Safety

ORNL systematically and fully integrates safety into management and work practices at all levels so that the mission of the Laboratory is successfully accomplished while protecting the public, the worker, and the environment. Operations are conducted in compliance with regulations and in a manner consistent with the hazards associated with the work. Work processes are systematically evaluated by ORNL through an ongoing self-assessment program designed to ensure that the mission of the Laboratory is carried out in a safe and effective manner. ORNL has adopted Integrated Safety Management (ISM) by Contract (DEAR Clause 970.5204-2) and carries out the requirements of ISM by way of an integrated set of management systems that apply controls tailored to all the work being performed.

To ensure employee and guest safety, buffer areas around training facilities and other hazard areas are identified with highly visible signage. Employees and guests are expected to comply with signage and are encouraged to report unsafe conditions observed in the field.

2.5.2.1 Security

A 5-mile stretch of Bethel Valley Road was closed to the public in December 2001 for safety and security reasons. Bethel Valley Road access is limited to those with official business as part of security upgrades at ORNL. East Bear Creek Road at Y-12 continues to be restricted to access for official business only.

2.5.2.2 Training Facilities with Surface Danger Zones

Two contiguous major firing ranges are located within the ORNL area of responsibility: the Southeastern Couriers Transportation and Safeguards Training Facility operated by DOE Albuquerque and the Central Training Facility (CTF) operated by Wackenhut Services, Inc. (Fig. 2.13). The ranges and their surface danger zones or buffer areas encompass about 2500 acres. Public entry into these areas is prohibited and strictly controlled. The two range areas, which are located on the south side of Bear Creek Road about 5 miles west of the Y-12 Plant, extend from the DOE ORR boundary on the west to Highway 95 on the east and from Bear Creek Road on the north to the Clinch River on the south. The eastern portion of the site is operated by DOE's Transportation and Safeguards Division Southeastern Courier Section and consists of four individual live-fire ranges and associated support facilities. The western portion of the range site is operated for DOE by Wackenhut Services, Inc., as a CTF and consists of an indoor range, five outdoor ranges, a shooting tower, three live-fire facilities, and assorted tactical facilities. Fire is directed to the south and southeast into an approximately 200-foot-high ridge. Safety analyses for the firing range activities were based on the absence of a permanent population in the downrange areas. Any change in land use in the vicinity of the firing ranges would entail a change in the safety analyses.

2.5.2.3 Emergency Planning Zones

Federal statutes [40 *Code of Federal Regulations* (*CFR*), Parts 301, 302, 304, and 355] require each state, tribal, or local government to protect its citizens from releases of hazardous materials. The

emergency planning zone around each ORO site (ETTP, ORNL, and the Y-12 National Security Complex) extends out 5 miles and is subdivided into emergency planning sectors that are defined by easily recognizable terrain features (*Oak Ridge Reservation Emergency Plan* 1998). Hazard assessments support the designation of emergency planning zones in which special planning is required to ensure that prompt and effective protective actions can be taken to minimize the risk to on-site personnel, the general public, and the environment in the event of an emergency.

2.5.3 Compliance and Monitoring

Operations at all facilities on the ORR must comply with environmental requirements established by federal and state statutes and regulations, executive orders, some DOE orders, and legal compliance and settlement agreements. The TDEC and EPA are principal among the regulatory agencies that issue permits, inspect operations, and oversee environmental compliance on the ORR. Changes in land use have the potential for impacting not only widespread ongoing compliance activities, but also operations at the EPA- and TDEC-regulated facilities. The facilities were intentionally located away from population centers with unpopulated land area between the facilities and local residents. Changes in the unpopulated land area could alter dose calculations required for meeting radiological requirements, such as those in the Clean Air Act National Emission Standards for Hazardous Air Pollutants (NESHAP) (40 *CFR* 61, Subpart H), and thereby impact facility operations.

As regulatory agencies transition to watershed-based load-allocation permitting for wastewater discharges, the presence of additional new facilities on the ORR that need to discharge wastewaters to ORR streams under the National Pollutant Discharge Elimination System (NPDES) could cause DOE to reduce constituent concentrations in DOE-facility wastewater effluents in order to control watershed loading to an acceptable standard. An annual summary, prepared for the ORR environmental activities (Hughes et al. 2001), can be found on the World Wide Web at http://www.ornl.gov/aser. Figure 2.14 shows environmental compliance and monitoring locations on the reservation.

2.5.3.1 Environmental Monitoring

Environmental monitoring on the ORR consists of two major activities: effluent monitoring and environmental surveillance. Effluent monitoring consists of the collection and analysis of liquid, gaseous, or airborne effluents at their sources. Environmental surveillance consists of the collection and analysis of samples of air, surface water, groundwater, foodstuffs, biota, and other environmental media from areas that have the potential to be affected by activities on the ORR. Data from the analyses are used to assess chemical and radiation exposures to members of the public and to demonstrate compliance with environmental permits and regulations.

2.5.3.2 Air Monitoring

Numerous activities conducted in facilities on the ORR emit, or have the potential to emit, pollutants to the atmosphere. In general, these activities are regulated and monitored as nonradiological sources or radiological sources. The most environmentally significant nonradiological sources include steam production plants located at each plant site (ETTP, Y-12, and ORNL) fired with coal, fuel oil, and/or natural gas. Radiological sources include emissions from production areas, research activities, and decontamination work. All sources are in compliance with emission standards, reporting requirements, and monitoring requirements.

Meteorological conditions on the ORR are provided by seven widely spaced meteorological towers. The data are used in dispersion modeling to predict impacts of facility operations. In addition, these data

are essential as input to emergency response atmospheric models used in the event of accidental releases from a facility. The towers range from 100 to 330 feet in height, and data are collected at two to three levels above ground.

In addition to monitoring the sources of effluent release (e.g., stacks), ambient air is monitored at various locations on the ORR to determine whether effluents from the facilities are increasing levels of radiation or air contaminants. The ambient air monitoring program, which assesses the impact to air quality of operations on the entire ORR, includes operation of a network of perimeter air monitoring stations. These stations incorporate gamma radiation detectors as well as instrumentation for quantifying alpha-, beta-, and gamma-emitting radionuclides, uranium, tritium, and beryllium. NOAA/ATDD operates 16 meteorological towers for collection of routine observations throughout East Tennessee, including one at Walker Branch Watershed. Local climatological data for the Oak Ridge area includes records back to 1950.

2.5.3.3 Surface Water Monitoring

The primary statute governing the monitoring of effluent discharges to surface waters on the ORR is the CWA, which requires the issuance of NPDES permits. The ORNL NPDES permit lists 161 point-source discharges that require compliance monitoring, the Y-12 permit lists 100 sources, and the K-25 permit lists about 150, for a total of approximately 400 CWA discharge points for the ORR.

To assess the impact of ongoing, as well as past, discharges to receiving streams, surface water samples are collected from 22 stream locations on and around the ORR. Water quality measurements serve as guides to the health of the environment, and measurements therefore include sampling of reference streams upstream of operations on the ORR. Reference data are used to establish the baseline against which the health of ORR streams is assessed for regulatory purposes. These reference streams, which are located in undeveloped portions of the ORR, have been sampled for years and provide a long-term baseline against which current data can be evaluated. The sites were carefully selected, have been approved by the regulatory agencies, and must remain undisturbed for the indefinite future.

2.5.3.4 Groundwater Monitoring

The ORR is underlain by complexly deformed bedrock (folded and faulted sedimentary rock) that includes clastic rock types such as shales, siltstones, sandstones and pure carbonate rocks comprised of dolostone and limestone. The clastic bedrock types make up approximately 30 to 50% of the outcrop area, while the pure carbonate rock types make up the remainder. The clastic rock units (Rome Formation, Conasauga Group, and the Chickamauga Group) are generally categorized as “aquitard” units, while the massive pure carbonate rock units (Maynardville limestone and the Knox Group) are categorized as “aquifer” units on the ORR. Groundwater flow in the aquitards is dominated by flow through fractures of variable length and connectivity and discharge may be visible at “seeps” or may occur invisibly in stream channels. In fracture-dominated groundwater flow systems, groundwater movement depends on the length and connectivity of the fractures, and contaminants may move relatively rapidly (meters/day). Porosity of the rock matrix between fractures often functions as a sponge to retain contaminants in inaccessible pores. Groundwater flow in the carbonate aquifer units is dominated by the presence of solution conduits. In conduit-dominated groundwater flow systems, such as the Knox Aquifer, large volumes of water move rapidly (hundreds of meters to kilometers per day) through discrete channels that discharge at springs that may be visible near streams or may occur in the base of stream channels.

Depth of active groundwater circulation in the ORR aquitards is on the order of 100 meters below ground surface. Ancient brines (highly saline waters) are present in the aquitards at depths of 200 to 300 meters

below ground surface. Yields of wells in the aquitards are quite variable but are generally low (<1 to 10 gpm). Fresh water is known to circulate to depths greater than 200 meters in the Knox Aquifer, and brines have not been encountered in Knox Aquifer monitoring wells. Yields of wells in the Knox Aquifer are often high, and wells in the intersect conduits can produce hundreds to more than 1000 gpm.

In fracture- and conduit-dominated groundwater flow systems such as those at the ORR, the direction and rate of groundwater movement are determined by the orientation and aperture (minimum cross sectional area) of the interconnected fractures or conduits and occurrence of precipitation. Fractures and conduits at the ORR tend to be oriented parallel to geologic outcrop trends because of the regional and local geologic structure (dipping strata) and differential weathering of interbedded rock types (carbonate vs. clastic). The geographic scale (basin area) and discharge volume of fracture and conduit flow systems at the ORR vary depending on the rock types. In the aquitard outcrop areas, groundwater basins tend to conform to surface watershed areas, although some exceptions are known to occur. In the Knox Aquifer outcrop area, groundwater basin delineation is difficult because the extensive conduit development and depth of groundwater flow promote flow beneath topographic divides. Although carbonate basins are less discrete than those formed in the clastic rock types, the influence of geologic structure (strike and dip) is apparent in observed groundwater flow patterns in the Knox Aquifer. Groundwater discharge volumes in fracture and conduit flow systems vary with seasonal and rainfall patterns. During the growing season (May – October), much of the rainfall is transpired back to the atmosphere by trees and other plants. This evapotranspiration reduces the amount of recharge to the groundwater system with the result that base flows in springs and streams diminish. During the late autumn, winter, and early spring seasons, rainfall is more effective at recharging the groundwater system because of much-reduced evapotranspiration and spring and stream base flows increase. In conduit-dominated groundwater systems, the response to individual storm events can cause orders of magnitude increases in spring discharge volumes, depending on the groundwater basin area.

Since contamination follows groundwater movement, information regarding the direction and rates of groundwater flow is needed for assessing the potential for contamination exposure. However, the geohydrology of the ORR is sufficiently complex that contaminant transport is difficult to predict on a local scale. For example, the leading edge of a contaminant mass such as tritium may migrate along fractures at a typical rate of 1 m/d, whereas the center of mass of the contaminant plume migrates at less than 0.06 m/d. The presence of dense non-aqueous phase liquids (DNAPLs) contaminants in the ORR hydrogeologic setting also exemplifies the site complexity. DNAPLs discharged on the land surface or in shallow pits at the ORR tend to seep downward through fractures and bedding planes to depths at which either the openings terminate or pore pressures equilibrate with the DNAPL density. This results in infiltration of contaminant masses to depths of several hundred feet in the fractured rock. Plumes of contaminated groundwater at these depths are fed by the gradual dissolution of the DNAPL masses.

Because of the geohydrologic complexity of the ORR and the many different regulations governing groundwater monitoring requirements [e.g., the Resource Conservation and Recovery Act (RCRA), CERCLA, TDEC Solid Waste Management regulations, and regulatory requirements for groundwater monitoring for petroleum underground storage tanks], an integrated groundwater monitoring program has been established.

To fully comply with regulatory requirements, to delineate and predict the extent of groundwater contamination on the ORR, and to protect the public and the environment, a groundwater surveillance monitoring program is in effect. The program includes groundwater monitoring wells on the ORR. Although most wells are located at the facility sites where contamination is greatest, the areas on the ORR containing groundwater monitoring wells are essential for providing regulatory compliance data and supporting monitoring program objectives.

Source Water Protection Area. The First Creek headwaters have been identified as a sensitive water source for the Aquatics Research Laboratory, Building 1504. Figure 2.4 shows the First Creek Source Water Protection Area. The area is based on a combination of surface topography and geology. The southern boundary of the area was confirmed in June 1999 by groundwater tracing from disappearing streams to springs in the First Creek headwater. Extensive terrain modification or contamination of groundwater or surface water within this area will have adverse impacts on the water quality of First Creek and consequently impact the Aquatics Research Laboratory.

2.5.3.5 Terrestrial Vegetation Monitoring

Contaminants released from facilities on the ORR can accumulate in food crops and in terrestrial animals that feed on vegetation on the ORR. Because the primary exposure pathway for contaminants in humans is the ingestion of crops, meat (e.g., deer, geese, and wild turkey), and milk, both hay and food crops grown on or near the ORR are collected and analyzed to evaluate potential radiation doses.

Vegetables, such as tomatoes, lettuce, and turnips, are collected from local gardens which have been identified as potential deposition areas. Samples from each plot are analyzed for gross alpha and beta radiation, gamma emitters, and uranium. The results are compared to crops grown at a reference site outside the influence of ORR activities.

Because radionuclides can be transferred to humans from the environment through the food chain (e.g., grass to cow to milk to human), milk is considered a significant potential exposure source. Even small amounts of radionuclides deposited from airborne emissions can be significant because of the large surface area that can be grazed by a cow, the rapid transfer of milk from producer to consumer, and the importance of milk in the human diet. Milk is collected bimonthly from local producers and analyzed for radioactive iodine, radioactive strontium, and tritium.

2.5.3.6 Biological Monitoring and Abatement Program

Biological monitoring of streams on the ORR has been conducted for more than 15 years. The Biological Monitoring and Abatement Programs (BMAPs) at the three DOE facilities on the ORR were developed to meet NPDES permit requirements and include tasks on (1) toxicity monitoring; (2) bioaccumulation in aquatic biota; (3) bioindicators of fish health; and (4) fish, macroinvertebrate, and periphyton community surveys. Additional BMAP tasks are required by the individual facility-specific NPDES permit. Each of these tasks utilizes water or fauna from streams near the ETTP (Mitchell Branch and Poplar Creek), ORNL (White Oak Creek and its tributaries), and the Y-12 National Security Complex (East Fork Poplar Creek). In addition, reference streams used for comparison with contaminated sites include Scarboro Creek, Ish Creek, and Mill Branch (Peterson 2000; Smith 2000).

2.5.4 Contaminated Areas

Since 1942, the three plants on the ORR have had significantly different operations and missions, but all have generated various types of wastes that were disposed of on-site in waste management areas. On-site disposal of RCRA and/or polychlorinated biphenyl (PCB) wastes ceased in the early 1980s. However, the early waste disposal practices have resulted in contaminated streams, groundwater, and soil on the reservation. Spills, piping leaks, and other inadvertent releases (historic use of lead-based paint or PCB-contaminated paint) have contributed to environmental contamination. Most of the contamination occurs within the waste management areas and the developed and fenced areas of the Y-12 National Security Complex, ETTP, and ORNL (Fig. 2.15). Waste management at ORNL included such activities as the disposal of radioactive waste materials by shallow land burial from 1951 to 1993,

the disposal of liquids in shallow seepage pits and trenches from 1951 to 1981, and the injection of waste liquids and sludges mixed with cement grout into deep rock formations using the hydrofracture process from 1959 to 1984. During the period from 1955 to 1963, ORNL was designated by the AEC as the Southern Regional Burial Ground and received a wide variety of poorly characterized waste from approximately 50 different sources. These wastes were included in the shallow land burial sites in use by ORNL.

Remediation of the contaminated areas at ORNL is conducted under CERCLA. A Federal Facilities Agreement (FFA) was signed by DOE, EPA, and the State of Tennessee to coordinate environmental remediation activities on the ORR. Cleanup goals for the contaminated areas are negotiated through the CERCLA process and are documented in Records of Decision (RODs). A variety of issues must be addressed as cleanup goals are developed: anticipated future land and groundwater use, availability of waste treatment and disposal facilities, federal and state requirements that the remedy will attain, long-term stewardship/institutional controls, and risk to human and ecological receptors. The ROD for Interim Actions for the Melton Valley Watershed was signed by DOE, EPA, and the State of Tennessee in September 2000. This ROD documented the selected remedy for the remediation of waste sites and other contaminated sites in Melton Valley. The ROD also established land uses for the areas within Melton Valley. A similar ROD is expected to be signed in 2002 for Bethel Valley sites. The selected remedy for both watersheds leaves some hazardous substances in place which pose a future potential risk and which would require land use restrictions for hundreds of years or longer. Land use controls and monitoring, as appropriate, are included as part of the selected remedies to ensure protectiveness. Groundwater decisions have been deferred pending results of source removal and containment actions.

2.5.5 Land Application of Biosolids

The City of Oak Ridge has been applying sanitary sewage sludge to approved sites on the ORR since 1983 under agreements with DOE and the State of Tennessee. It is the policy of the federal government that DOE consider beneficial use of municipal sewage sludge for fertilizer, soil conditioner, or other uses, when such use enhances resources on federal lands and is cost effective (EPA, *Federal Register* July 91-30448). Locations are shown in Fig. 2.7.

ORNL is currently sending sanitary sewage sludge to the City of Oak Ridge for inclusion in the City's biosolids land application program. While not all sludge can be transferred because of low levels of residual radiological contamination, the portion that can be disposed of in this manner lessens the quantity of solid low-level contaminated waste generated at the ORNL facility. Efforts continue to determine possible sources of ground-based contamination that is leaching into the ORNL sewage collection system. Once identified, remedial actions will be undertaken to prevent this legacy contamination from entering the collection grid.

2.5.6 Reservation Infrastructure (Gas, Communication Lines, Power)

Since all major utilities cross the ORR, a number of companies have easements. ORR infrastructure is shown in Fig. 2.16. Details are not provided in this plan as they are described fully in the *Oak Ridge Reservation Management Plan*, February 1999. Section 3.3 of the plan, "Access Control," identifies companies with utility easements. Part of Sect. 3.4, "Surveillance and Maintenance," lists companies and organizations with operating and maintenance responsibilities. Appendix E, "ORR Roles and Responsibilities," explains in detail the activities of various governmental entities and companies, some of which involve utilities. Through permission granted by DOE realty licenses, mobile service towers have been erected in seven locations across the reservation. Additional towers are being considered to improve communication ability across the reservation.

2.5.7 Oak Ridge Wildlife Management Area

Management of wildlife on an area as large as the ORR is necessary to ensure public safety and maximize wildlife health and diversity. Most of the ORR is within the Oak Ridge Wildlife Management Area. Wildlife management is carried out by TWRA in cooperation with ORNL's ESD under agreements between TWRA and DOE and between DOE and UT-Battelle. Management includes wildlife population control through hunting, trapping, and removal; wildlife damage control; restoration of wildlife species; preservation, management, and enhancement of wildlife habitats; coordination of wildlife studies; and law enforcement. Wildlife resources are placed in management categories, each with a specific set of objectives and procedures for achieving them. These resource management categories are (1) wildlife habitats/species-richness, to ensure that all resident wildlife species exist on the ORR in viable numbers; (2) featured species, to maintain selected species in desired numbers on designated land units; (3) game species, for research, education, recreation, and public safety; (4) sensitive species needing inventory, preservation, and protection of both the species and their habitats; and (5) wildlife pest problems. The Oak Ridge Wildlife Management Area is shown in Fig. 2.7.

Three Bend Scenic and Wildlife Management Refuge Area. Secretary of Energy Bill Richardson set aside 2920 acres of the DOE ORR as a conservation and wildlife management area on June 23, 1999, in an agreement between the Energy Department and TWRA. The proclamation, signed by Secretary Richardson and George Akans, Jr., of the Tennessee Wildlife Commission, calls for the land to be cooperatively managed for preservation purposes under a use permit.

The Three Bend Scenic and Wildlife Management Refuge Area consists of 2920 acres located in the ORR buffer zone on Freels, Gallaher, and Solway bends on the north shore of Melton Hill Lake in Anderson County.

TWRA has signed a cooperative agreement with DOE to serve as a natural resources management plan for the Three Bend Area. The agreement establishes general guidelines for managing the area to preserve and enhance its natural attributes.

2.5.8 Public Opportunities

Most of the reservation is not freely accessible to the public, although parts are open at various times for recreation and educational activities (Fig. 2.6).

2.5.8.1 Public Greenways

Gallaher Bend Greenway, an experimental public greenway in the Oak Ridge National Environmental Research Park, was opened in December 1997. North Boundary Road Greenway, which follows East Ridge Road and Poplar Creek Road, was opened in 1999. The greenways are shown in Fig. 2.6.

2.5.8.2 Tennessee Wildlife Resources Agency Wildlife Management Area

Wildlife on the ORR is managed by TWRA under an agreement with the DOE Oak Ridge Operations Office (DOE-ORO). This management includes annual public managed quota deer and turkey hunts (special permits are required). Public deer hunts were initiated to reduce the rapidly growing deer population and as a safety measure to address the increasing number of deer/vehicle collisions. Each animal taken during deer and turkey hunts is monitored for radiation contamination. Since the hunts began in 1985, 2.2% of the 7842 deer taken (through 2000) have been retained due to radiological contamination. One turkey was retained due to radiological contamination during the first hunt in 1997;

another was retained in 2001. Deer hunts were canceled in the fall of 2001 but are planned for 2002. Turkey hunts were held in 2002. Deer and turkey hunt maps are available at http://www.ornl.gov/rmal/huntinfo.htm. Additionally, TWRA has led public bird walks during the spring and coordinated bird counts for input to the Partners In Flight interagency program.

2.5.8.3 New Bethel Baptist Church and Interpretive Center

New Bethel Baptist Church is one of the few remaining original structures of pre-Manhattan Project days and is listed on the National Register of Historic Places. This facility is open to the public, and its interpretive center contains displays and artifacts relating to the building's use before and after government occupancy.

2.5.8.4 Walks/Tours

ORNL sponsors annual activities on the ORR (e.g., bird walks, wild flower hikes, and trips to field research sites) that are open for public participation. These are advertised in local media. In addition, ORNL participates in Community Day, which offers the public an opportunity to visit Laboratory facilities. A DOE Oak Ridge facilities public bus tour is available at the American Museum of Science and Energy.

2.5.8.5 Ecological and Physical Sciences Study Center

This educational program offers hands-on experiences in outdoor environmental and physical sciences for kindergarten through high school students, as well as programs to familiarize teachers with new concepts. The programs are primarily centered at historic Freels Cabin and require preregistration through the ORNL Office of University and Science Education.

2.5.8.6 ORNL Graphite Reactor

A registered National Historic Landmark, the Graphite Reactor's primary wartime mission was to produce the first gram quantities of plutonium for experiments at the University of Chicago. Afterwards, it was dedicated to the peace-time development of atomic energy and operated until 1963.

2.5.8.7 Other Public Facilities and Educational Programs

Facilities on the reservation operated by others and open to the public include the Clark Center Recreation Area, the Wheat Community African Burial Ground near ETTP, the ETTP Visitors Overlook, and the Y-12 Visitors Center.

2.5.9 Facilities

A number of ORNL facilities, as well as facilities managed by ETTP, the Y-12 National Security Complex, and others, are located outside the ORNL developed area. ORNL facilities are identified in the "ORNL Integrated Facilities Plan" in Sect. 3 of this land use plan.

2.5.10 Other

Some land uses within the National Environmental Research Park are the responsibility of others as designated by DOE-ORO. These uses are identified in the *Oak Ridge Reservation Management Plan* (1999) and the *ORR Comprehensive Integrated Plan* (September 1999).

2.5.11 Maps - Current Land Use on the Oak Ridge Reservation

Maps included in this document were prepared on MapInfo software using data from the ORNL SDI. The SDI database is updated as data are available from ORNL projects as well as other ORR projects. Table 2.2 is a list of maps pertaining to current ORNL land usage.

Table 2.2. Current land use on the ORR

Fig. no.	Maps	Main components
2.6	Public, educational, and recreational opportunities	Ecological and Physical Sciences Study Center New Bethel Church Interpretive Center ORNL Graphite Reactor Gallaher Bend Greenway TWRA Wildlife Management Area Cemeteries, historic districts, churches, and home sites Clark Center Recreation Area North Boundary Road Greenway
2.7	Partnership areas	Sludge landfarming sites State Natural Areas TWRA Wildlife Management Area Oak Ridge Biosphere Reserve Gallaher Bend Greenway Wetland Mitigation Areas North Boundary Road Greenway
2.10 2.11 2.12	Research areas	National Environmental Research Park Active research areas Proposed research areas Planned research areas
2.13	Safety	Emergency planning zones Surface danger zones
2.14	Compliance and monitoring	Air monitoring sites Groundwater wells Surface water monitoring BMAP sites Meteorological towers Fish sampling locations Sludge landfarming site
2.15	Contamination areas	Potential release sites EM watershed project boundaries
2.16	Reservation infrastructure	Electrical lines Water lines Communications lines Natural gas lines Sanitary sewer lines Water treatment plants Water reservoirs Electrical substations Natural gas stations Main roads Mobile service antenna sites

2.6 FUTURE LAND USE ON THE OAK RIDGE RESERVATION

The Secretary of Energy's Land and Facility Use Management Policy states that DOE will exercise stewardship over its assets based on ecosystem management principles (DOE 1994). Management of the ORR as a viable and healthy ecosystem provides the foundation required for environmental research and for pursuing future scientific initiatives. Planning for future land use requires management of the ORR as an ecosystem unit. Ecosystem management is not a land use objective in itself. It is, however, a method for achieving the land use objectives. Additionally, it provides a mechanism for preservation of the land area needed to pursue future scientific research opportunities such as neutron science. Future land uses will, in most cases, expand and build on current land uses, not replace them.

2.6.1 Ecosystem Research

Ecosystem management has been defined as ". . . a collaborative process that strives to reconcile the promotion of economic opportunities and livable communities with the conservation of ecological integrity and biodiversity" (Keystone National Policy Dialogue 1996). Ecosystem management must be based on an understanding of the factors governing the limits on ecosystem sustainability and the controls on ecosystem response to environmental change. Such an understanding requires comprehensive, multidisciplinary research on a variety of ecosystems under different levels of human influence. Research approaches that combine ecosystem monitoring and experimental studies are most valuable for developing a mechanistic understanding of ecosystem sustainability and factors controlling ecosystem change.

Within this context of ecosystem management, the ORR provides a combination of complex geology and hydrology; ecological diversity; fundamental ecosystem process research, modeling, and long-term data records; a historical record of land use change; and dynamic pressures on its ecosystems resulting from its suburban/industrial setting. Future research will capitalize on the wealth of historical and ongoing ecological research and monitoring on the ORR to address the fundamental sciences underlying the structure and function of ecosystems, response of ecosystems to stress, and sustainability of ecosystems. The focus of future experimental research and monitoring activities is identified in greater detail in Appendix C.

2.6.2 Identified New Future Land Uses

Maps for future land use reflect identified new future needs; current land uses do not preclude different future uses. Land planning, however, will need to incorporate current land use with identified new future land uses.

New future land uses include

- research facilities,
- environmental research areas,
- environmental partnership areas,
- waste management facilities,
- future initiatives,
- transportation improvements,
- education and recreation, and
- land transfers/lease areas.

2.6.2.1 Research Facilities

Proposed locations of future research facilities are shown in Fig. 2.17 and are described in the following sections.

2.6.2.1.1 Spallation Neutron Source

The Spallation Neutron Source (SNS) will serve as a world-class facility for neutron research. The SNS is being constructed on approximately 90 acres on Chestnut Ridge, approximately 2 miles from the ORNL main entrance. The SNS consists of a front-end system (including ion source), linear accelerator, accumulator ring, target facility, and experimental areas. Within the site, support laboratories and shops, a central laboratory and office building, conference areas, user facilities, and a central utility building will be provided. A large water reservoir, an electric service switchyard, and a stormwater retention pond are also being constructed to serve the facility. After reviewing the analysis presented in the "Final Environmental Impact Statement for the Construction and Operation of the Spallation Neutron Source" (SNS FEIS, DOE/EIS-0247, April 23, 1999), DOE issued a ROD for the Construction and Operation of the Spallation Neutron Source on June 18, 1999, whereby the ORR (Chestnut Ridge) was selected as the site for the SNS.

The Joint Institute for Neutron Sciences is a proposed joint venture with The University of Tennessee, the State of Tennessee, and DOE for a user facility which will serve both the existing High Flux Isotope Reactor (HFIR) and the proposed new SNS. This project is funded by the State. A facility of approximately 25,000 square feet is proposed to provide short-term accommodations for visiting scientists and serve other user needs. Potential sites, integrated into the SNS campus, are being investigated.

2.6.2.1.2 Center for Nanophase Materials Science

The Center for Nanophase Materials Science (CNMS) will consist of a new multistory, multipurpose building of approximately 80,000 square feet. It will be located near the SNS Complex and will house the core support facilities, offices, and laboratories necessary to ensure the mission of the CNMS. The location and synergy of the functions planned for this facility will provide valuable support and services to a broad user base of educational, industrial, and research organizations.

2.6.2.1.3 West Campus

The West Campus will be centered around the new Laboratory for Comparative and Functional Genomics, a DOE Line Item now in the design stage that will house the ORNL mouse colony critical to ORNL's future genomics research. This 35,000-square-foot facility will allow the mouse colony to be moved from its historical (but now deteriorated) home at the Y-12 National Security Complex and open the availability of that important DOE resource to a broader research community.

That enhanced research community will be better able to utilize this resource through the Joint Institute for Biological Sciences (JIBS), a State of Tennessee funded research laboratory and office facility to be co-located in the West Campus during Phase I.

2.6.2.1.4 East Campus

The East Campus of the Laboratory will feature the planned construction of the Research Support Center, three private-sector research buildings, two State of Tennessee Joint Institutes, a general purpose support office building, and the infrastructure that integrates the new facilities with the existing Laboratory and provides a new face to the public and visiting scientists. In addition to the new construction, renovations will begin to take place on existing research and support buildings to accommodate staff consolidation and new science initiatives, the most notable of those being the upgrades to 4500N/S, the High Temperature Materials Laboratory (HTML), and Building 5500 (for ESH&Q consolidation). Research wings of the 4500N/S complex will be prioritized for upgrade, and staff will be temporarily relocated in a phased approach to allow the existing 1950s laboratories to be updated to current technology. At the HTML, a new special-foundation-designed facility will be constructed adjacent to the current laboratory to allow consolidation of the primary ORNL electron microscopes into a single, unique, and highly stable facility to support long-term use of these supersensitive instruments.

2.6.2.1.5 Development in the 7600 and 7900 Areas

While not within the main ORNL campus boundaries, critical activities are occurring in the HFIR/ Radiochemical Engineering Development Center (REDC) complex (7900 Area) and the Robotics and Process Systems Complex (7600 Area) that are important to the overall ORNL revitalization initiative. The improvements to HFIR operations and research capabilities occurring during their ongoing upgrade program will make the reactor and adjacent facilities more user-friendly and available. To support that increase in mission, several DOE general plant project (GPP)-level projects will be undertaken to eliminate multiple trailers housing research and support staff, provide much-needed highbay operations and storage areas, and improve the user-facility status of the complex. The 7600 Area has been selected to be the location for consolidation of Fusion Energy Division staff and facilities that have been historically located at Y-12. A new DOE GPP facility will be constructed (for offices and for highbay process space needs).

2.6.2.1.6 Research and Development Facilities

Space for future Melton Valley research and development (R&D) facilities has been identified bordering Melton Hill Lake (known as the Ramsey Drive Site). Approximately 39 acres of land adjoining the proposed Fusion Materials Irradiation Facility have been identified for future use. No specific facility designations have been identified for the site.

2.6.2.2 Environmental Field Research Areas

Environmental field research is proposed and/or planned across the entire reservation (except for the ETTP area) in addition to areas where it is already being done (Fig. 2.17).

- Proposed Research Areas – areas identified for specific projects for proposal submittals or pending actions
- Planned Research Areas – areas with high potential for studying research issues of interest to DOE and other Research Park users

For both types of areas, proposed changes in land use that could affect the ability to use the land for research must be considered.

Four projects, the National Ecological Observation Network (NEON), the Terrestrial Ecosystem Research Facility (TERF), the Bioenergy and Carbon Sequestration Initiative, and the Global Water Cycle Test Bed, encompass the entire Research Park. Proposed and planned research projects corresponding to the compartments shown in Fig. 2.12 are listed as follows.

Area 2
Planned research areas:
- Carbon Experimental Site, Blackoak Ridge Replicated Dolomite
- Control Area for Impacts of Urban Fragmentation on (a) Plant and Soil Carbon Sequestration Rates, (b) Forest Successional Dynamics on Biodiversity, (c) Wildlife and Neotropical Migrants, and (d) Geneflow and Genetic Isolation

Area 4
Proposed research areas:
- Biodiversity of Productive Riparian Areas, Invasive Plant Species

Planned research areas:
- Carbon Experimental Site, Bottomland Forest Communities
- Carbon Biogeochemistry in High-Fertility, Hydric Environments
- Role of High-Productivity Habitats in Wildlife Conservation
- Partnership with City of Oak Ridge, Bechtel Jacobs Company, LLC, and DOE on Biosolid Landfarming for Carbon Research

Area 5
Planned research areas:
- Carbon Experimental Site, East Fork Poplar Creek
- Ecosystem Consequences of High Geological Complexity
- Partnership with City of Oak Ridge, Bechtel Jacobs Company, LLC, and DOE on Biosolid Landfarming for Carbon Research

Area 7
Planned research areas:
- Carbon Experimental Site, Wetland
- Carbon Biogeochemistry in High-Fertility, Hydric Environments
- Role of High-Productivity Habitats in Wildlife Conservation

Area 8
Proposed research areas:
- Ecosystem Processes (Carbon Sequestration, Biodiversity, Wildlife, Non-Native Invasive Species) in High-Contrast Landscapes (Dry Ridges, Wet Valley Bottoms)

Planned research areas:
- Ecosystem Processes (Carbon Sequestration, Biodiversity, Wildlife) in High-Contrast Landscapes (Dry Ridges, Wet Valley Bottoms)

Area 9
Planned research areas:
- Carbon Experimental Site, Pine Ridge Replicate Experimental Catchments
- Ecosystem Processes (Carbon Sequestration, Biodiversity, Wildlife, Non-Native Invasive Species) in High-Contrast Landscapes (Dry Ridges, Wet Valley Bottoms)
- Biomass Recovery Plots

Area 13
Proposed research areas:
- Invasive Exotic Plant Species Research

Area 14
Proposed research areas:
- Invasive Exotic Plant Species Research

Planned research areas:
- Long-Term Recovery from Agricultural Impacts in Complex Terrains
- Biofuels Research and Demonstration Site
- Replicated Controls for Chestnut Ridge
- Control Area for Walker Branch Watershed and Chestnut Ridge Experimental Catchments
- Carbon Biogeochemistry in High-Fertility, Hydric Environments
- Biodiversity of Productive Riparian Areas
- Role of High-Productivity Habitats in Wildlife Conservation
- Control Area for Pine Ridge Experimental Catchments (Sandstone and Shale Soils Similar to Pine Ridge)
- Partnership with City of Oak Ridge, Bechtel Jacobs Company, LLC, and DOE on Biosolid Landfarming for Carbon Research

Area 17
Planned research areas:
- Replicated Controls for Chestnut Ridge
- Partnership with City of Oak Ridge, Bechtel Jacobs Company, LLC, and DOE on Biosolid Landfarming for Carbon Research

Area 19
Planned research areas:
- Pine Bark Beetle Recovery Area Research
- Biofuels Research and Demonstration Site
- Forest Succession Experimental Sites for Wildlife, Carbon Sequestration, Invasive Species, Biodiversity
- Carbon Experimental Site, Bethel Valley Replicated Limestone

Area 20
Planned research areas:
- Y-12 Partnership Area, Carbon Sequestration Demonstration Site, Biomass and Soil Carbon Experimental Facility
- Recovery of Soil Carbon and Biodiversity on Ash Fields
- Partnership with City of Oak Ridge, Bechtel Jacobs Company, LLC, and DOE on Biosolid Landfarming Sites for Carbon Research

Area 21
Planned research areas:
- Carbon Experimental Site, Valley Bottom
- Biofuels Research and Demonstration Site
- Carbon Biogeochemistry in High-Fertility, Hydric Environments
- Biodiversity of Productive Riparian Areas
- Role of High-Productivity Habitats in Wildlife Conservation
- Control Area for Pine Ridge Experimental Catchments (Sandstone and Shale Soils Similar to Pine Ridge)

- Bethel Valley Agricultural Land Use Impacts and Carbon Sequestration Research Area
- Pine Bark Beetle Recovery Area Research
- Forest Succession Experimental Sites for Wildlife, Carbon Sequestration, Invasive Species, Biodiversity

Area 22
Proposed research areas:
- Large-Scale Catchment Study Area
- Forest Succession Experimental Sites for Wildlife, Carbon Sequestration, Invasive Species, Biodiversity

Planned research areas:
- Carbon Experimental Site, Bethel Valley Replicated Limestone
- Long-Term Recovery from Agricultural Impacts in Level Terrains
- Control Area for Pine Ridge Experimental Catchments (Sandstone and Shale Soils Similar to Pine Ridge)
- Bethel Valley Agricultural Land Use Impacts and Carbon Sequestration Research Area
- Pine Bark Beetle Recovery Area Research

Area 23
Proposed research areas:
- Invasive Exotic Plant Species Research

Planned research areas:
- Biofuels Research and Demonstration Site
- Effects of Current Land Management Practices on Soil and Plant Carbon Storage
- Control Area for Pine Ridge Experimental Catchments (Sandstone and Shale Soils Similar to Pine Ridge)

Area 25
Planned research areas:
- Carbon Experimental Site, Replicated Controls for Chestnut Ridge

Area 26
Proposed research areas:
- Invasive Exotic Plant Species Research

Planned research areas:
- High-Complexity Shoreline Effects on Wildlife, Biodiversity, Biogeochemical Flux Rates
- Long-Term Recovery from Agricultural Impacts in Complex Terrain
- Replicated Controls for Chestnut Ridge

Area 29
Planned research areas:
- Bethel Valley Agricultural Land Use Impacts and Carbon Sequestration Research Area
- Invasive Exotic Plant Species Research

Area 30
Planned research areas:
- Urban/Industrial Impacts on Isolated Natural Areas, Invasive Exotic Plant Species Research
- Urban/Industrial Impacts on Isolated Natural Areas, Carbon Sequestration

2.6.2.3 Environmental Partnership Areas

"Environmental Partnership Areas" are sites of special environmental significance or sites with great potential for restoration and/or mitigation where state, federal, and educational agencies are working together, or can work together, to solve environmental problems. Some of these areas are shown in Fig. 2.7.

2.6.2.3.1 State Natural Areas

In June 2001, TDEC submitted a request to DOE for expanded areas of designation. This request is being considered in the overall approach to comprehensive land-use management and mission objectives of DOE. Seven State Natural Areas were noted on the ORR in 1985 through a letter agreement between DOE and TDEC. These areas qualified as State Natural Areas because of rare plant or animal species or community types. Additional threatened and endangered species data have been collected since 1985 when the original Natural Areas were registered (Awl et al. 1996; The Nature Conservancy 1995).

To register a State Natural Area, the site must meet TDEC qualifying criteria as determined by a natural heritage evaluation and review by the State Natural Areas Advisory Committee. Registration of a State Natural Area is by a written, nonbinding registry agreement signed by the landowner and the Commissioner. Protection of the natural area is a voluntary, nonbinding conservation tool which relies on the landowner's sense of pride and stewardship; the designation can be removed if DOE decides on an alternative land use and the designation is no longer appropriate.

2.6.2.3.2 Wetland Mitigation Areas

Over 580 acres in wetlands have been identified on the ORR (see Sect. 2.4.5.3, "Wetlands"). Some of these wetlands, including one of the single largest wetlands areas, are in locations where new program construction and waste management or remedial actions may occur, resulting in direct wetland impacts. Before any activities occur that will directly impact wetlands, it is necessary to obtain federal and/or state permits or to fulfill the substantive requirements of the law in those cases where permits are waived (e.g., CERCLA actions). Individual permits issued by the federal and state governments will, in most cases, require compensatory mitigation as a permit condition. Mitigation, in the wetland regulatory context, is a sequential process consisting of (1) avoidance of wetland impacts, (2) minimization of wetland impacts, and (3) if impacts are unavoidable, compensatory mitigation. Compensatory mitigation includes wetland restoration and wetland creation.

Bethel Valley Pre-Impact Wetland Mitigation Evaluation. In 1999, ten sites in the Bethel Valley area of the ORR were evaluated with respect to their potential for pre-impact wetland mitigation (Durr 1999). Of these ten areas, the potential for success was ranked as "high" for three areas, "medium" for two areas, and "low" for the other five areas. There are not extensive areas of high-quality wetland mitigation opportunities in the Bethel Valley portion of the reservation. Most reliable water sources are positioned within narrow, steep-sided hollows that offer little potential for lateral expansion with highly porous native soils that do not have the physical capacity to remain saturated for extended periods of time. However, at least 7.5 to 8 acres were determined to be suitable for small-scale wetland creation/ enhancement projects, most requiring a relatively minor amount of earth moving to convert them to jurisdictional wetlands. An additional 8 acres of bottomland were identified that are more marginal. With extensive work, these marginal areas might be manipulated to support a dominance of wetland plant species or even open water environments, making a nice addition to the diversity of habitat within forested portions of the reservation.

The areas ranked as "high" or "medium" are shown in Fig. 2.17. Areas included in the evaluation and the potential acreages are:

(1) McCoy Branch (high) in lower McCoy Branch watershed contains approximately 1.5 acres of moderate- to high-quality creation potential, plus approximately 0.5 acres of enhancement opportunity. The area includes young palustrine forested wetlands and emergent wetlands.

(2) Jones Island Terrace (high) includes a seasonal drainage with periodically inundated terraces, plus a number of small wet depressions. This site offers the potential for approximately 3 acres of creation and another 2 acres of enhancement of existing wetlands. Because of the site's close proximity to the Clinch River, small open-water areas that can be used as feeding stations by migratory waterfowl are possible as well.

(3) Hembree Cemetery wetland in upper McNew Hollow (high) is a small, but high-quality palustrine forested/palustrine scrub-shrub area with approximately 0.75 acres of combined creation and enhancement potential.

(4) Melton Branch area (medium) is approximately 1.8 miles upstream of the confluence with White Oak Lake, just downstream from a palustrine forested wetland. Approximately 1 acre of wetland creation is possible within the primary terrace of Melton Branch with enhancement of an additional 1.5 acres.

(5) Vanden Bulck Bridge Terrace (medium) is located along the east bank of the Clinch River about 2000 feet downstream of Vanden Bulck Bridge. Opportunities exist to create about 1 acre of wetland and enhance an additional 1 acre.

(6) Lower Raccoon Creek (low) is a tributary of the Clinch River entering the river about 6.2 km below Melton Hill Dam. The potential mitigation area lies within the flattened terraces of lower Raccoon Creek. The area contains an estimated 2 acres of low-quality mitigation opportunity.

(7) Lou Cagle Road (low) is in the upper watershed of an unnamed tributary to Clinch River. The area includes a mature palustrine forested wetland lying immediately adjacent to the unnamed tributary, but there is less than an acre of mitigation potential. There is little opportunity for lateral expansion due to relative steep topography.

(8) New Zion Cemetery (low) area currently supports a moderate high-quality palustrine forested wetland. The potential mitigation site is about 500 feet southwest of the New Zion Cemetery in the upper watershed of an unnamed tributary to the Clinch River below Melton Hill Dam. The only possibility for mitigation is immediately adjacent to existing wetland areas.

(9) Friendship Cemetery (low) is near the Bearden Creek Bridge on Melton Valley Drive. It includes an unnamed tributary to Bearden Creek. It presents a number of low-quality wetland creation opportunities that total less than 1 acre.

(10) Bearden Creek (low) area encompasses a large flat at the upper end of the Bearden Creek watershed. The location contains a limited number of small depressions that support a dominance of hydrophytic vegetation and wetland hydrology, but it is less than 1 acre.

One approach to compensatory mitigation is pre-impact wetland mitigation, which is undertaken to compensate for unavoidable wetland losses in advance of development actions. Among the advantages

of pre-impact mitigation are (1) a greater potential for a successful mitigation project that effectively replaces wetland functions; (2) a reduction in permit processing times; and (3) the economies of scale relating to the planning, implementation, monitoring, and management of mitigation projects.

The U.S. Army Corps of Engineers, the EPA, the U.S. Fish and Wildlife Service, the Natural Resources Conservation Service, and the National Marine Fisheries Service issued final policy guidance regarding the establishment, use, and operation of mitigation banks (*Federal Register* 60, No. 228, November 28, 1995). The establishment of a pre-wetland mitigation on the ORR would require the involvement of several federal and state agencies, including the Corps of Engineers, EPA, Fish and Wildlife Service, and National Marine Fisheries Service, as well as the TDEC, TWRA, and TVA.

2.6.2.3.3 Wildlife Habitat Restoration

The TWRA has initiated a cooperative effort with TVA and Quail Unlimited to improve the wildlife habitat under TVA electrical distribution lines on the ORR by restoring native, warm season grasses. An approximately 70-acre demonstration plot was treated in 1998 with plans to convert additional acreage annually. Habitat improvement will enhance conditions for both resident wildlife and migratory birds, provide soil erosion control, and lower power line right-of-way maintenance needs. The habitat improvement will benefit quail, turkey, ground-nesting birds, rabbits, songbirds, snakes, mammalian predators, and other mammals. Some neotropical migratory birds are especially in need of this native grass habitat. Additionally, TWRA has plans to continue restoration of wildlife species and habitats such as Freels Bend.

The Environmental Sciences Division of ORNL has also initiated programs to improve the habitat on the ORR. One program is aimed at the restoration of some of the disturbed areas on the ORR (e.g., decimated pine plantation areas that resulted from recent outbreaks of the southern pine beetle). These areas will be prepared for restoration (e.g., removing fallen pine tree debris) and, in some cases, tilling the soil. Following the site preparations, a variety of grass communities will be planted that are designed to emphasize different management goals. These goals include improved wildlife habitat, erosion control, aesthetic beauty, and biomass production. Some areas that are prepared will also be left to naturally re-vegetate to promote native grass communities that currently exist on the ORR. These sites will serve as both test plots and demonstration areas and will be located along Bethel Valley Road (see Fig. 2.7). Supplementing this native grass restoration program will be an effort to target selected areas to remove invasive non-native plant species. The spread of these exotic species threatens rare native species that are currently protected on the ORR and are a threat to the overall diversity of the ORR. Such species as kudzu, privet, and nepal grass will be targeted with a combination of mechanical and herbicidal treatments, with an emphasis on the natural areas identified on the ORR. As part of this effort, a partnership of ESD, TVA, and TWRA has targeted some transmission line right-of-ways for treatment, with supplemental replacement planting using native low-growing shrubs.

2.6.2.4 Waste Management Facility

Reservation land is also needed for the EM Transuranic Waste Processing Facility (Fig.2.17), which is in progress.

2.6.2.5 Future Initiatives

Land for future initiatives may not have specific projects associated with it. Diverse physical characteristics and the evaluation of proposed sites for past projects are factors used to identify suitability of such lands for future initiatives. Some of the general land areas identified for future needs are shown in Fig. 2.17.

Associated with reservation management are a number of infrastructure needs which are identified in Table 2.3.

Table 2.3. Oak Ridge Reservation infrastructure needs ($ in 000s)

Project	Estimated cost	Funding year
ORR communications system	6,000	FY 2002
Wildland fire equipment trailer	15	FY 2002
Upgrades to road barricades/signs	165	FY 2002
Repair and maintenance of secondary roads	3,700	FY 2002–11
Bethel Valley Road upgrades	3,000	FY 2003–05
Lambert Quarry fencing	165	FY 2003
Dump/tow vehicle	62	FY 2003
4 x 4 3/4-Ton truck with fire tank	35	FY 2003
D7 Bulldozer	425	FY 2004
Boundary fence upgrades	500	FY 2004
Bethel Valley Road/Highway 95 intersection	3,000	FY 2005
Road grader	140	FY 2005
D4 Bulldozer	125	FY 2006
Trackhoe excavator	200	FY 2007
4 x 4 3/4-Ton truck with fire tank	35	FY 2007
Hydroseeder vehicle	115	FY 2008
Backhoe excavator	60	FY 2009
Total	17,742	

2.6.2.6 Transportation Improvements

The following projects on the ORR have been identified as proposed by the Tennessee Department of Transportation:

- Highway 58 widening from I-40 to the Highway 58/95 intersection (initiated)
- Highway 58 widening from the Highway 58/95 intersection east (proposal pending to DOE)

2.6.2.7 Education and Recreation

In 2001 DOE signed an agreement with the City of Oak Ridge for a greenway on Old Bethel Valley Road. Due to security upgrades, this greenway has been put on hold.

2.6.2.8 Land Transfers/Lease Areas

Areas identified by DOE that have recently been, or will soon be, leased or released are shown in Fig. 2.17. They include the following:

Private-Sector Research Facilities: As described in Sect. 3.4.1, up to 25 acres of DOE property at the ORNL site will be transferred to the private sector to allow for construction and space rental of research and office facilities for continuing the DOE mission at the site. Repurchase of this land by DOE at a specified time in the future will be provided for in the deed language.

Industrial Development: Areas that have been leased or may be leased, licensed, or transferred for industrial development have been identified. These do not include facilities within the ETTP developed area. Actions include

- Parcel ED-1 [leased April 1998 to the Community Reuse Organization of East Tennessee (CROET) for industrial development; DOE is currently considering a proposal to sell the parcel]
- Tower Shielding Facility (26 acres leased 1998 to BioNeutrics, Inc.)
- Parcel ED-2 (15 acres leased to CROET)
- Parcel ED-3 (450 acres currently under review for leasing to CROET)
- Parcel G
- Shoreline/floodplain along Boeing property (sold to the City of Oak Ridge, 2001)
- Water Treatment Plant and associated facilities (transferred to the City of Oak Ridge, 2000)
- American Museum of Science and Energy (currently under review for transfer to the City of Oak Ridge)

2.6.2.9 Oak Ridge Institute for Science and Education

The Oak Ridge Institute for Science and Education (ORISE), which is managed for DOE by ORAU, includes the 223-acre Scarboro Operations Site on the ORR. ORAU also manages several ORISE sites in downtown Oak Ridge, as shown in Fig. 2.2. DOE granted an easement to the Tennessee Department of Transportation for highway construction on the 24 acres east of Scarboro Creek, and it has been proposed to transfer about 20 acres immediately west of the creek to the City of Oak Ridge. The remaining 203 acres, and the structures located on them, will be adequate for ORISE's current operations in support of the DOE mission. Because no ORISE town site includes developable land, the Scarboro site is the only land now available to accommodate future growth.

2.6.3 Maps - Future Land Use on the Oak Ridge Reservation

Maps included in this document were prepared on MapInfo software using data from the ORNL SDI. The SDI database was updated with data from ORNL and other subcontractors, as available. Table 2.4 lists the categories contained on the future land use map.

2.7 STAKEHOLDER INPUT

2.7.1 Stakeholder Definition

Recognizing that ORNL, ETTP, and the Y-12 National Security Complex have differing missions and diverse stakeholders, DOE requested that each site establish and implement a tailored stakeholder involvement plan.

ORNL stakeholders include those who use the land for DOE mission activities, those who fund activities on the ORR, those with state or federal regulatory interest, neighbors who may be impacted by land use decisions, and those with a perspective on regional/national/international impacts of ORR land use decisions.

2.7.2 Process for Input

Earlier *ORNL Land and Facility Plans* incorporated stakeholder input from the DOE Environmental Management's Future Use Initiative or "Common Ground" process (The Nature Conservancy 1995), as appropriate, during the plan development. Comments were also received from individuals and

Table 2.4. ORNL future land use map

Fig. no.	Category	Main components
2.17	New research facilities	Spallation Neutron Source Center for Nanophase Materials Sciences Joint Institute for Neutron Sciences East Campus West Campus 7600 Area 7900 Area Future Research and Development Facilities NOAA Meteorological Research Tower
	Research areas	Proposed research areas Planned research areas
	Environmental partnership areas	Wildlife Refuge Pre-Impact Wetland Mitigation Areas Native grass restoration
	Waste management area	Transuranic Waste Processing Facility
	Transportation improvements	Highway 58 Widening
	Land transfers/lease areas	BioNeutrics, Inc. Parcel ED-1 (Horizon Center) Parcel ED-2 Parcel G Water Treatment Plant Parcel ED-3 (proposed) DOE shoreline (sold) Private Sector and State of Tennessee Facilities American Museum of Science and Energy

agencies on the draft plans and were incorporated, as possible. The DOE Land Use Planning Process, initiated in August 2001, is now providing a mechanism for updated input. Suggestions received as part of this process will reflect more current thoughts and ideas from ORNL stakeholders. Input for this update of the *ORNL Land and Facility Plan* has been and will be solicited as described in Appendix D. Additionally, a copy of the plan is located in the DOE Public Reading Room.

2.7.3 Use of Input

Recognizing that land and facilities planning is not a static process, solicitation of tailored ORNL stakeholder responses will be ongoing. Input received subsequent to publication will be incorporated in update documents.

All input is or will be evaluated for compatibility with the *ORNL Land and Facilities Plan.* Where appropriate and possible, these responses have been or will be incorporated into current and future land use planning.

Land use planning is an opportunistic and dynamic process. Through the ORNL Land and Facilities Use Committee, additional comments, ideas, and suggestions will be evaluated in a timely manner and will be reviewed through the RMO and DOE Reservation Management Team, as required.

3. ORNL INTEGRATED FACILITIES PLAN

3.1 PURPOSE

Excellence in Laboratory operations is one of the three key goals of the Oak Ridge National Laboratory (ORNL) Agenda. That goal will be met through a comprehensive upgrade of facility conditions and operational approaches over the next few years. This ORNL Integrated Facilities Plan is designed to provide a summary of the critical components of that upgrade process, outline the cost and schedule associated with implementing the plan, and document the basic facilities information necessary to properly manage the U.S. Department of Energy (DOE) assets at this site. The plan serves many planning functions for ORNL, as well as for multiple DOE and public stakeholders; therefore, it is an integrated document that represents input from a variety of data sources that can be consulted for more detail on any given technical topic. New information contained in this year's plan includes (1) specific plans for implementing activities associated with the just-completed Facility Environmental Vulnerability Assessment (FEVA) (Sect. 3.2.3.2.2), (2) a more detailed review of facilities operations and maintenance costs (Sect. 3.2.3.2.5.2), (3) an overview of the recently implemented Facility Management Model for ownership and operations of all ORNL facilities (Sect. 3.2.3.2.5.1), and (4) an overview of the Laboratory's energy efficiency and environmental sustainability goals (Sect. 3.2.3.2.5.6).

This Integrated Facilities Plan is structured to provide a current inventory and condition summary of all of the supporting ORNL facilities (Sects. 3.2.1 and 3.2.2), a brief review of the current ORNL program mission areas and needs (Sect. 3.2.3), and a brief overview of the ORNL site planning methodology used for infrastructure decision making (Sect. 3.3). Following this baseline information, future planning for ORNL facilities improvements is outlined in Sect. 3.4, with overall cost and schedule data provided in Sect. 3.5. Conclusions and recommendations are summarized in Sect. 4. Detailed data sets and project listings supporting the plan are provided in the appendices.

The plan references documents and other management systems whenever possible to assure a cogent, comprehensive presentation of appropriate information within the context of this plan. Users, therefore, should access the referenced documents for detailed information. Table 3.1 is a listing of key planning documents/databases that support this plan. Appendix F provides a description of the contents of each of the listings in Table 3.1. The *ORNL Land and Facilities Plan* will be updated periodically to assure the most current planning base; however, general plant project (GPP), Line Item (LI), and general-purpose equipment (GPE) projects, schedules, and funding are continually revised to meet the current needs of the Laboratory. The Infrastructure Planning Division Web Site (http://www.ornl.gov/camext/) will provide the most current planning base decisions and funding allocations.

3.2 SITE AND PROGRAM DESCRIPTION

UT-Battelle manages the site and programs both functionally and cost effectively in support of the Laboratory Agenda for excellence in science and technology; excellence in Laboratory operations and environment, safety, and health (ES&H); and excellence in community service. Each of these agenda initiatives at ORNL requires a variety of facility types, systems, and equipment to conduct research and support functions. ORNL currently has one of the oldest physical plants in the DOE laboratory system, which requires efforts to maintain, renovate, and rehabilitate general-purpose buildings and utility systems, as well as to provide new mission-related facilities for expanded scientific endeavors.

Table 3.1. List of organizational contacts for documents/databases

Document/Web Address	Organizational Contact	Bldg./MS	Phone	UID*
Comprehensive Integrated Planning Process for the Oak Ridge Operations Sites (September 1999) (http://www.ornl.gov/~dmsi/cip/)	P. D. (Pat) Parr UT-Battelle	Bldg. 1505/MS 6038	576-8123	par
ESHQ&I Management Plan Information System (http://svr1.cmo.ornl.gov/eshwc/wc.dll?eshweb~TopPage)	P. E. (Patty) Cox UT-Battelle	Bldg. 1000/MS 6302	576-4183	pcx
Environmental Management Program Life Cycle Baseline (http://www.bechteljacobs.org/busmgt/baseline/Baselines.html)	N. J. (Nancy) Montgomery Bechtel Jacobs Company, LLC	Bldg. K-1225/MS 7293	576-4010	njm
ESHQ&I Budget Formulation Submission for ORNL (http://www.ornl.gov/camext/CAMIndex.htm)	P. E. (Patty) Cox UT-Battelle	Bldg. 1000/MS 6302	576-4183	pcx
ESHQ&I Management Plan and Execution Plan for ORNL (http://www.ornl.gov/camext/CAMIndex.htm)	R. J. (Rick) Forbes UT-Battelle	Bldg. 1000/MS 6302	574-5490	rfs
ORNL Facility Index (http://www-sap.ornl.gov/scripts/wgate/ ZKWWW_FACINDEX/!?_FUNCTION=Z_K_WWW_FACINDEX_MENU)	D. (Dave) Kennard UT-Battelle	Bldg. 1000/MS 6302	574-9282	k33
ORNL Institutional Plan (http://www.ornl.gov/inst_plan/IP_Outline.html)	D. P. (Debbie) Stevens UT-Battelle	Bldg. 4500N/MS 6251	574-4763	svn
ORNL Laboratory Agenda (http://home.ornl.gov/offices/strategic_planning/stratplan/labagenda/lab_agenda.htm)	M. B. (Bonnie) Nestor UT-Battelle	Bldg. 4500N/MS 6251	574-4173	mnj
ORNL Land and Facilities Plan (http://www.ornl.gov/~dmsi/landUse/)	A. R. (Tony) Medley, UT-Battelle P. D. (Pat) Parr, UT-Battelle	Bldg. 1000/MS 6302 Bldg. 1505/MS 6038	574-9156 576-8123	arm par
Oak Ridge Reservation Annual Site Environmental Report (http://www.ornl.gov/Env_Rpt/aser2000/aser2000.htm)	J. F. (Joan) Hughes UT-Battelle	Bldg. 4500S/MS 6137	574-6649	fhu
Oak Ridge Reservation Management Plan (http://home.ornl.gov/general/orrmp/)	P. D. (Pat) Parr UT-Battelle	Bldg. 1505/MS 6038	576-8123	par
ORNL Strategic Facilities Plan (http://www.ornl.gov/~dmsi/strategic_plan/index.html)	T. E. (Tim) Myrick UT-Battelle	Bldg. 1000/MS 6336	241-4597	uyt
ORNL Parking Lot and Traffic Flow Plan (http://www.ornl.gov/~dmsi/parking/)	F. S. (Faye) Brewer UT-Battelle	Bldg. 1000/MS 6302	241-4710	sni

*Users external to ORNL should add the extension @ornl.gov to all UIDs (e.g., par@ornl.gov).

Modernization of the Laboratory's infrastructure through support by DOE programs, the commitment of the State of Tennessee to build three new buildings, and the commitment of UT-Battelle to enable private-sector development of three new facilities is the focus of the ORNL Facilities Revitalization Project (FRP) documented in ORNL/TM-2000, *Oak Ridge National Laboratory Strategic Facilities Plan for Making ORNL a 21st Century Laboratory*.

3.2.1 Current Facilities and Uses

ORNL's main site encompasses approximately 1100 acres in the Bethel (Fig. 3.1) and Melton (Fig. 3.2) valleys, approximately 10 miles southwest of the center of the City of Oak Ridge, Tennessee, with additional facilities located on the adjacent Copper Ridge (Fig 3.3). ORNL also occupies space at the Oak Ridge Y-12 National Security Complex (Fig. 3.4), leases some space off-site, and manages some space for DOE functional activities (e.g., the American Museum of Science and Energy). An approximately 90-acre site on Chestnut Ridge north of the main ORNL site is currently being developed for the Spallation Neutron Source (SNS). ORNL has responsibility for management of a 21,076-acre portion of the approximately 34,235-acre ORR, including ORNL facilities and most of the 20,000-acre Oak Ridge National Environmental Research Park. The ORNL site has many functions and requirements similar to those of a small city. It is supported by a dedicated fire department, a medical center, a security force, and a steam plant. Amenities include 180 miles of roads, 34 miles of overhead power lines, 27,000 feet of steam lines, 100,000 feet of treated water piping, and about 225 acres of mowed grounds.

As indicated in Table 3.2, buildings at the main site in Melton Valley, Bethel Valley, and Copper Ridge comprise approximately 3.6 million gross square feet of building space. At the Y-12 National Security Complex, ORNL use accounts for 0.9 million square feet, with the remaining space leased or made available through operating contracts (approximately 0.3 million square feet). At the Y-12 National Security Complex, ORNL has responsibility for building maintenance and ES&H functions as approved by Memoranda of Understanding (MOUs) between ORNL and Y-12. ORNL is actively reducing the square footage of space used at Y-12 by transitioning operations to the ORNL main site and placing facilities in cheap-to-keep status or transferring facilities to the Y-12 operating contractor.

Table 3.2. ORNL space distribution

	Buildings		Trailers		
Location	**Number**	**Space, ft^2**	**Number**	**Space, ft^2**	**Total space, ft^2**
ORNL main site					
UT-Battelle (DOE-SC)	329	2,991,676	48	44,096	3,035,772
UT-Battelle (DOE-	1	37,191	—	—	37,191
Bechtel Jacobs	130	445,482	34	30,118	475,600
Subtotal, ORNL main site	460	3,474,349	82	74,214	3,548,563
ORNL off-site:					
AMSE	3	56,583	1	552	57,135
ORNL at Y-12	16	1,137,738	1	680	1,138,418
Leased off-site	5	297,064	—	—	297,064
Total	**484**	**4,965,734**	**84**	**75,446**	**5,041,180**

[a]The National Nuclear Security Administration's Deputy Administrator for Defense Programs owns Building 3019A.

The National Transportation Research Center (NTRC), a partnership of DOE, ORNL, and UT, provides a mechanism for promoting and supporting research activities focused on major transportation research and development (R&D) issues related to energy, environment, and security for the nation and the world. It is located in a new facility in Knox County, between ORNL and UT's Knoxville campus, that was constructed through a collaborative effort involving DOE, ORNL, UT, and the Development Corporation of Knox County. The NTRC was formally designated a national user facility in FY 2001.

UT-Battelle is moving forward with implementation of a plan to ensure the financial stability of the American Museum of Science and Energy (AMSE). In response to the plan's recommendations, DOE has agreed to transfer the museum and the surrounding property to the City of Oak Ridge. DOE has also completed an environmental assessment associated with the museum's proposed transfer. Three of DOE's largest contractors have agreed to provide five-year bridge funding for the museum. The city has hired a consultant to determine the best means of managing the museum. UT-Battelle continues to work with DOE and the City of Oak Ridge to secure the museum's future for the community.

Of the 3.6 million gross square feet of building space at the main site, approximately 0.5 million square feet has been transferred to Bechtel Jacobs Company, LLC, under the management and integration (M&I) contract for Environmental Management (EM). Bechtel Jacobs Company, LLC, manages the EM Program and waste management systems at the ORNL main site.

Facility use designations are identified in Figs. 3.1– 3.4. Of the total square footage of ORNL facility space, 16% is for administration and support functions (including vacated facilities being dispositioned), 18% is designated as multiprogram support, 20% is for physical science programs, 6% is for biological and environmental sciences programs, 21% for energy and engineering sciences programs, 1% for computing and computational sciences programs, 2% for the Spallation Neutron Source program, and 16% for Bechtel Jacobs Company, LLC, programs for EM projects and waste services. Space usage within the facilities is shown in Fig. 3.5.

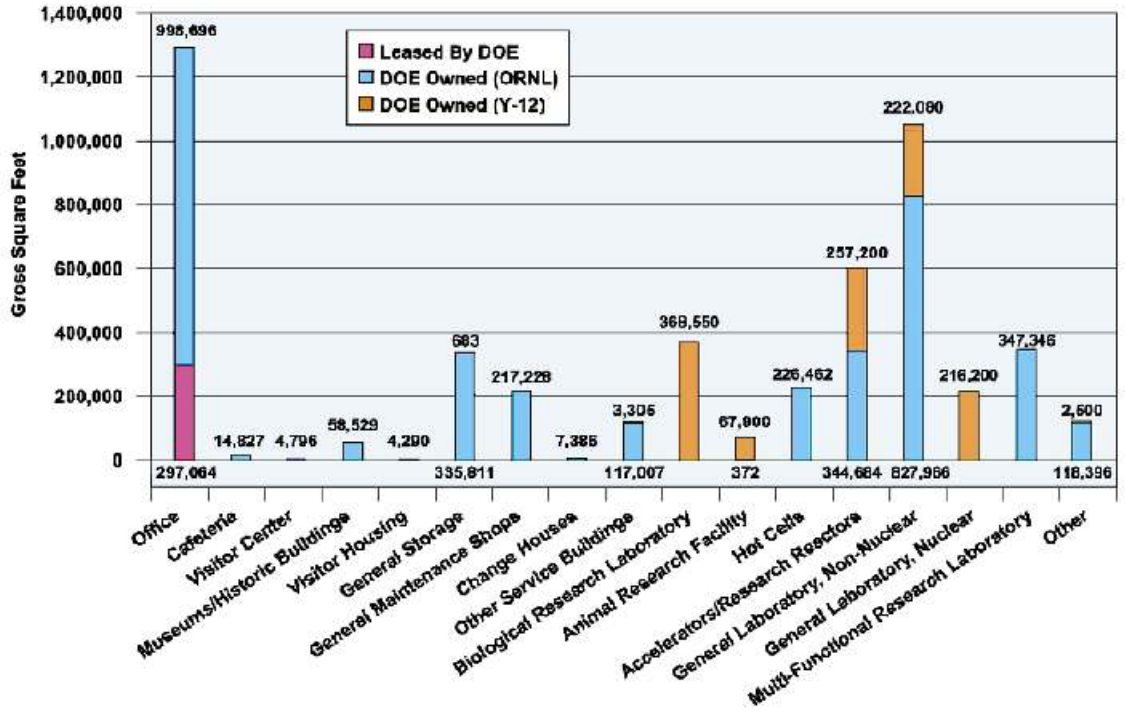


Fig. 3.5. Use of ORNL space.

3.2.2 General Infrastructure Conditions

UT-Battelle has the responsibility to ensure that scientists and engineers conduct first-rate scientific research in modern and efficient facilities with state-of-the-art equipment and instrumentation. The overall condition of the ORNL space is shown in Figs. 3.6 and 3.7. The condition assessment surveys provide data regarding adequacy of the facilities to meet intended uses. Approximately 33% (or 1.2 million square feet) of the ORNL site facilities is in good to excellent condition for intended uses, with the remaining in need of modernization or replacement. The Facilities Revitalization Project has scheduled the replacement and/or modernization of facilities to increase the amount of space in good to excellent condition to 70% (or 2.48 million square feet) by FY 2009. Photographs of some of the representative substandard facilities are provided in Figs. 3.8 – 3.11. A summary of building age is shown in Fig. 3.12 and indicates that the majority of buildings are over 30 years old.

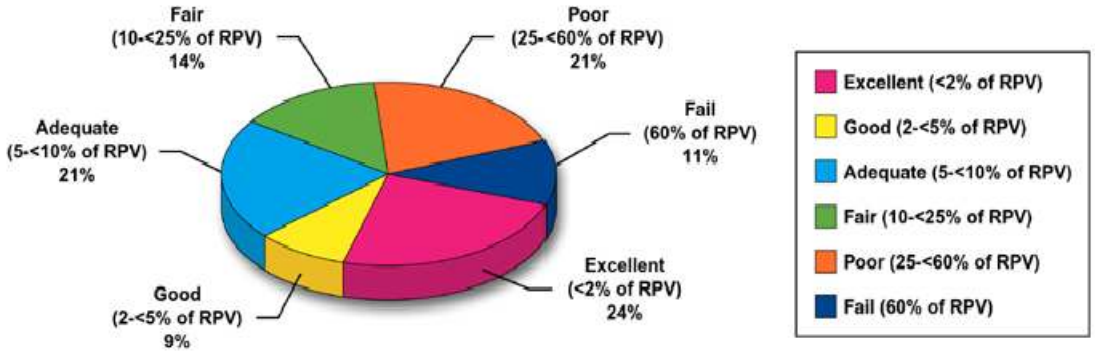


Fig. 3.6. Condition of space at ORNL.

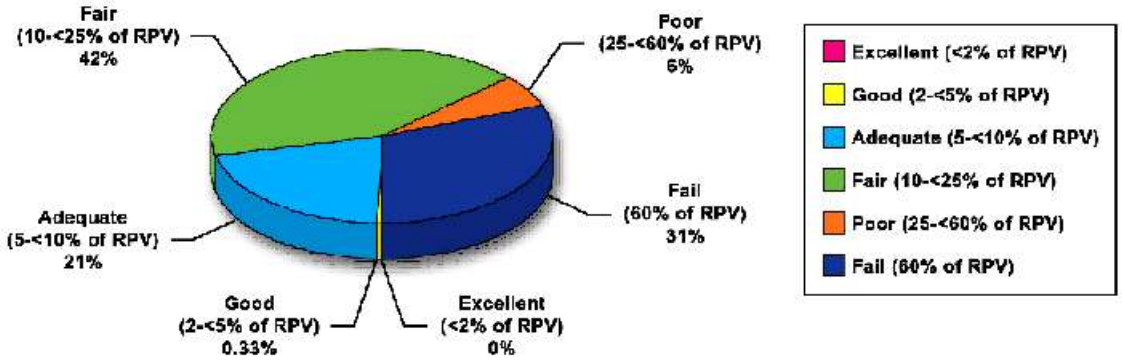


Fig. 3.7. Condition of ORNL space at Y-12.

ORNL actively uses the Condition Assessment Information System (CAIS) to document facility condition. Replacement plant value (RPV), defined as the cost for replacement of a building/facility to include fixed equipment, is presented in Table 3.3.

Table 3.3
Estimated replacement plant value (RPV) for ORNL main site (in millions of FY 1997 dollars)

Facility type	Replacement cost
Buildings and structures	3,550
Utility systems	650
All other	300
Total	**4,500**

To support research activities, a wide variety of infrastructure systems are in place across the Laboratory. Similar to the research facilities, they are in various stages of deterioration due to age. These systems include utilities (electrical, gas, compressed air, potable/process water, chilled water, steam, industrial gases, HVAC, stormwater collection, and telecommunications); transportation infrastructure (roads and parking areas); security (fencing, portals, building access controls); fire protection; and waste management (conventional and hazardous). Appendices G through K provide more detailed descriptions of the conditions and needs in each of these areas. It is important to understand that these infrastructure systems are critical to the mission of the Laboratory and must receive equal attention in revitalization planning.

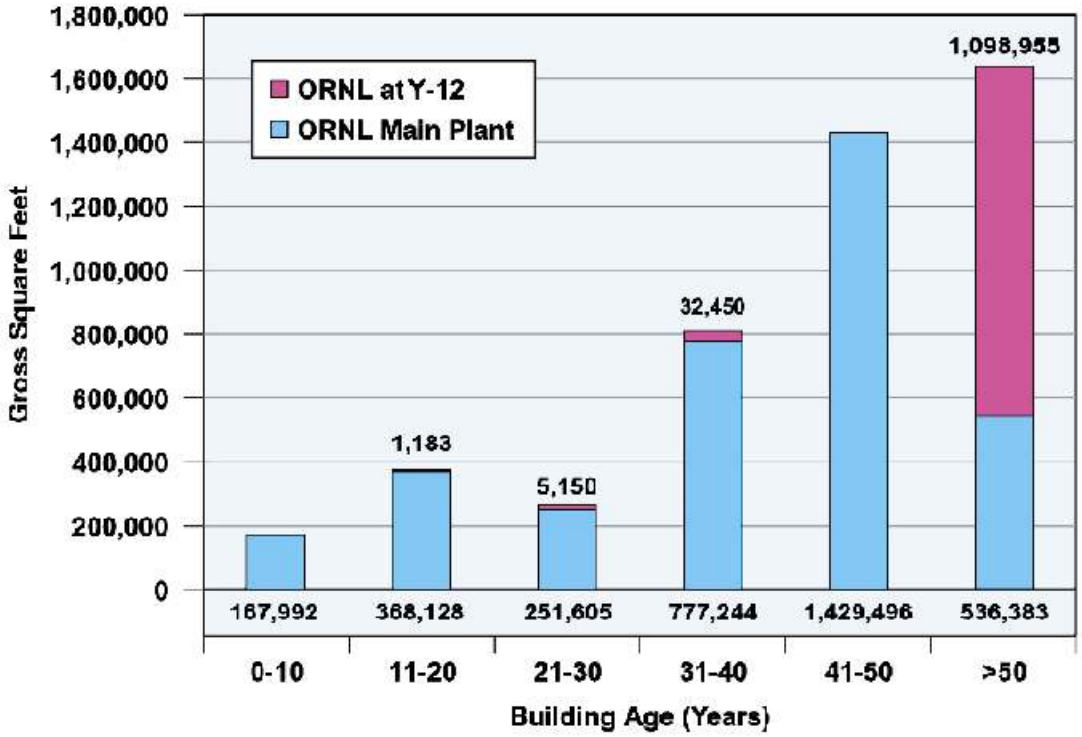


Fig. 3.12. Age of ORNL buildings.

The systems having the greatest need for refurbishment or replacement as part of the Laboratory's modernization initiatives are those related to facility conditions identified in the Facility Environmental Vulnerability Assessment and to other general upgrades of the electrical distribution system, process/chilled water systems, ventilation and exhaust systems, transportation infrastructure, and security. Many of the upgrades are driven by health and safety requirements that can no longer be met by 35- to 50-year-old electrical or heating, ventilating, and air-conditioning (HVAC) equipment, or for which reliability concerns cannot be tolerated (e.g., the primary potable water systems). Underground piping for water and waste systems is a primary health and safety concern being addressed by the Facility Environmental Vulnerability Assessment Recommendation Implementation (FEVARI) project. Roadways and parking are becoming an important issue as related to security improvements, safety improvements for entrances, and parking associated with new facility construction and the open campus initiatives. Similarly, site security upgrades are required due to changes in DOE's approach to operations, as well as UT-Battelle's desire for a more open campus environment as part of Laboratory revitalization efforts. Projects related to these initiatives are identified in Sect. 3.4 of this plan.

3.2.3 ORNL's Programmatic Direction and Needs

Trends in ORNL's site and facilities management and planning are driven by the need to develop an integrated research campus for the 21st century. To support the programmatic direction of research, the key issues include (1) relocation of ORNL organizations at Y-12 to the main ORNL site, (2) upgrades and modifications to existing laboratory and experimental space to better facilitate R&D activities, (3) upgrades and replacement of site and facility utility systems, and (4) disposition of inactive/surplus facilities. Traditional funding sources for infrastructure include GPP and GPE budgets, programmatic Line Items, and DOE's Multiprogram Energy Laboratory Facility Support (MEL-FS) Program. To assist ORNL's needs for programmatic facility modernization, innovative arrangements have been established to add funding sources from the State of Tennessee and the private sector. Sect. 3.4, the Master Plan planning description, provides a detailed listing of all projects supporting both programmatic and general landlord maintenance and upgrades.

3.2.3.1 Science Programs

To extend the nation's capabilities in key areas of science and technology, ORNL is pursuing major research initiatives in neutron sciences, complex biological systems, terascale computing and simulation science, energy and environmental systems of the future, and advanced materials. The University Partnerships Initiative is aimed at increasing the value of ORNL's science and technology through active involvement of university faculty and students in Laboratory programs. These initiatives are captured in the Laboratory Agenda and described in detail in the *ORNL Institutional Plan*. A brief overview of these initiatives is presented below, organized by Laboratory research directorates. Needs for new facilities to support research initiatives are summarized in Table 3.5 at the end of this section (p. 3-38).

3.2.3.1.1 Physical Sciences

HFIR Upgrade. ORNL is engaged in a Neutron Sciences Initiative to ensure that the Laboratory continues its stewardship of neutron science in support of DOE's missions. This initiative has two major elements: (1) design and construction of the SNS, a next-generation spallation neutron source facility, in collaboration with five other DOE national laboratories and (2) upgrades and refurbishment of the High Flux Isotope Reactor (HFIR), which will greatly enhance the neutron science capabilities of the world's highest-power research reactor and will extend its life well into the 21st century. An overview of the SNS follows in Sect. 3.2.3.1.2.

The HFIR is among the world's best research reactor facilities. Its flexible design allows it to serve multiple missions—neutron scattering, isotope production, materials irradiation, and neutron activation analysis—and, when operating at 85 MW, HFIR produces the world's highest peak thermal neutron flux, 2.3×10^{15} neutrons per square centimeter per second.

HFIR was shut down October 1, 2000, for a beryllium reflector replacement. The outage provided an outstanding opportunity to install larger beam tubes and new and improved instrumentation for neutron scattering. On November 30, 2001, ORNL received DOE approval to restart HFIR, and, currently, operations are resuming.

Improvements to HFIR's research capabilities will continue during FY 2002 and FY 2003. Basic Energy Sciences has provided $3 million for the construction of the Small-Angle Neutron Scattering (SANS) Guide Hall and is also supplying support for the installation of the cold-neutron source and instrumentation. These endeavors will be completed during FY 2002 and FY 2003. The SANS Guide Hall will provide the necessary space to support a new 20-m SANS instrument and a new 16-m biological SANS instrument, which will be dedicated to biological research. The cold neutron source will allow HFIR to support leading-edge cold-neutron research that could result in key new discoveries and applications involving polymers, plastics, alloys, and biochemical systems.

The performance of the upgraded HFIR will be comparable to the best in the world for cold and thermal neutron scattering. It will have 15 state-of-the-art neutron scattering instruments with thermal or cold-neutron beams with intensities equivalent to the world's best. Its neutron scattering capabilities will complement those of the SNS and will help restore U.S. leadership in neutron science. In addition, the upgraded HFIR will maintain its exceptional capabilities for isotope production, materials irradiation, and neutron activation analysis.

A large neutron guide hall that would extend the HB-2 beam line to as many as 15 instruments and would allow many more users to be accommodated has been proposed. This guide hall would provide more space for instruments in a low-background area outside the reactor building. It would also provide office and laboratory space for outside users and ORNL researchers. Other proposed changes would improve access for radioisotope production and would enhance the neutron activation analysis mission.

Advanced Materials Initiative. ORNL's Advanced Materials Initiative is aimed at sustaining ORNL's position as an excellent advanced materials R&D laboratory supporting DOE's missions. The initiative includes the development of a recognized capability in nanoscale science, engineering, and technology; the development of extraordinary tools for materials characterization and the extension of ORNL's capabilities for synthesis and processing; the establishment of the Center for Nanophase Materials Sciences; and the construction of a new Advanced Materials Characterization Laboratory (AMCL).

The Center for Nanophase Materials Sciences. The Center for Nanophase Materials Sciences (CNMS) will be a national facility for advancing the understanding of nanoscale phenomena in materials. It will leverage the unprecedented opportunity for new research on the structure and dynamics of nanoscale materials systems that will be afforded by the SNS and the upgraded HFIR. The focus will be on interdisciplinary research areas that benefit from access to neutron scattering, including soft materials, interfaces, nanoscale magnetism, and other nanophase systems. Research will provide the foundation for new nanotechnologies based on the systems of these materials and will optimize the use of the SNS and the upgraded HFIR for nanoscience-related research. Working through university and industry partnerships, CNMS will create an environment and provide facilities for rapid progress in interdisciplinary nanoscale science and engineering. It will also provide training for graduate students and postdoctoral associates in interdisciplinary nanoscale

science, with particular emphasis on nanoscale materials synthesis and characterization, assembly of nanomaterials systems, and fundamental understanding of nanoscale phenomena. The CNMS was approved by Basic Energy Sciences (BES) in FY 2001 and has been funded as a Line Item construction project beginning in FY 2002 (see Table 3.4). It will be housed in an 80,000-square-foot laboratory/office complex to be constructed adjacent to the SNS and the Joint Institute for Neutron Sciences (JINS). This facility will include clean rooms and specialized equipment for nanoscience research that cannot be accommodated in existing space at ORNL. The CNMS responds to the recommendations of *Nanoscale Science, Engineering, and Technology Research Directions,* a 1999 report prepared by members of the Office of Basic Energy Sciences Nanoscience/Nanotechnology Group, and will provide a unique national resource in the nanosciences. Preliminary design activities for the facility have been initiated in FY 2002. A workshop to facilitate community involvement in the planning for the Center, held in October 2001, was attended by more than 270 participants from 67 institutions.

Table 3.4. Funding profile for the Center for Nanophase Materials Sciences
Project engineering and design and construction

FY 2002	FY 2003	FY 2004	FY 2005	Total
$1,500K	$25,000K	$20,000K	$17,250K	$63,750K

Advanced Materials Characterization Laboratory. As a leader in the development of techniques and instrumentation for analysis of materials at the atomic level, ORNL has one of the nation's strongest and broadest materials sciences programs. This area is the focus of collaborative research with universities and industries across the United States. Many of these collaborations involve characterization of materials at ORNL user facilities and participation in collaborative research centers. Appropriate housing for the Laboratory's advanced analytical electron microscopes, atom probe field ion microscopes, and similar instrumentation is a high priority. This equipment is now scattered across the ORNL campus in buildings that either do not meet the manufacturers' requirements for optimum operation or are only marginally adequate. These buildings will not allow ORNL to maintain state-of-the-art instrumentation for the next generation of this equipment. Therefore, ORNL will construct an Advanced Materials Characterization Laboratory (AMCL) to address this issue. A new structure with 12,000 square feet of space, the AMCL will provide the high-quality environment required to optimize the performance of sophisticated characterization equipment essential for the next generation of advanced materials R&D. The AMCL is included in ORNL's Facilities Modernization Initiative as a GPP budget item with a cost of $4.8 million. Architects have been selected and design is under way. Construction is expected to start in the late summer of 2002. The AMCL will foster state-of-the-art materials characterization that is essential for understanding materials and materials-related processes and phenomena that underpin energy technologies and industrial endeavors. Specifically, the facility will house equipment funded by several DOE offices, primarily the Office of Science (DOE-SC) and the Office of Energy Efficiency and Renewable Energy (DOE-EE). Two of ORNL's major user programs—the High Temperature Materials Laboratory, funded by DOE-EE, and the Shared Research Equipment Collaborative Research Center, funded by DOE-SC—include a strong emphasis on electron-beam characterization and related techniques that will be supported by this facility (Fig. 3.13).

3.2.3.1.2 Spallation Neutron Source

The SNS is an accelerator-based, next-generation neutron scattering facility that is under construction on the ORR. It will produce neutron beams that are 12 times as intense as any existing pulsed source, enabling researchers to "see" never-before-observed details of physical and biological materials, ranging

from high-temperature superconductors to proteins. The SNS is the top-priority project of DOE-SC, which plays a key role in supporting DOE's goals and strategies in science (Fig. 3.14). At a total cost of $1.4 billion, construction began in FY 1999 and will be completed in FY 2006.

Other planned improvements are to develop innovative research programs that take advantage of the unique capabilities afforded by the HFIR, SNS, and other neutron facilities (including a new HFIR user support facility); to build a world-class user program that provides access to these capabilities; and to construct an $8 million facility, funded by the State of Tennessee, for the Joint Institute for Neutron Sciences (JINS).

3.2.3.1.3 Biological and Environmental Sciences

ORNL is developing a significant program in complex biological systems that builds on established programs and expertise in the life and environmental sciences. The Complex Biological Systems Initiative incorporates innovative applications of computational, physical, chemical, and engineering science, as well as special facilities and resources in analytical technologies, to advance the understanding of biological systems. This initiative engages organizations and disciplines across the Laboratory and draws on programs in comparative and functional genomics, structural biology, and computational biology and bioinformatics. It focuses ORNL's distinctive expertise and facilities in mammalian genetics, biochemistry, environmental microbiology, plant genetics, analytical technologies, computational science and applied mathematics, physical sciences, and engineering on the challenges of observing and understanding the functioning of complex biological systems. Five key areas will be pursued through the Complex Biological Systems Initiative: comparative and functional genomics, proteomics and structural biology, the microbial cell, biological systems analysis, and predictive toxicology.

A significant investment in a new Center for Systems Biology at ORNL is being initiated. The Center is planned as a modular complex of buildings, equipment, and infrastructure to house current and future research programs in functional genomics, structural biology, proteomics, and systems biology. The initial element of the Center for Systems Biology is the recently completed Environmental and Life Sciences Laboratory constructed with GPP funds. The next phase in the development of the Center is the construction of the William L. and Liane B. Russell Laboratory for Comparative and Functional Genomics (LCFG) to house the Mouse Genetics Research Facility. The LCFG, which will replace an aging building at the Oak Ridge Y-12 National Security Complex, will be constructed with DOE Line Item funding ($13.9 million). Construction completion for the LCFG is scheduled for August 2003. In addition to the mouse colony, the LCFG will include laboratories with special phenotype screening capabilities, thus supporting the ORNL Functional Genomics and Proteomics Program. In support of the mouse colony, laboratories for microinjection of mouse embryos and cryopreservation facilities will be constructed and attached to Building 1059 with GPP funding (approximately $1.2 million). The Center for Systems Biology will also encompass the Center for Structural Molecular Biology (CSMB) and the Joint Institute for Biological Sciences. The principal new capital resource needed to support the CSMB beyond 2003 is a beam line dedicated to structural biology on the SNS. Construction of a facility to house the Joint Institute for Biological Sciences will be funded by the State of Tennessee at a cost of $8 million. Figure 3.15 shows the West Campus facilities.

Building 1503 is scheduled for modification in FY 2003 at a cost of $1.5 million with GPP funding. The greenhouses and modernized laboratories to be renovated will enable researchers to develop quantitative characterizations of the structure and functional relationships among terrestrial and aquatic ecosystems, populations, and communities and a better understanding of processes affecting carbon management and carbon sequestration. Other anticipated research areas this facility will support include the toxicity evaluation of compounds to plant ecosystems and the evaluation of microbial and plant remediation

techniques for purposes of environmental management. A particularly important area also to be supported is bioenergy research in which Environmental Sciences Division (ESD) researchers are developing and demonstrating environmentally beneficial, commercially viable biomass production systems.

3.2.3.1.4 Computing and Computational Sciences

DOE's Scientific Discovery through Advanced Computing (SciDAC) Program is being developed to take the nation into a new era of information and communications technology. It will rapidly deploy computing and communications capabilities that are at least ten times faster than today's fastest systems for government, academic, and industrial use.

This capability will revolutionize current approaches to solving complex problems in energy, the environment, fundamental research, and technology development, and it will stimulate the national system of innovation. Attaining the proposed capability will demand significant advances in computational resources. Fully exploiting the power of massively parallel machines requires the creation of new programming paradigms, languages, scheduling and partitioning techniques, and algorithms. All of these elements must be integrated into systems that are accessible and useful to a diverse user community.

ORNL has been selected as the primary site for SciDAC application development and deployment. With computational power of 5.5 teraflops, ORNL is among the nation's most powerful unclassified computing facilities. In order to support the growing mission-critical computational needs of DOE, ORNL must continue to maintain state-of-the-art supercomputing and networking infrastructure. ORNL has plans to increase the capacity of its computers to 10 teraflops in FY 2003 and is currently working on a cooperative R&D agreement (CRADA) that will lead to a 180 teraflops computer in FY 2004 or FY 2005. At the current rate of advance in computing capabilities, petascale computing will be required by FY 2008 or FY 2009 to support programmatic needs.

In support of this effort, a new Computational Sciences Building (CSB) is the highest-priority building for ORNL. Plans are being finalized to construct the CSB using private funds and to lease this building. Current schedules call for the groundbreaking in early FY 2002 and occupancy of the building in mid FY 2003. The CSB will provide 40,000 square feet of state-of-the-art computer room space with another 40,000 square feet for computer science laboratories and offices.

In addition, the State of Tennessee has committed funding for a new facility to house the Joint Institute for Computational Sciences, which promotes collaborative relationships among ORNL, UT, and the UT-Battelle core universities and encourages and facilitates the effective use of high-performance computing resources in the southeastern United States. This $10 million, 50,000-square-foot building is scheduled to start construction in the summer of FY 2002, with move-in planned for late FY 2003.

With the explosive growth of computing expected over the next decade, ORNL must increase the network bandwidth linking the site with other DOE facilities to as much as a terabit per second. This requires that both the internal and external network connections to the Laboratory be upgraded. ORNL's current backbone fiber infrastructure was installed ten years ago. It was designed and architected to provide data interface service only within the main ORNL campus; it offers no service to outlying facilities and is frequently hundreds of feet from buildings where service is needed. It is essential to upgrade this infrastructure to at least 100 times the current capacity and to provide a direct feed to every major ORNL building and facility. In conjunction with this upgrade, several ORNL buildings should also be rewired with modern copper, fiber, and hubs able to support local and interlaboratory networks.

The facilities planned and under construction are expected to provide unparalleled laboratory space for computing and computational sciences. However, as DOE programs become more and more dependent on high-performance computing, the staff of the Computing and Computational Sciences Directorate is expected to continue to grow. To support expected DOE programs, ORNL will need to double the size of the staff to approximately 800 by the year FY 2011. This expansion will certainly require additional office and laboratory space.

3.2.3.1.5 Energy and Engineering Sciences

ORNL's fully integrated strategy of Energy Security, Environment, and Economics (E^3) differentiates ORNL throughout the DOE system. This focus marshals ORNL's extensive capabilities for R&D on energy production, the energy infrastructure, and critical elements of global energy security. This strategy will sustain ORNL's position as DOE's premiere energy laboratory, providing comprehensive, coordinated support across energy efficiency and fossil, fusion, nuclear, and renewable energy.

One of the new facilities needed to support this initiative is the Energy Reliability and Efficiency Laboratory (EREL). The EREL will provide expanded laboratory space, controlled testing, and analytical capabilities necessary to meet DOE's goals in three strategically important R&D areas: distributed energy resources, high-temperature superconductivity, and buildings research.

3.2.3.1.6 University Partnerships

In support of the University Partnerships Initiative, ORNL is undertaking the development of the Oak Ridge Center for Advanced Studies (ORCAS) in cooperation with Oak Ridge Associated Universities. ORCAS will serve as a center of intellectual inquiry to encourage interactions between ORNL researchers and university faculty and students. A building to be constructed with funding from the State of Tennessee will provide offices for visiting faculty, state-of-the-art distance education classrooms, and high-speed network connections to facilitate communication with the six UT-Battelle core universities and other partners. This facility will be jointly housed with the Joint Institute for Computational Sciences.

3.2.3.1.7 User Research Facilities

An important part of DOE's science mission is conceiving, constructing, and operating large-scale, complex facilities for R&D. ORNL is home to 16 designated national user facilities (more than any other national laboratory) that are available to laboratory, industrial, and academic users. Designated user facilities are the following:

- Bioprocessing Research Facility
- Buildings Technology Center
- Californium User Facility for Neutron Science
- Fuels, Engines, and Emissions Research Center
- High Flux Isotope Reactor Facility
- High Temperature Materials Laboratory
- Holifield Radioactive Ion Beam Facility
- Metals Processing Laboratory User Center
- Metrology R&D Laboratory
- Mouse Genetics Research Facility
- National Transportation Research Center
- Oak Ridge Electron Linear Accelerator
- Oak Ridge National Environmental Research Park

- Physical Properties Research Facility
- Power Electronics and Electric Machinery Research Center
- Shared Research Equipment Program

3.2.3.2 Support Programs

ORNL facilities are managed in a safe, secure, environmentally responsible manner to maximize flexibility and adaptability to enable programmatic efforts to respond efficiently to new developments and changing priorities in an increasingly dynamic research environment. The Laboratory support organizations are committed to maintaining facilities for the long term and ensuring that improvements keep pace with advancing technology and new program needs.

3.2.3.2.1 Environment, Safety, Health, and Quality

The ORNL Environment, Safety, Health, and Quality Directorate (ESH&Q) is a service provider. The principal ESH&Q products are technical support services, environmental protection and waste services, industrial medicine services, training services, and, a new major initiative, the deployment of management systems via the Standards-Based Management System (SBMS). The ESH&Q Directorate is responsible for the development and implementation of the following management systems: Environmental Management, Nuclear and Facility Safety, Occupational Medicine, Performance-Based Management, Quality, Radiological Protection, SBMS, Records and Information Management, Training and Qualification, and Worker Safety and Health.

The ESH&Q support services and management systems strengthen scientific integrity, ingenuity, and innovation by helping line organizations protect the health and safety of workers and the public, monitoring the Laboratory's impact on the environment, ensuring compliance with federal and state statutes and DOE regulations in these areas, managing permitting and operations for newly generated waste, and supporting quality and effectiveness in operations. Appendix G details the ESH&Q structure, with current activities and future needs impacting infrastructure.

3.2.3.2.2 FEVA Recommendations for Improvement

A Facility Environmental Vulnerability Assessment (FEVA) was completed and issued in June 2001. The primary goal of FEVA was to establish an environmental vulnerability baseline that could be used to support the Laboratory planning process and place environmental liabilities in perspective. The information developed by FEVA provided the basis for management to identify and initiate immediate, near-term, and long-term actions to respond to the identified vulnerabilities. Although no immediate “stop work” actions were identified, a number of near-term and long-term actions and initiatives were identified to address the FEVA recommendations. Two initiatives that the FEVARI project will fund in FY 2002 include the development of a Strategic Facilities Upgrade Plan and a Strategic Plan for the Minimization of Single-Pass Cooling Water. Current and planned Line Item projects, GPPs, and GPE projects, some of which support FEVA recommendations, are listed in Appendix M. Following development of the Strategic Facilities Upgrade Plan, projects will be identified, scoped, and documented in the ESHQ&I Information Data System. Appendix G provides specific information concerning FEVA.

3.2.3.2.3 Sustainable Designs

ORNL is committed to providing sustainable designs. The initial tool chosen to help incorporate sustainable features into ORNL projects was the U.S. Green Building Council’s Leadership in Energy and Environmental Design (LEED™) rating system. The LEED rating system helps designers and owners establish sustainable project goals, identify green design strategies, measure

and monitor progress, and document success. There are five categories within the LEED system: site planning, water and water efficiency, energy efficiency, conservation of materials and resources, and indoor environmental quality.

The LEED rating system assigns points within each of these five categories with a total of 69 total points available. There are four levels of accreditation in the LEED system:

- Certified 26-32 points
- Silver Level 33-38 points
- Gold Level 39-51 points
- Platinum Level 52+ points

Five of ORNL's FY 2002 GPP and Line Item projects used the LEED rating system to focus design activities on sustainable measures and assess the project's performance. Lessons learned during the design phases of these projects revealed that a custom ORNL sustainable process was needed. This custom process will facilitate communications between ORNL and the Architectural-Engineer design staff, emphasize energy performance, and simplify documentation requirements. This custom ORNL sustainable process is being finalized for use on future projects.

The five FY 2002 projects and their LEED goals are as follows:

- Advanced Materials Characterization Laboratory 26 points
- Laboratory for Comparative and Functional Genomics 26 points
- Research Support Center 33 points
- Energy Reliability and Efficiency Laboratory 33 points
- Parking Lots 16 points

Future projects, including new facilities and renovations, will use the ORNL sustainable system.

3.2.3.2.4 Waste Management and Environmental Restoration

Since April 1, 1998, Bechtel Jacobs Company, LLC, has conducted all of the DOE-EM operations on the ORR. In this role, Bechtel Jacobs Company, LLC, assumed responsibility for the waste management, environmental restoration, technology deployment, and enrichment facilities programs at all DOE-ORO sites (ORNL, Y-12, ETTP, Paducah, and Portsmouth). ORNL UT-Battelle is responsible for its generator functions, including waste packaging, characterization, and certification. To facilitate these functions, UT-Battelle maintains a small (core) staff with waste management experience to assist generators.

Responsibility for the ORNL EM Program resides with the ESH&Q Directorate. Under this directorate, the Environmental Protection and Waste Services Division is responsible for the EM Program Office, Environmental Protection Division, and Laboratory Waste Services Division. The Quality Services Division provides support to the Waste Certification Official. Responsibility for the Environmental Technology Development Program resides in the Biological and Environmental Sciences Directorate. The major UT-Battelle goals for the EM Program are to (1) ensure effective interface with Bechtel Jacobs Company, LLC, in the management of ORNL waste and (2) coordinate the ORNL mission, work force, and Laboratory environment as full-scale remediation in both Melton and Bethel valleys progresses in accordance with the accelerated cleanup plans.

Figures 3.1, 3.2, 3.16, and 3.17 show the facilities operated by Bechtel Jacobs Company, LLC, and Table H.2, Appendix H, provides a list, which will be updated as necessary to reflect contractual responsibilities of the specific contractor. Facilities are classified as CROET leased (CR), watershed

projects (MV and BV), Waste Disposition (WD), and Waste Operations (WO). Buildings 3597 and 9735 were accepted for transfer to the EM Program in October 2001. In addition, DOE-EM has contracted with Foster Wheeler Environmental Corporation for the construction and operation of the Transuranic (TRU) Waste Processing Facility. This facility, to be located adjacent to the Melton Valley Storage Tanks, will be used to package solid TRU waste and TRU waste sludges for transport to the Waste Isolation Pilot Plant in New Mexico for disposal.

Low volumes of wastes are produced by a number of UT-Battelle operations, resulting in an aggregate amount for the Laboratory that is substantial. However, another large volume of radioactive and hazardous waste comes from the remediation and demolition projects in the EM Program that will continue to increase over the next ten years. Indeed, ORNL has 344 sites that are contaminated to the extent that they require monitoring and remediation. Previously, these sites were grouped into 20 Waste Area Groupings (WAGs) for management and budgeting. Currently, under the Bechtel Jacobs Company, LLC, EM Program, environmental restoration activities are organized on a watershed basis (Fig. 3.18). Waste management activities across the ORR are organized under the Waste Disposition and Waste Operations Projects. Additional information on waste management activities is included in Appendix H.

3.2.3.2.5 Facilities and Operations Management

The management systems comprising facilities and operations management at ORNL include (1) Facility Operations and Management, (2) Infrastructure Acquisition and Disposition, (3) Emergency Management, (4) Safeguards and Security, and (5) Transportation. The primary emphases of these management systems are to maintain and upgrade the Laboratory's infrastructure and to provide effective stewardship of facilities and operations resources.

3.2.3.2.5.1 Facility Management Model

On April 1, 2000, UT-Battelle became the management and operating contractor for ORNL and began a transition to a building manager/occupant model of facility operations at the Laboratory. Under this Facility Management Model, a building (or group of buildings) is managed and maintained by the Facilities Management Division (FMD) to achieve the Laboratory's overall tactical and strategic objectives for facility management, maintenance, and operation and to satisfy the Laboratory's needs for space management. The expected benefits of this new approach to facility management include improvements in customer satisfaction, work control processes, and safety performance. Successful implementation will also reduce costs and ensure faster delivery of services.

Under this new model, the occupant organizations obtain the facilities they need at a space cost established to support agreed-upon service activities and maintenance. All ORNL facilities are organized into several Complexes, which are each managed by a Complex Facility Manager (CFM). A facility use agreement (FUA) is established between the CFM and the building occupants. This agreement spells out the roles and responsibilities of both parties. The FMD is responsible for buildings and related infrastructure, while the research organizations are responsible for their own laboratory and research operations. In this way, the occupants are free to focus on scientific research and development, while the

building management and maintenance organizations focus on ensuring that the facilities are available for their intended use in accordance with the Laboratory's vision and mission.

To implement the new Facility Management Model, the Plant and Equipment Division was replaced by three smaller organizations with specific organizational missions. The Facilities Management Division serves as the landlord and steward of all facilities at ORNL and also manages functions such as site utilities, leased space, and controls and instrumentation services. The Fabrication and Site Services Division (FSSD) provides fabrication shops (machining, welding, glasswork, etc.) as well as various reservation services (the garage, waste pickup, roads, transportation, etc.). The Craft Resources Division houses the majority of bargaining unit craft workers at the Laboratory. The craft workers report administratively to the Craft Resources Division, but their project-related tasks are directed by Project Leaders in FMD and FSSD.

Within the FMD, each Complex is managed by a Core Team led by a Complex Facility Manager. These Core Teams (seven) consist of building managers, building engineers, craft, ESH&Q professionals, project leaders, and administrative staff. The accountabilities of the Core Teams are implemented through the SBMS. Specific details for services provided, clarity of system ownership, system/building design capabilities and operating boundaries, and similar topics are being included in FUAs between the Core Team and its customers (building occupants). These agreements are planned for completion by FY 2003. The core teams for all non-nuclear facilities were established in FY 2002 and will be established for all non-reactor nuclear facilities by FY 2003. The FUAs and operational work control (also defined within SBMS) establish a documented basis for facility-level controls tailored to the level of hazard and acceptable risk, provide a basis on which to evaluate the conduct of proposed activities in terms of the recognized building work scope and operating boundaries, and drive the implementation of a documented review and change control process when work activities have the potential to exceed the operating boundary. Budgets are allocated by Complex, with each CFM responsible for managing both space-related maintenance funding and customer-funded work (research support, etc.).

Complex Descriptions:

Central: The Central Complex contains more than 500,000 square feet of facilities centered around the 4500 buildings. The Central Complex contains several multiple-occupant buildings. Work environments in the Central Complex range from offices, to high-performance computing, to wet chemistry laboratories. Primary facilities include the Central Research and Administration Buildings (4500N and S), the High-Temperature Materials Laboratory (4515), and the Metals and Ceramics Laboratory (4508).

West: The West Complex contains more than 600,000 square feet of facilities located west of Fifth Street. In general, the Complex consists of buildings in the 1000, 2000, and 3000 areas. Major activities include environmental science research, instrumentation and controls research and support, the ORNL cafeteria, and several maintenance shops. The Solid State Division has a significant presence in the area, and numerous business management functions are performed from Building 1000. These facilities range in age and condition from newly constructed office buildings to contaminated, decades-old research facilities. Some of the older buildings contain legacy contamination as well as ongoing environmental protection issues. The West Complex is a focal point for deactivation activities for the next several years.

East: The East Complex contains more than 500,000 square feet of facilities located east of Sixth Street. In general, the Complex consists of buildings in the 5505, 5510/10A, 6000, and 7000 areas. The facilities house operations ranging from warehouses and shops to research projects involving computational sciences and fiber optics. East Complex facilities are also supporting SNS activities, and the Complex is preparing to receive Fusion Energy operations that will be migrating from Y-12. Multiple infrastructure issues include aging facilities, legacy contamination, and protection of the environment.

Y-12: The Y-12 Complex contains nearly 1 million square feet of facilities located at the Y-12 National Security Complex. Primary occupants of the facilities are ORNL's Engineering Technology, Fusion Energy, and Life Sciences divisions. Many of the facilities have legacy contamination issues that predate ORNL's occupancy of the space. A major focus in the near term will be deactivation of buildings as ORNL continues a multiyear move out of Y-12 space. The movement of people and operations from Y-12 is resulting in construction, maintenance, and logistical needs in the Central, East, and West complexes.

Leased: The Leased Facilities Complex includes several buildings outside the DOE Oak Ridge Reservation, including the National Transportation Research Center, 1060 Commerce Park, 701 Scarboro Road, and 111 Union Valley Road. In the future, several additional privately owned facilities will be built on the ORNL main campus and leased back to UT-Battelle for DOE and other work. Infrastructure issues will be addressed through contract management and oversight of facility maintenance for these buildings.

Utilities: In addition to programmatic and landlord building facility needs, the ORNL utilities systems are also critical components of the plant infrastructure. Traditional utilities services, such as those found in any industrial environment, are provided and managed by the FMD. The Utilities Complex, a suborganization within the FMD, has the day-to-day responsibility for operating, maintaining, and managing what has been divided into two distinct operating entities. The Electrical Operations Group has responsibility for operating and maintaining the electrical distribution system and the central chilled water system. The Mechanical Operations Group has operations and maintenance responsibility for the Steam Plant, Sewage Treatment Plant, water reservoirs, and the associated utility supply, distribution, and collection systems.

Other unique utility systems, such as central off-gas, process waste collection and treatment, and radioactive waste handling and disposal, that are required to support the Laboratory's programs and operations are provided by Duratek Federal Services under contract with Bechtel Jacobs Company, LLC.

Appendix I details the utilities systems with current activities and future needs impacting infrastructure.

Significant Utilities Infrastructure Issues:

Electrical: Although many improvements and upgrades have occurred over the years, many mid-1940s electrical systems, both inside and outside of buildings, need upgrades to meet current codes, to provide redundancy for critical applications, and to install metering and other energy-saving technologies to improve system efficiency. An Electrical Systems Upgrade Line Item project is currently under way that addresses some of these issues, and a future Line Item is proposed that will upgrade and improve ORNL's primary electrical substation. Other GPE and GPP needs have been identified to address facility-specific needs, as well as to provide the equipment and technology needed to ensure that maintenance personnel have the tools needed to operate and maintain this critical and complex system.

While the current operating and maintenance focus is on the main ORNL plant site, work is progressing on the construction of a new electrical substation and distribution system at the SNS site. This ORNL facility is located away from the main ORNL campus and has its own specific power requirements—requirements that could not be met by extending ORNL's existing power system. The Tennessee Valley Authority (TVA) is constructing a new 161-kV substation at the SNS site specifically to address SNS needs. This substation will be fed from TVA's 161-kV Fort Loudon line and can receive power from either the Fort Loudon Dam or through the Elza Switchyard. Because the substation will become another important switching point on the TVA power grid, TVA will retain

operating and maintenance responsibility for the 161-kV side, and ORNL will have responsibility for the reduced voltage side of the substation. As designed, the substation will consist of two 45-MVA transformers that will reduce the 161,000 volts to 13,800 volts for internal distribution and usage in SNS facilities and operations.

ORNL is also working with other groups on a proposal that would transfer operating and maintenance responsibility for the existing ORNL substation, Building 0901, to ORNL. This responsibility currently resides with the Power Operations Group working for BWXT at both the Y-12 and ETTP sites. Due to logistical issues, as well as problems associated with having different employers and contracts, groups from Y-12, ORNL, and DOE are investigating different operating scenarios that will enable each site to become more independent and allow each to become more focused on achieving and managing site-specific needs and requirements.

Compressed Air: Significant investments have been made to upgrade the air production capability at the Steam Plant. While air production is not considered a problem, drying the air to a level that is needed by customers is becoming questionable. A new, 4000-scfm dryer unit is being proposed to ensure research customer needs.

Natural Gas: Most of the natural gas distribution system within the Laboratory was constructed in 1948 and is still in reasonably acceptable condition. The geographical area served by the existing system is centered in the older areas of the Bethel Valley Complex with no service lines extending into the Melton Valley areas or areas currently identified in plant revitalization plans. Facilities now located outside the service grid in Bethel Valley and in Melton Valley either do not use natural gas or have installed bottled gas manifold systems to serve in limited applications. A GPP is in the planning base to upgrade the existing distribution system, but no plans exist to expand system coverage using internal funds. Costs to extend natural gas service into the areas identified for East Campus redevelopment will be funded through the landlord GPP program.

Potable and Process Water: Several upgrades have been made and are currently being implemented to improve the potable and process water distribution systems. Fire protection is a driver for many of these issues. The FEVA Recommendations for Improvement have a focus on improvements to legacy-type problems associated with water lines running through the older process areas within the plant. Studies are being conducted to determine risks associated with water lines and potential leaks in areas where potential existing contamination may be present. Current projects for new construction will require upgrades and new installation of water lines. Much of this work will be funded using specific project monies; however, some proposed improvements will address general needs to allow ORNL to continue providing ORNL consumers with a safe and reliable water supply.

The SNS construction and the FY 2001 water plant transition from DOE to the City of Oak Ridge are two areas deserving special recognition. The SNS project required the relocation of over 1 mile of ORNL's sole 24-inch water supply line. Part of the preliminary site work at the SNS involved installation of a new 24-inch line to replace the 1948 vintage line that bisected the SNS site. The new line skirts the outside perimeter of the site and is well out of the way of major construction activities that have the potential to cause significant disruption of ORNL's main campus water supply. SNS construction forces and ORNL maintenance personnel are to be commended on relocating this line without significant disruption to the ORNL water supply. The SNS water system that tees off this main will become part of the ORNL water distribution system. Maximum water usage at the SNS site is expected to be in the range of 1 million gallon per day. This additional demand on the 24-inch supply line should not cause delivery pressure or flow problems at either the SNS site or within the ORNL main campus.

During the past few years, the anticipated change in management at the water treatment plant that provides ORNL's water supply had been an area of concern due to the potential for disruption of

services. Since the water plant's transition from DOE to the City of Oak Ridge over one year ago, however, ORNL has continued to receive the same high levels of quality water and extraordinary service previously enjoyed when DOE owned and operated the water plant.

Chilled Water: Water for air conditioning and process cooling is generated at a central plant located in the Bethel Valley portion of ORNL. This central chilled water plant serves the 4500 Complex as well as Building 3500, Building 6010, and buildings in the 5500 Area. In general, most of the production and distribution system is in good condition except for the need to replace an inoperable, out-of-service 1200-ton chiller and a 2400-ton cooling tower located at the central plant. Replacement of this equipment will help equalize tower and chiller capacity and expand opportunities for further improvements and possible expansions of the service area. A 1500-ton cooling tower located at Building 6000 is in need of replacement, and a cost-benefit must be performed to determine whether replacement of the tower or expansion of the central chilled water system into the area is the best option. An ongoing CFC chiller replacement project was initiated in 1994, which has been replacing air conditioning units having the potential to exceed regulatory limits for CFC releases should a leak occur. This effort is funded through FY 2003 when most of the Laboratory's vulnerabilities will have been mitigated. An FY 2001 Laboratory Facilities HVAC Line Item is under way to upgrade components attached to the chilled water system such as coils, supply fans, and controls. Its completion will further improve the overall reliability and effectiveness of the system.

Steam: While the Steam Plant remains reliable, the major equipment systems, including the boilers, have exceeded their useful design lives. A Steam Plant study was completed that identifies replacement and upgrade projects necessary to continue to operate reliably and efficiently. The Steam Plant study provides major component replacement and upgrades needed for planning. Several projects have been completed, and ongoing projects are planned for the next ten years to ensure system reliability.

Stormwater: Generally, the condition and performance of the stormwater collection system is adequate. A FEVA Recommendation for Improvement identified the need to dechlorinate flows related to the use of once-through cooling water systems. The Laboratory is pursuing projects for the procurement and installation of recirculating cooling systems to eliminate this problem.

Conventional Waste (Sanitary/Industrial Wastes and Sanitary Sewage Collection and Treatment): No major deficiencies have been identified. An improvement to the east end collection system to accommodate the new flows generated by the SNS facilities is currently being studied to determine the need for potential upgrades. The Sewage Treatment Plant is halfway through its designed life. Proposed pollution prevention projects include a denitrification system to remove nitrates from the plant's effluent stream to reduce pollutant discharges.

Transportation Infrastructure: Facility modernization, security, and safety have placed significant emphasis on the current transportation infrastructure. Upgrades to the transportation infrastructure include new parking lot construction, Bethel Valley Road improvements, Melton Valley Road improvements, and other on-site transportation initiatives.

Nuclear Facilities: ORNL has a number of unique experimental and production facilities that involve nuclear or other hazardous materials. These facilities utilize design features for safety and implement administrative controls to minimize the probability and consequences of an accidental release of hazardous material to on-site and off-site receptors. DOE-STD-1027-92 provides guidance for the categorization of these facilities based primarily on that facility's nuclear material inventory. Using this guidance, ORNL has one hazard Category 1 nuclear facility (i.e., HFIR), six hazard Category 2 facilities, and four hazard Category 3 facilities. Safe operation of these facilities is ensured by implementing the safety systems and operating within the limitations established by DOE-approved Safety Analysis Reports (SARs) or Basis for Interim Operations (BIOs) and Technical or Operational

Safety Requirements (TSRs/OSRs) developed in accordance with DOE Orders 5480.22 and 5480.23. As part of the *ORNL Project Management Plan for Enhancing Non-Reactor Nuclear Facility Operations*, efforts are under way to upgrade the existing Safety Basis documentation to meet 10 *CFR* 830, Subpart B, "Safety Basis Requirements," by April 2003.

Non-reactor nuclear facilities are currently being transitioned to the Facility Management Model. Reactor nuclear facilities are controlled through the Research Reactors Division. Appendix L provides a description of each nuclear facility, infrastructure issues, and safety documentation needs and upgrades.

Significant nuclear facility infrastructure issues include:

- Reactor Nuclear Facilities: A recent upgrade of the HFIR facility has been completed, and the reactor is currently in initial operations. The following infrastructure issues are needed to ensure user research requirements: (1) an increase in the size and intensity of existing neutron beams; (2) addition of a cold neutron source and an experimental guide hall; (3) addition of several neutron beam guides and a second neutron guide hall and new instrumentation; (4) addition of a neutron radiography/ tomography facility; (5) improvements to isotope production, materials irradiation, and neutron activation analysis capacities; and (6) improved/new user access facilities.

- Non-Reactor Nuclear Facilities: Recent studies of non-reactor nuclear facilities have identified several needed improvements for ongoing operations and support to the research community. Specific issues are related to upgrades to ventilation systems, electrical system improvements for feed and distribution center systems, hot cell structure improvements (windows and manipulators), obsolete equipment replacement, drawing updates, waste management system upgrades, and process pump replacements.

3.2.3.2.5.2 Enhanced Maintenance Planning

The Enhanced Operational Discipline Initiative includes the task of upgrading the Laboratory's infrastructure and providing effective stewardship of facilities and operations resources. A key initiative for upgrading the Laboratory's infrastructure is the Facilities Revitalization Project. An outcome of this project is the ability of the Laboratory to redirect the total existing maintenance budget to an improved portfolio of buildings. This portfolio consists of a set of aged buildings that have been greatly reduced in size (by about 1.2 million square feet) and a set of new buildings with fewer initial maintenance demands. As a result, the future maintenance budget, based on a cost per square foot of operated space, will increase 50% in three years (from $3.73/square foot in FY 2002 to $5.72/square foot in FY 2004). A bigger budget will thus provide the opportunity to maintain the overall condition and enhance the longevity of Laboratory buildings. Maintenance expenditures in FY 2001 were approximately $10.9 million, or 0.24% of RPV, and in FY 2002 they are projected to increase to approximately $14 million, or 0.31% of RPV. This increase serves as an indicator of continuous improvement toward achieving the appropriate level of maintenance, as described in the National Research Council's 1998 publication *Stewardship of Federal Facilities: A Proactive Strategy for Managing the Nation's Public Assets*, wherein having the necessary level of maintenance is pictorialized in Fig. 3.19.

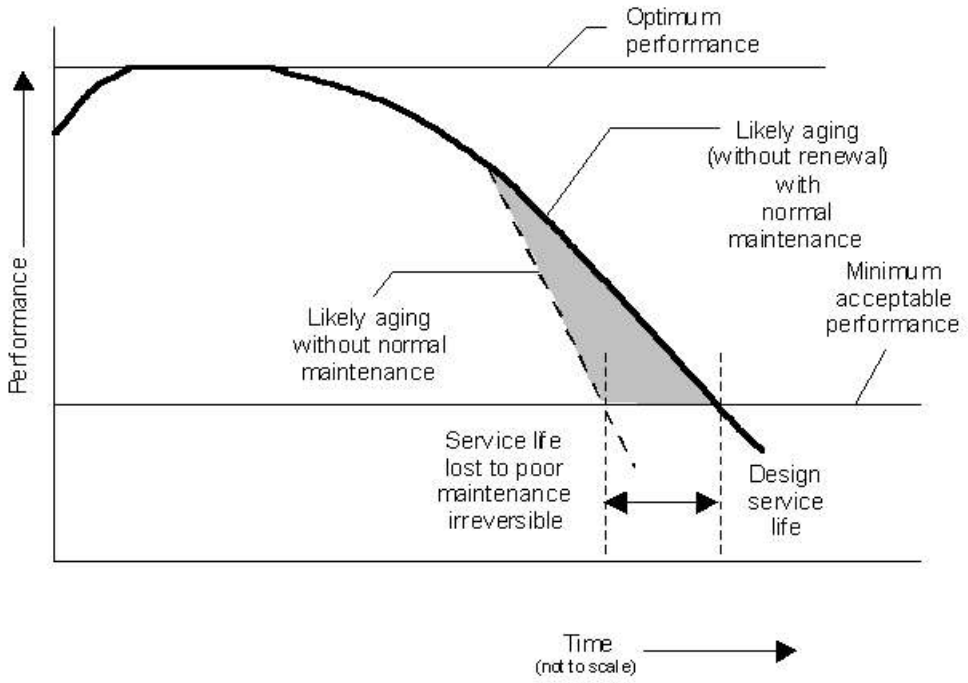


Fig. 3.19. Effect of adequate and timely maintenance and repairs on the service life of a building. *Source:* National Research Council, Fig. 1-1 (p. 13) in *Stewardship of Federal Facilities: A Proactive Strategy for Managing the Nation's Public Assets,* National Academy Press, Washington, D.C. 1998.

The Enhanced Operational Discipline Initiative is also expected to improve ORNL maintenance requirements planning by promoting a more comprehensive, uniform approach to identifying maintenance needs. In the new ORNL Facility Management Model, each core team complex manager will be responsible for the identification and prioritization of facility needs. Within the core team are building engineers and ESH&Q professionals who will not only utilize the information generated through the CAIS but also their real-time day-to-day knowledge of the buildings for which they are responsible and the expectations defined within the FUAs to establish appropriate needs and priorities. It is also through these core teams and their familiarity with, and ownership of, the facilities, that efficiencies in work management will be realized so that more of the limited indirect maintenance funds can be applied to completion of craft work.

Specific initiatives being pursued to enhance maintenance planning and implementation include development of plans for maintenance and upgrades to site utilities systems patterned after the *Central Steam Plant Ten-Year Plan* developed in FY 1997. The Steam Plan has been an effective tool in guiding system upgrades and maintenance activities for the steam system to meet evolving Laboratory needs. Additionally, a roof asset management program will be developed to maintain Laboratory facility roofs at a high level of repair subsequent to the extensive ORNL roof replacement program recently completed.

3.2.3.2.5.3 Security

The ORNL Laboratory Protection Division (LPD) has the overall responsibility for providing classified matter protection and control, a foreign national visits and assignments program, a foreign travel program, nuclear materials control and accountability, nuclear materials management, personnel security, physical security, security program management and planning, and visitor services to all ORNL organizations and operations. The objective of the LPD is to implement appropriate

security measures needed to protect against events that may cause adverse impacts on national security, the environment, and the health and safety of Laboratory employees and the public, while maintaining an environment conducive to the conduct of scientific research and development and the efficient operation of the installation. Appendix J provides additional information concerning infrastructure security improvements at the Laboratory.

Under a prime DOE-ORO contract awarded in September 1999, Wackenhut Services, Inc. - Oak Ridge (WSI-OR) started providing selected security services to ORNL on January 10, 2000. Although WSI-OR provides some select security services to the Laboratory, overall management responsibility for ORNL's multifaceted security programs remains with UT-Battelle. WSI-OR, however, does have programmatic responsibility in two specific areas: ORNL Protective Force operations and the Personnel Security Assurance Program.

Significant Security Infrastructure Issues: Construction of new access control portals along Bethel Valley Road was completed during FY 2002. The new portals provide a more efficient and effective control mechanism for maintaining authorized staff and visitor access to the site. To ensure continued response to security needs, projects have been identified for closed-circuit television (CCTV) replacements, installation of a hardened central alarm station, upgrades to the intrusion detection alarm systems, and continued improvements to the automated access control systems.

3.2.3.2.5.4 Space Management and Inactive Surplus Facilities

ORNL's space charge system promotes effective and efficient use of ORNL buildings and equitable distribution of the costs associated with maintaining these buildings. Space charge components include facility planning and administration, nonprogram Line Item/GPP construction design, space relocation (forced), lease costs, janitors, asbestos abatement (management), building maintenance/ services, HVAC maintenance, grounds maintenance, utilities on returned space, activity data sheet (ADS) requirements, In-House Energy Management, and fire protection engineering. The Space Allocation Management System (SAMS), which contains data associating a specific employee and organization with occupied space, is used for allocation of space charges. The space charge system will continue to be refined to drive greater efficiency in the use of space, supporting the aims of the Enhancing Operational Discipline Initiative. Currently, organizations are assessed space charges based on two categories of space: (1) conditioned space at $21.60 per square foot and (2) unconditioned space at $7.20 per square foot.

As a result of space charge implementation, more than 600,000 square feet of marginal space has been vacated. Approximately 350,000 square feet of this space has been completely deactivated. Seven buildings, totaling 220,000 square feet, have been transferred to the Y-12 National Security Complex; 15,000 square feet is contaminated and is being transferred to the EM Program in FY 2002. Appendix K, Table K.1 provides a list of facilities that are candidates for disposition to DOE-EM or to DOE-SC. Table K.2 provides an outline of the ORNL Space Management Plan being developed to support the Facilities Revitalization Project and other consolidation initiatives.

3.2.3.2.5.5 Facilities Consolidation and Deactivation

The FRP is responsible for developing and implementing an exit strategy for nonstrategic ORNL facilities; transferring nonstrategic, uneconomical, or underutilized facilities that no longer support the Laboratory's mission to other parties; and placing facilities that cannot be transferred in a "cheap-to-keep" mode (i.e., a state of minimum cost, with the minimum utilities, maintenance, and surveillance) until ultimate disposition can be funded. Figures 3.20 and 3.21 provide the disposition status of facilities at the ORNL main site and ORNL at Y-12.

An inventory of existing facilities uses and conditions has been developed to identify nonstrategic facilities. Two disposition paths will be used to handle facilities determined to be surplus: facility transfer and facility deactivation. Facilities on the transfer path will be transferred to another program (DP or EM) or to an entity such as the Community Reuse Organization of East Tennessee (CROET). Facilities on the deactivation path will be placed in "cheap-to-keep" mode and put under a routine surveillance and maintenance (S&M) program. Those that meet the criteria for DOE's Environmental Management Program will be transferred to DOE-EM as soon as possible.

ORNL faces an enormous challenge in the deactivation and disposition of its nonstrategic facilities. Many of these facilities are large and complex, and some contain multiple hazards. There are 40 facilities, representing approximately 1.4 million square feet, as candidates for disposition through DOE-EM, and 57 facilities, including a number of trailers, that will remain the responsibility of DOE-SC. The estimated cost of facilities consolidation and S&M during the time frame of the *ORNL Strategic Facilities Plan* (FY 2001–FY 2011) is $113 million. The estimated cost for ultimate decontamination and decommissioning (D&D) of ORNL's nonstrategic facilities is $126 million.

3.2.3.2.5.6 Energy Management

ORNL's In-House Energy Management (IHEM) program is directed toward saving energy, reducing energy costs, protecting the environment, enhancing the workplace environment, improving operations, and providing leadership in the adoption of new energy technologies. The program has yielded a 20% reduction in energy use per square foot of occupied space since 1985.

Several energy management initiatives are under way, and positive results are being realized. Key activities include the following:

- About 43,000 fluorescent lamps have been replaced with more efficient lamps; almost 23,000 ballasts have been replaced with more efficient units that do not contain polychlorinated biphenyls (PCBs); and about 900 occupancy sensors have been installed to switch off lights in empty rooms. Energy usage and costs have been reduced by 30 to 70% in the affected areas.

- ORNL continues to retire chlorofluorocarbon (CFC) chillers or replace them with high-efficiency, non-CFC chillers. To date, 16 chillers totaling 8,200 tons in cooling capacity have been replaced. As a result, chiller energy use has dropped an average of 21% for annual savings of $280,000, and CFC emissions have been cut by 5000 pounds per year, saving another $76,000 annually.

- Energy management control systems have been installed in 13 buildings. This includes the installation of 19 variable-speed drives on supply and exhaust fan motors.

- Following an assessment of the energy efficiency of 16 office buildings at ORNL, one building has been officially designated as an Environmental Protection Agency (EPA) Energy Star building. Documentation of the performance of the Buildings Technology Center headquarters building was submitted to the EPA, and the certification was subsequently awarded. This was one of the first DOE buildings to achieve this rating and only the second building in the State of Tennessee to do so. Electric metering has been added to 11 other candidate buildings so that they can also be evaluated for Energy Star awards.

ORNL also intends to apply Energy Star rating criteria to future new facilities, major renovations, and infrastructure upgrades where appropriate. ORNL's currently planned Line Item, private-sector, and State-funded facilities will be assessed using the Energy Star rating criteria.

In addition, the conversion of the ORNL Steam Plant from coal to natural gas is expected to save about $1 million per year in operating costs and $8 million in capital funding over ten years, while also avoiding emissions from coal combustion.

ORNL is also pursuing energy savings performance contracting (ESPC) as a way to implement projects using the funding and support of an energy service company (ESCO). When a project is complete, the ESCO is paid back from the energy savings. Once the ESCO is paid in full, the infrastructure improvements and future energy savings belong to ORNL. The first ESPC project has been completed, and a second site-wide ESPC project proposal is being evaluated.

ORNL was the first industrial participant in the Green Power Switch program established by TVA. The program offers power produced using renewable energy sources such as sunlight, wind, and landfill gas. Although this "green power" costs slightly more than power from traditional energy sources, it is expected to improve regional air and water quality by reducing waste and pollution. In addition, increased demand should lead to expanded power production capacity and, eventually, to lower costs.

3.2.3.2.5.7 Hazardous Materials Transportation, Storage, and Handling

Many buildings at ORNL receive, store, or use hazardous materials or chemicals. Storage of chemicals is typically limited to amounts that can be used in short periods and involve small amounts or consumer volume (defined as laboratory quantities, which, if suddenly released, would have no measurable off-site impact). Larger volumes of hazardous materials may be stored in bulk at various locations. Only two facilities have been identified as bulk storage areas, and neither poses any off-site release impact. The refueling station is the primary location where large volumes of hazardous fuels and oils are stored. It is separated from other facilities by sufficient distance to minimize any on-site or off-site impact from an inadvertent spill, release, or fire. The Materials Receiving Area provides large-capacity storage for compressed gases used throughout ORNL. Gas cylinders are properly secured to prevent inadvertent tipover accidents, and hazardous gases are segregated to prevent the formation of toxic chemical combinations. Transportation of hazardous materials and chemicals is typically performed by the ORNL shipping and receiving function in accordance with all applicable DOT regulations. A Transportation Safety Document (TSD) has been completed for on-site transportation that provides a process to transport hazardous material with negligible risk due to equivalent DOT safety practices when all DOT requirements cannot be achieved.

Chemicals and radioactive materials in transit within the ORR are packaged in accordance with DOT regulations or equivalent packaging requirements and are not considered capable of creating an off-site release of hazardous materials. Moreover, receipt, handling, and storage of bulk chemicals is not expected to affect facility operations. Efforts have been made to minimize the probability of these types of accidents so that the potential for off-site releases from the affected facilities is minimal.

Table 3.5 Future mission facility needs

Title and description	Proposed funding years(s)/type
Joint Institute for Neutron Sciences (JINS) ▸ Center to provide a world-class user program that provides access to the capabilities of the SNS, HFIR, and other ORNL neutron sciences research programs. 60,000-square-foot facility housing office, laboratory, process, and meeting space for collaborations	FY 2005–06 $8.0M State funded
HFIR Maintenance Building ▸ Building to provide facilities critical to the maintenance and support of reactor operations. 22,000-square-foot facility to house maintenance shops and process space	FY 2004–05 $2.9M GPP
Small-Angle Neutron Scattering (SANS) Guide Hall ▸ Building to provide the necessary space to support a new 20-m SANS instrument and a new 16-m biological SANS instrument, which will be dedicated to biological research	FY 2001–03 $4.3M BES
William L. and Liane B. Russell Laboratory for Comparative and Functional Genomics (LCFG) ▸ Building to provide facilities for the location of the mutant mouse colony. 36,000-square-foot facility with accredited, environmentally controlled accommodation areas for housing animal research	FY 2001–02 $13.9M LI
Modifications to Building 1059 ▸ Modifications to support research in LCFG by providing laboratories to perform microinjection of mouse embryos and cryopreservation of mouse gametes and embryos	FY 2004–05 $1.2M GPP
ORNL Center for Systems Biology ▸ Research programs for functional genomics, structural biology, proteomics, and systems biology staged facilities to house the Center for Systems Biology user facilities. 50,000-square-foot facility with a modular complex of buildings, equipment, and supporting infrastructure to be located in the West Campus	FY 2007–09 $20.0M LI
Proteomics and Protein Complex Analysis Laboratory ▸ The Proteomics and Protein Complex Analysis Laboratory would consist of a 130,000-square-foot laboratory/office complex. This building would house facilities for cell growth, molecular biology, protein chemistry, mass spectrometry, protein analysis, and computational biology.	FY 2004–2008 $150.0M LI
Joint Institute for Biological Sciences (JIBS) ▸ Center for the promotion and development of collaborative education and research in the biological sciences of functional genomics, structural biology, and computational biology and bioinformatics 60,000-square-foot facility housing office, laboratory, process, and meeting space for collaborations	FY 2004–05 $8.0M State funded
Modifications to Building 1503 ▸ Upgrade of greenhouses and research laboratories to support plant genomics	FY 2003–04 $1.7M GPP

Table 3.5 Future mission facility needs

Title and description	Proposed funding years(s)/type
Private-Sector-Funded Facilities (Fig. 3.22) ▸ Computational Sciences Building – Center for computer science research to address effective use of distributed computers and massive parallel computer systems composed of symmetric multiprocessing clusters linked with high-speed network fibers. 137,000-square-foot facility to house supporting laboratories, process space, offices, and supporting infrastructure ▸ Engineering Technology Facility – Multidisciplinary R&D facility relevant to energy conservation and utilization; mechanical, structural, and thermal sciences; and manufacturing sciences. 98,000-square-foot private-sector-funded facility to house supporting laboratories, process space, offices, and supporting infrastructure ▸ Research Office Building – Multistory 133,000-square-foot office building for research and support staff personnel	FY 2001–03 $72.0M Private-sector funded
Joint Institute for Computational Sciences and Oak Ridge Center for Advanced Studies (JICS/ORCAS) ▸ JICS – User- and visitor-oriented facility to provide access to high-performance computers, inspire collaborations and outreach between ORNL and partnering universities, facilitate enhanced high-speed networking systems, and facilitate auxiliary technologies. 40,000-square-foot facility to house computing system laboratories, offices, and meeting space for collaborations ▸ ORCAS – Theoretical and applied R&D-oriented facility to explore grand queries, big thoughts, and major potentials for long-term program development for ORNL and core universities. 30,000-square-foot facility to house state-of-the-art collaboration meeting room with teleconferencing and computing networking, offices, and information resource center	FY 2002–03 $10.0M State funded
Energy Reliability and Efficiency Laboratory ▸ Facility designed to operate as a demonstration of energy efficiency technology and to support R&D initiatives in distributed energy resources, electricity transmission and distribution, and net zero energy building systems. 52,000-square-foot research facility to be located in the Central Campus to house about 40 occupants with conference/ meeting rooms, a highbay, and two cranes	FY 2004–05 $16.0M LI
Central Campus Research Building ▸ Activity to provide for the construction of a research building of approximately 14,000 square feet. This facility will house a number of research programs currently located in Buildings 2024, 3115, 3080, and 2019. These very old and high-maintenance buildings provide substandard space for many high-profile research programs. The new facility will house multidivision programs supported by a number of agencies within the Office of Science (KC, EW, and EB) with direct ties to other national laboratories and industry	FY 2005–06 $4.5M GPP
Laboratory Expansion for Nanoscience Metrology and Instrumentation ▸ Space for scientific and engineering research initiatives for nanomaterials, nanostructures, and their applications. 3,000-square-foot renovation of space in Building 3500 to house laboratory and process space with two new clean rooms	FY 2000–02 $1.9M GPP

Table 3.5 Future mission facility needs

Title and description	Proposed funding years(s)/type
Advanced Materials Characterization Laboratory (AMCL) ▸ Facility for next generation of research for materials characterization and for centralization of advanced materials structural characterization equipment to include the Aberration-Corrected Electron Microscope Facility to house the advanced materials research user facilities. 12,000-square-foot structure with microscope modules	FY 2001–03 $4.8M GPP
Center for Nanophase Materials Science (CNMS) ▸ National center for nanoscience research on soft materials, interfaces, nanoscale magnetism, and other nanophase systems that benefit from access to neutron scattering ▸ Response to BES panel recommendations for the creation of Nanoscale Science Research Centers ▸ Provision of clean rooms and specialized equipment that cannot be accommodated in existing space. 80,000-square-foot laboratory/office complex adjacent to the SNS	FY 2002–05 $63.8M LI

3.3 RESOURCE PLANNING, PRIORITIZATION, AND ALLOCATION PROCESS

The ORNL ESHQ&I budget formulation and management planning process provides the planning structure and tools needed to identify and prioritize ESHQ&I needs, make and communicate cost-effective ESHQ&I risk-management decisions, integrate ESHQ&I into all activities and operations, and establish accountability for ESHQ&I performance. ESHQ&I resource planning and prioritization are implemented in a manner consistent with guidance from DOE, as provided in the *DOE Guidance Manual for the ES&H Planning Process*, the Office of Environmental Management Budget Formulation Guidance, DOE Order 430.1A, "Life Cycle Asset Management," and any supplemental guidance received from individual DOE program offices. The ORNL site planning methodology is outlined in Fig. 3.23.

The process generally consists of the following steps:

- Needs assessment identification — Needs assessments are performed by ORNL organizations and line management to identify the activities, systems, and programs needed to ensure the effective management of operations, ES&H, and infrastructure risks and to create a culture within ORNL that effectively integrates employee protection into work planning and the execution of work activities.

- Activity data sheet (ADS) preparation — ADSs contain the essential scope, schedule, cost estimate, and management information necessary for ORNL organizations to support planning and provide input to the budgeting process. ADSs are prepared for all landlord programs and activities needed to operate ORNL in a manner that protects the employees, the public, and the environment; meet those requirements set forth in the ORNL Work Smart Standards and by DOE; and ensure adequate infrastructure resources to meet the mission of the Laboratory.

- Risk-based prioritization of activities — The ORNL Risk Ranking Board uses a Risk-Based Priority Model (RPM) to perform risk evaluations of all landlord operations, ES&H, infrastructure activities, and other identified ADSs. Using the RPM, a risk-reduction benefit score is derived for each ADS, and ADS scores are used to establish preliminary priority lists that are reviewed by senior management. Priority adjustments are made, as necessary, in consideration of additional planning factors.

- Allocation of resources — Resource planning and allocation are done on the basis of programs essential for compliance, fulfillment of ORNL missions, and assurance of the safety and well-being of ORNL personnel, the public, and the environment. Resource allocation is determined by supporting the highest-ranking activities within the target funding levels. The ORNL Leadership Team and the DOE Site Office review and approve proposed GPP, GPE, and overhead programs.

For capital and operating cost requirements outlined in this plan, the individual projects will be evaluated through this formal process prior to funds allocation and project execution.

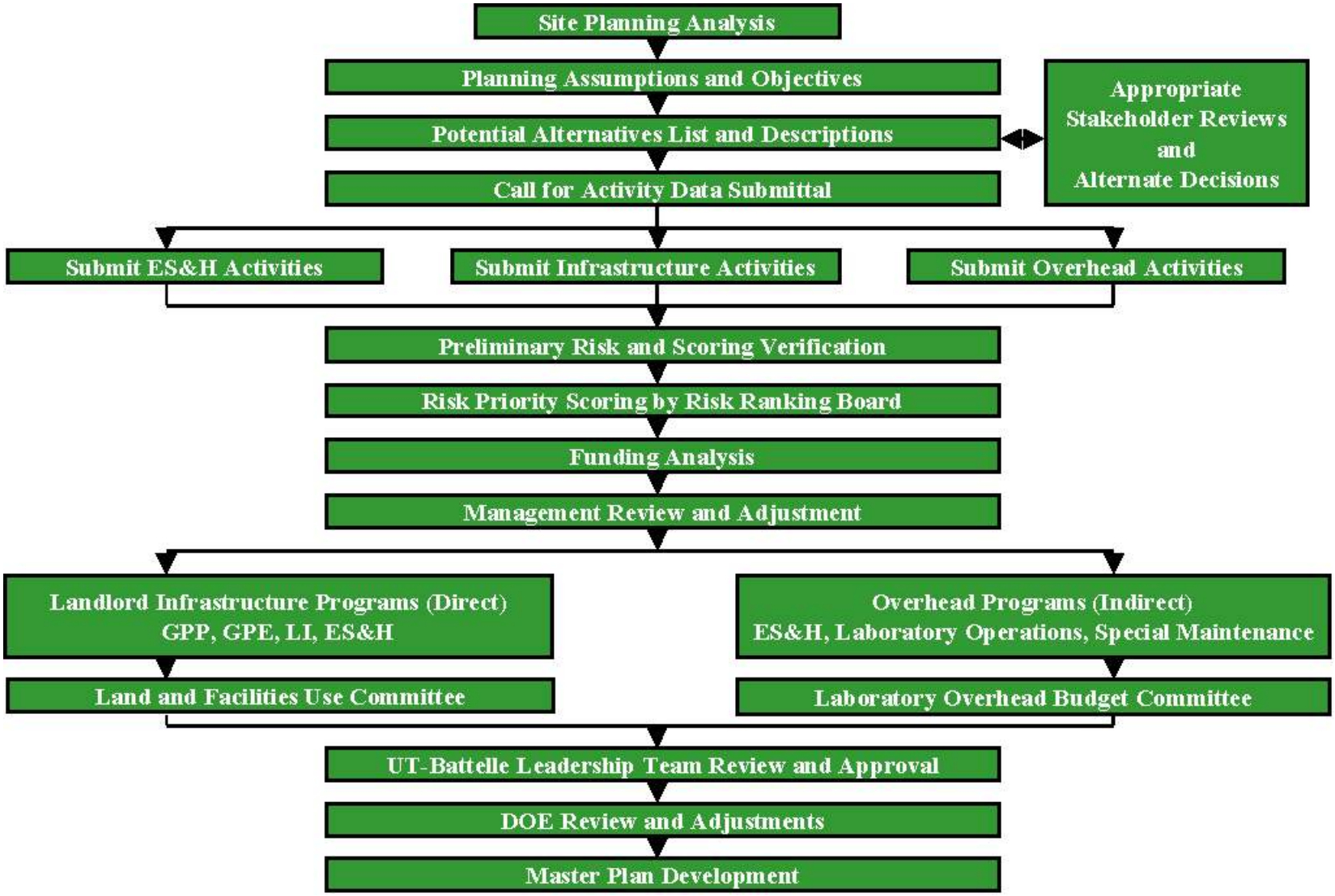


Fig. 3.23. ORNL site planning methodology.

3.4 ORNL MASTER PLAN

The Master Plan for development of the ORNL Laboratory of the 21st Century has been formulated to meet the scientific needs of the research community utilizing the facilities; provide a safe, quality, and energy-efficient work environment for ORNL staff; and ensure adequate flexibility and growth potential for future expanded research missions. The following description of the Master Plan includes a review of the basic guiding principles used in developing the plan, an overall view of the long-term Master Plan, and separate descriptions of each of the phases of the Master Plan growth. Appendix M provides detailed information concerning projects listed in the Master Plan.

3.4.1 Master Plan Vision/goals

The guiding principles for the ORNL Master Plan were developed early in the Laboratory revitalization planning process and incorporated input from a variety of stakeholders, including ORNL research, operations, ESH&Q, land use, program development, and DOE staff. From formal brainstorming sessions, stakeholder surveys, management- and staff-level briefings, and written DOE guidance, an overall vision for the facilities revitalization effort was developed and adopted. That vision is to provide ORNL staff with world-class facilities, consolidated at the main ORNL site, that lay the foundation for ORNL's scientific excellence into the 21st century.

Specific Master Plan goals to be realized when modernization is complete are defined in each of the following areas:

Scientific Mission: Support the multiprogram nature of the Laboratory and accommodate program growth and technology changes well into the 21st century. Integrate the program needs into a research campus environment that encourages interdisciplinary teaming.

Work Environment: Provide a quality work environment for employees and visitors that enhances their productivity and attracts the next generation of world-class scientists to ORNL. Facilities will contain the latest advances in information technology and research laboratory infrastructure and will be designed to provide maximum flexibility for program changes.

Environment, Safety, Health, and Security: Provide a safe, healthy, environmentally conscious, secure workplace for employees and visitors. The Master Plan should maximize the use of already disturbed (brownfield) areas for new development, emphasize energy efficiency and sustainability design features, and provide an open campus security environment wherever possible.

Operations and Maintenance: Provide facilities and infrastructure that are efficient to operate and maintain. New building designs will incorporate energy-efficient heating/cooling systems, utility services, insulation, and exterior surface materials that are state-of-the-art, yet durable and maintainable.

Architectural: Provide a new ORNL campus of unifying architectural style that reflects the mulitprogram scientific nature of the Laboratory mission and celebrates the unique history of the main ORNL site and the natural beauty of East Tennessee. The new research facilities will be built around an identifiable campus center where staff, visitors, and the general public will be welcomed and allowed to meet and exchange ideas.

To accomplish the goal of a fully modernized Laboratory of the 21st Century, ORNL has established a dedicated project team to implement the Facilities Revitalization Project. The FRP team reports to the Director for Facilities and Operations and has a Steering Committee led by the ORNL Deputy

Directors for Operations and Science and Technology. DOE-ORO is providing direct support and leadership for the facilities revitalization effort through a similar Steering Committee headed by the ORNL Site Office Deputy Manager.

The UT-Battelle facilities revitalization approach is to provide new, integrated facilities constructed in close proximity to the existing ORNL strategic research facilities, utilizing a combination of DOE, State of Tennessee, and private-sector financial resources. UT-Battelle will focus DOE capital funding on capabilities that are not likely to be financially or technically feasible by third parties, use State funds for the type of shared scientific facilities appropriate for collaborative research, and use private-sector construction for light laboratory and office support needs that accompany research efforts. These facility types will be constructed in an integrated campus layout that allows the free flow of scientific research between multidivision teams, with consistent architectural themes, regardless of construction funding source.

Because of the magnitude of needed facilities improvements and the historical limitations on federal funding availability, UT-Battelle has implemented an innovative use of federal, private, and State funds to accomplish the facilities revitalization. The key component of this approach is the transfer of land ownership from DOE to allow for (1) construction and lease of buildings by the private sector and (2) siting and construction of State of Tennessee facilities. A mutually acceptable approach for land transfer has been developed between the DOE-OR Realty Office and UT-Battelle that involves the use of DOE's authority under Sect. 161(g) of the Atomic Energy Act and the establishment of a not-for-profit 501(c)(3) corporation by UT-Battelle that will be the responsible party for acceptance of the DOE land, with subsequent lease of that land to the private sector for construction and space rental of the property to UT-Battelle (with DOE approval) for research activities. Under this arrangement, UT-Battelle utilizes the 501(c)(3) corporation to oversee land management, building construction, and lease (for private sector) or MOU implementation (for State of Tennessee) for the FRP, and DOE has transferred, through fee simple title via a Quitclaim Deed, specifically identified parcels of land to that development corporation. A block-flow diagram of this approach is provided in Fig. 3.24. The legal and contractual details associated with this concept are beyond the scope of this document but can be obtained through contact with the UT-Battelle or DOE project managers.

This unique approach requires integrated planning and new facilities construction and operations models to be employed; hence, the decision to implement the first phase as an identifiable project with a specific short-term mission and scope. The FRP team will define the process, implement it for the first round of construction, and provide the project execution framework for the remaining phases of the revitalization effort. However, those future projects will be managed as part of the routine ORNL Facilities and Operations organization mission.

3.4.2 Master Plan for ORNL Site Development

A view of the Master Plan for long-term site development at ORNL is provided as Fig. 3.25, with the planned new facilities highlighted in color by phase of construction. This plan, incorporating the vision and goals described above, focuses on a multicampus layout (East, Central, and West Campuses) to accommodate the multiprogram nature of ORNL research activities. The East Campus was structured to continue the historical mission work in High Energy Physics, Computational Sciences, Chemical/Analytical Sciences and Engineering, and Materials Research, as well as to provide expansion room for the Engineering Technology field of study and future collaborations with UT and the broader university community through new Joint Institutes. The West Campus Master Plan focuses on support of Environmental and Life Sciences research needs, making the Marilyn Lloyd Environmental and Life Sciences Complex historical vision a reality. The Central Campus plan for redevelopment is a bit more

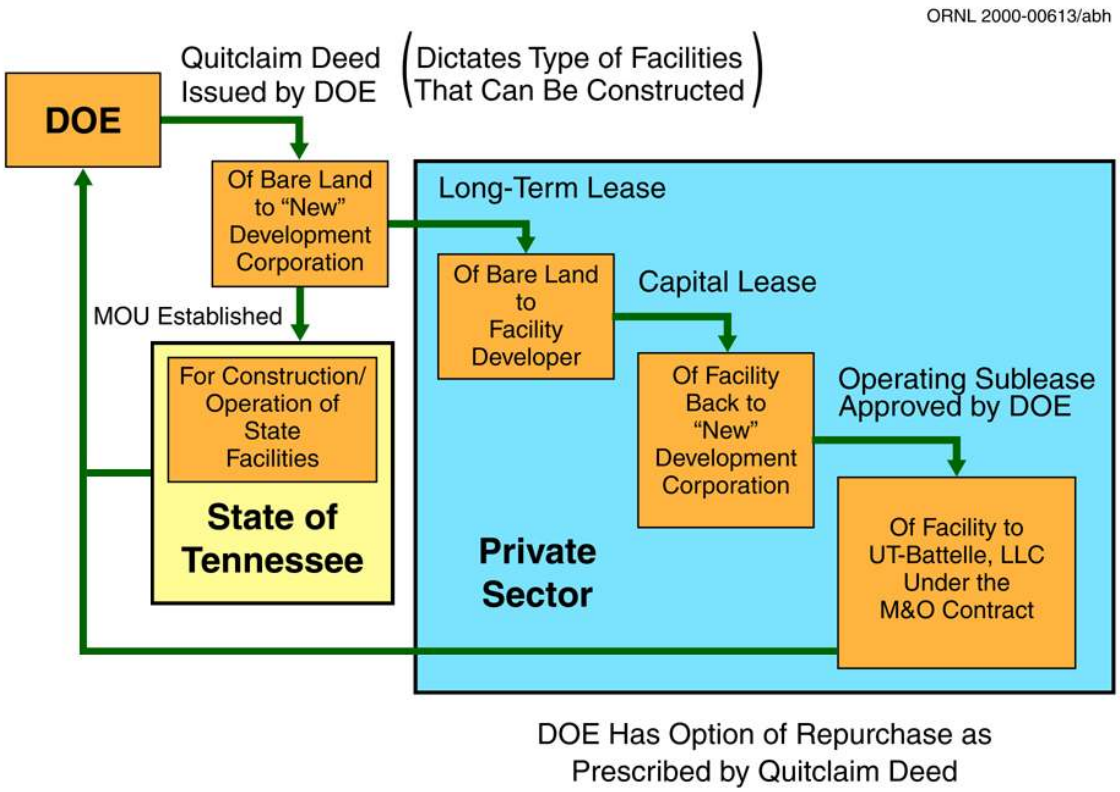


Fig. 3.24. Property/facility lease flow diagram.

complicated, due to the presence of a large number of contaminated facilities that were critical to ORNL's early years and are now part of the EM Program for D&D. That portion of the ORNL site will continue to be a primary area for Solid State, Materials, Energy, Instrumentation, and Chemical Technology research, but with limited new facilities construction planned until D&D activities are completed in 10 to 15 years. Once the Central Campus area is returned to useable/ buildable status, then additional research and support development will occur as part of the long-term Master Plan.

The multicampus site layout provides identifiable campus centers for development in the East, Central, and West portions of the site, around commons areas that promote researcher collaboration, and with reasonable walking distances maintained for all critical services to promote energy savings and improved worker health. The close-pack arrangement of new buildings, and their purposeful proximity to the existing strategic ORNL buildings, minimizes the area required for new development and allows reuse of already disturbed land (parking lots, remediated sites) in a brownfield-type approach. The natural areas on the hillsides overlooking the ORNL site to the north are maintained in their current state under this plan. This entrance area comes to a focal point at the Research Support Center where visitors to the Laboratory will be welcomed, conference facilities are provided, and ORNL staff are encouraged to congregate and collaborate in the main cafeteria facility and surrounding open areas.

Architectural consistency will be provided within each campus to ensure blending of new construction with the existing strategic structures, while allowing state-of-the-art improvements in building sustainability designs. Recognition of the history of the ORNL site will be a critical element of the design and siting of new buildings, with preference given, where possible, to protecting those important features

of the Laboratory. The proposed site layout, use of between-building spaces, and dispersed parking concepts are predicated on a change in the physical security approach at the Laboratory. Such a change would involve, in its simplest form, implementation of access controls on a building-by-building basis through a badge-reader-type system at each building entrance, while site access will be controlled at new portals located east and west of the developed site on Bethel Valley Road.

The emphasis of the Master Plan is on the main ORNL site in Bethel Valley since the majority of the research staff and the old facilities are located there; however, the important missions at HFIR and the Robotics and Process Systems areas (the 7900 and 7600 Areas, respectively) are also integrated into this plan. Facilities improvements and new construction investments will continue to be made in those areas throughout the planning horizon, as noted in the details that follow. As well, the significant investment being made by DOE in constructing the SNS is factored into the ORNL Master Plan, with recognition of the entrance requirements for that facility and the availability of shared resources and facilities.

3.4.2.1 East Campus Design Features

The East Campus (see Fig. 3.25) is built around the new ORNL Research Support Center as the central point for interface with visitors and for congregation of Laboratory staff. This facility contains the visitor reception area, the main ORNL cafeteria, and the primary large auditorium for Laboratory seminars and briefings (with adjacent breakout conference rooms). These conference rooms will also become a critical resource to the Laboratory for support of normal research project teams, university/commercial partnerships, and routine audit teams. Commons areas in front and behind the Research Support Center will provide a quality environment for researcher/visitor interactions and congregating space for conference attendees and lunch-time crowds.

Support for the research mission is a primary emphasis in the East Campus design, with siting proposed for up to eight new research and related buildings within walking distance of the Research Support Center and the current research/administration hub of 4500N/S. These buildings will be phased, as required by program growth, and located in strategic proximity to collaborating organizations. Existing research laboratories and offices in the 4500N/S complex, as well as those in the Physics and Computational Sciences complex in the 6000 Area and the HTML area (4515), will be upgraded, as required, under this Master Plan to bring them up to 21st century technology and infrastructure capabilities to allow them to continue serving as the research backbone for this portion of the Laboratory.

A key component of the new research capabilities in the East Campus will be the addition of a facility to house the Joint Institute for Computational Sciences (JICS) and the Oak Ridge Center for Advanced Studies (ORCAS), a commitment made by the State of Tennessee as part of the UT-Battelle facilities revitalization proposal. This user-facility/scientific-collaboration-type building will be consistent with the open campus nature of the East Campus setting and will be sited to best accommodate researcher/visitor needs. The location of this facility is shown in Fig. 3.25.

Additional facilities currently under construction in the East Campus are a Computational Sciences Building, an Engineering Technology Facility, and a Research Office Building. The Computational Sciences Building, to be located near the JICS, will contain the latest high-speed super computer and research staff associated with computational science research and development. The Engineering Technology Facility will consist primarily of laboratories for testing and research associated with transportation, materials development, and energy research. Research and support staff will be housed in the Research Office Building, which will be located adjacent to these new research facilities. These three facilities, which will contain in excess of 350,000 square feet of new space, will be

interconnected and are designed to improve circulation among 4500N, JICS/ORCAS, and the Research Support Center to promote collaboration.
Utilities and infrastructure improvements will be made as part of the development of the East Campus, with upgrades anticipated in potable water, electrical distribution, steam, HVAC, and wastewater collection/distribution systems. As the majority of new facility construction activities are sited on the former main ORNL parking lot, replacement of that critical piece of infrastructure also becomes important. Traffic flow and parking availability planning has been factored into the Master Plan, with particular emphasis on traffic calming along Bethel Valley Road, visitor parking associated with the Research Support Center, and use of previously disturbed areas for provision of staff parking near places of work assignments.

3.4.2.2 West Campus Design Features

The emphasis on the West Campus development (Fig. 3.25) is to consolidate Environmental and Life Sciences research activities into an identifiable complex surrounding a natural commons area. The existing strategic research facilities housing ESD and Life Sciences Division (LSD) staff will be retained and upgraded as required to meet the state of science in the 21st century. Adjacent to those buildings, the new Laboratory for Comparative and Functional Genomics, the Joint Institute for Biological Sciences, and a proposed Center for Systems Biology office/laboratory facility will be constructed around a commons area, all of which are tied visibly to the East Campus by the landscaped avenue that runs east to west through the main ORNL site. Accomplishing this vision for the West Campus will require the demolition of Building 1000, one of the prime examples of outdated, substandard office buildings that are the focus of the revitalization effort. Similar to the East Campus, upgrades will have to be made in the general infrastructure of the West Campus to accommodate planned growth and replace/reorient roadways and parking.

3.4.2.3 Central Campus Design Features

Few design features have been developed at this point for the long-range redevelopment of the Central Campus area (Fig. 3.25), since remediation of the majority of the structures located there is still 10 to 15 years away. What is planned, however, is the continued use and upgrade of current strategic research facilities in the heart of the campus, the addition of a few key near-term facilities in proximity to existing concentrated program complexes (e.g., the Energy Reliability and Efficiency Laboratory), and longer-term development of a central commons area to be bounded by future mission-related research laboratories/offices. In addition, the Master Plan includes an ultimate relocation of ORNL support services capabilities from the 7000 Area into the center of the ORNL site to complete the consolidation of ORNL operations within the compact, three-campus setting. While the existence of closed/remediated EM sites within the Central Campus area will certainly restrict the location and type of buildings sited, sufficient unrestricted development areas are expected to be made available for the needed ultimate consolidation. In fact, early planned reuse of the remediated surface impoundments area for parking is a good example of the type of brownfield redevelopment that will be the hallmark of the Central Campus revitalization.

3.4.3 Master Plan Phase I: FY 2002–06

Accomplishment of all of the ORNL Master Plan objectives will obviously take many years. Phasing of the project will be required to correspond to the availability of each of the various funding types, the programmatic needs of the research organizations, and the constraints of the existing/planned infrastructure to support construction and operations. The following discussion of each of the planned construction phases is intended to outline the general goals desired for accomplishment during those time frames, blending the reality of these constraints with the strong push from the Office of Science

to modernize ORNL on an ac celerated schedule. The Master Plan has been separated into three primary phases, representing plans for the periods FY 2002–06, FY 2007–11, and beyond FY 2011. Obviously, the details of specific projects and timing gets less clear after the first five years, and for the period beyond FY 2011, information deals only with general programmatic mission potential and the anticipated successful remediation of the Central Campus area by EM.

Phase I is the most critical stage for the revitalization effort, as it is here that the concept of private-sector involvement and State of Tennessee investment in the ORNL campus upgrade must happen. It is here, also, where the "new" look of 21st Century ORNL begins to take shape around the Research Support Center in the East Campus and the Laboratory for Comparative and Functional Genomics in the West Campus. This phase also includes completion of the relocation of ORNL staff (from off-site locations at Y-12 and most leased space) to the main ORNL site. Details of the activities in each campus area are outlined as follows.

East Campus. The research campus nature of the Laboratory will appear during Phase I, with the planned construction of the Research Support Center, three private-sector research buildings, two State of Tennessee Joint Institutes, a general purpose support office building, and the infrastructure that integrates the new facilities with the existing Laboratory and provides a new face to the public and visiting scientists. In addition to the new construction, renovations will begin to take place on existing research and support buildings to accommodate staff consolidation and new science initiatives, the most notable of those being the upgrades to 4500N/S, the HTML, and Building 5500 (for ESH&Q consolidation). Research wings of the 4500N/S complex will be prioritized for upgrade, and staff will be temporarily relocated in a phased approach to allow the existing 1950s laboratories to be updated to current technology. Adjacent to the HTML, a new facility, the AMCL, will be constructed to allow consolidation of the primary ORNL electron microscopes into a single, unique, and highly stable facility to support long-term use of these supersensitive instruments.

As described earlier, the Research Support Center will contain the most public parts of the campus, housing the visitor reception area, main Laboratory conference center, and cafeteria. This roughly 53,000-square-foot facility will be built with DOE Line Item funds and will become the "statement" building for ORNL, with design features that will emphasize the importance of ORNL as one of the country's premier research institutions and incorporate energy efficiency and sustainability in building materials of construction and operation. Its glass facade will front the expanded pond area to the east and a courtyard to the west, providing ORNL staff and visitors an opportunity to embrace the beauty of the East Tennessee setting of the Laboratory during normal conduct of business. Similarly, each of the private-sector buildings will have a view to the north of the existing pond and hillside landscape through glass-enclosed fronts that form the southern boundary of the new campus quadrangle. These roughly 120,000-square-foot laboratory/office buildings will be built in a style complementary to the Research Support Center but will be focused on very specific research mission functions. One will be dedicated to the work performed by Engineering Science and Technology Division, which will be moved from its location at Y-12 into a facility designed to house its special mechanical, thermal, and materials research needs. The second will be designed for movement of the ORNL supercomputer capabilities into 21st Century Laboratory space and establishment of a Computational Science Building at ORNL. The third private-sector building is expected to house energy and materials research staff, as well as support organizations critical to the research mission.

The other new buildings in the East Campus area consist of a DOE GPP-funded office building adjacent to the existing Building 5002, and the two State-funded joint institutes. The Joint Institute for Computational Sciences and the Oak Ridge Center for Advanced Studies will be sited in the East Campus, in close proximity to the Research Support Center and the ORNL Computational Sciences Building to ensure close ties to those complementary functions. The East Campus Service Building

has been proposed to provide a new, more space-efficient and centrally located home for the ORNL Graphics and Reproduction Center, along with office space to be used for temporary overflow space for staff being displaced during the 4500N/S complex upgrades. This facility is expected to utilize the standard office design concept for GPP offices that has worked so effectively in minimizing the cost of construction of standard office facilities at ORNL. The 4500N upgrade program will be initiated in Phase I and will focus on Wing 4 and the headhouse portions of that complex as the first Line Item project, with subsequent projects (over a ten-year period) sequenced, as appropriate, to address the laboratory upgrade needs in the rest of 4500N, 4500S, and the adjacent attached buildings, such 4501, 4505, and 4508.

The primary infrastructure improvements in the East Campus during Phase I will be associated with providing necessary utilities support to the new facilities construction; construction of the roads, walkways, and commons areas between buildings; and the replacement of parking that is eliminated by new campus construction. Another key infrastructure change during Phase I is the reorientation of the security perimeter for the main ORNL site to allow building-controlled access in the East Campus and implementation of a revised traffic/parking plan.

Central Campus. Limited development will be initiated in the Central Campus during Phase I due to ongoing environmental remediation activities throughout this campus. The Advanced Materials Characterization Laboratory, a 12,000-square-foot facility, will house electron microscopes that will foster state-of-the-art materials characterization. This facility will be constructed adjacent to, and west of, the High Temperature Materials Laboratory. The Energy Reliability and Efficiency Laboratory, a new multistory building of approximately 52,000 square feet, will be constructed in the Central Campus. It will be located at the north entrance of ORNL and will provide facilities for R&D activities in support of the Energy Efficiency and Renewable Energy program initiatives in distributed energy resources, electricity transmission and distribution, and net zero energy building systems. This building will be an attractive state-of-the-art facility designed to operate as a demonstration of energy efficiency technology. Energy Star certification will be sought for applicable portions of the building, which will include on-site power generation, virtual laboratory capabilities, and built-in flexibility to incorporate new R&D and next-generation technologies. Utilities will be extended from the existing distribution systems adjacent to the site and will be upgraded as required. New parking lots will be provided in areas that have been remediated by the EM Program.

West Campus. Phase I activities in the West Campus will be centered around the new Laboratory for Comparative and Functional Genomics, a DOE Line Item now in the design stage that will house the ORNL mouse colony critical to ORNL's future genomics research. This 35,000-square-foot facility will allow the mouse colony to be moved from its historical (but now deteriorated) home at Y-12 and open the availability of that important DOE resource to a broader research community.

That enhanced research community will be better able to utilize this resource through the Joint Institute for Biological Sciences (JIBS), a State of Tennessee funded research laboratory and office facility to be co-located in the West Campus during Phase I. Only the necessary infrastructure to support the construction and operation of these facilities will be provided in the West Campus during Phase I, with commons areas, restructured parking, and roads to await Phase II funding.

7600 and 7900 Areas Development. While not within the main ORNL campus boundaries, critical activities are occurring in the Phase I time period in the HFIR/REDC complex (7900 Area) and the Robotics and Process Systems Complex (7600) Area that are important to the overall ORNL revitalization initiative. The improvements to HFIR operations and research capabilities occurring during their ongoing upgrade programs will make the reactor and adjacent facilities more user-friendly and available. To support that increase in mission, several DOE GPP-level projects will be

undertaken in Phase I that will eliminate multiple trailers housing research and support staff, provide much-needed highbay operations and storage areas, and improve the user-facility status of the complex. The 7600 Area has been selected to be the location for consolidation of staff and facilities that have been historically located at Y-12. To allow that consolidation to occur, staff from several divisions in existing 7600 space will have to be moved to the East Campus, upgrades provided for the vacated space, and new DOE GPP facilities constructed (for highbay process space needs). Locations of the planned new facilities in the 7600 and 7900 Areas are shown in Figs. 3.26 and 3.27.

Spallation Neutron Source. The SNS is an accelerator-based, next-generation neutron scattering facility that is under construction on the ORR. It will produce neutron beams that are 12 times as intense as those available from any existing pulsed source, enabling researchers to "see" never-before-observed details of physical and biological materials, ranging from high-temperature super-conductors to proteins. The SNS is the top-priority project of DOE's Office of Science (DOE-SC), which has committed nearly $841 million through FY 2002 for its design and construction. It will play a key role in supporting DOE's goals and strategies in science. (Fig. 3.28).

General-Purpose Line Item, GPP, and GPE Projects. In addition to projects directly associated with the Facilities Revitalization Project, there are numerous projects for general-purpose facilities, improvements, and upgrades needed to assure the adequacy and viability of ORNL's utility system, facilities, and other site infrastructure. Figures 3.29 and 3.30 show locations of general-purpose Line Items and major GPP and GPE projects in Bethel and Melton valleys, respectively. Descriptions of these projects are included in Appendix M.

3.4.4 Master Plan Phase II: FY 2007–11

Phase II of the Master Plan focuses on continuation of the upgrade to the 4500N/S complex in the East Campus area, additional development of the West Campus quadrangle, and refinements of the infrastructure (roads, parking, and utilities) across the ORNL site (Fig. 3.25). While the site construction efforts decrease in Phase II of the plan, significant investments are made in the placement of vacated buildings in "cheap-to-keep" mode and implementation of facility decommissioning for the highest-priority projects. During this phase, cost savings from the Phase I exit from inefficient buildings will peak and will help fund many of the ongoing maintenance improvements needed for the remaining inventory of ORNL facilities.

East Campus. The primary construction activities in the East Campus during this phase will be continuation of the 4500N/S complex laboratory upgrade projects, with completion of that work expected in Phase III. Infrastructure improvements will also continue throughout Phase II, focusing on final road and parking lot upgrades to support the private-sector buildings, traffic calming improvements along Bethel Valley Road, and the more routine utilities and facilities needs for the existing main plant area.

West Campus. In the West Campus, Phase II brings form to the commons quadrangle at that end of the ORNL site. A new Center for Systems Biology Line Item facility will be constructed with common space between it and the Genomics Laboratory/Joint Institute for Biological Sciences complex further to the west. The Biological Sciences facility will provide space to complete the consolidation of all LSD staff from off-site and other on-site locations, finally bringing to fruition the concept of the Environmental and Life Sciences Complex.

General-Purpose Line Item, GPP, and GPE Projects. In addition to projects directly associated with the Facilities Revitalization Project, there are numerous projects for general-purpose facilities, improvements, and upgrades needed to assure the adequacy and viability of ORNL's utility systems, facilities, and other site infrastructure. Figures 3.31 and 3.32 show locations of general-purpose Line Items and major GPP and GPE projects in Bethel and Melton valleys, respectively. Descriptions of these projects are included in Appendix M.

3.4.5 Master Plan Phase III: Beyond 2011

While programmatic and site infrastructure needs are not well defined for the period beyond FY 2011, the Master Plan has incorporated the necessary flexibility and expansion room to accommodate any level of growth that would conceivably occur. This phase of expansion could involve construction of office/laboratory space in the East Campus north of 4500N, additional office/laboratory space to the east of the 6000 Area, new Environmental and Life Sciences expansion in the West Campus, and/or redevelopment of a Central Campus area on sites that are remediated by the EM Program by that time frame (Fig. 3.25). The specific location and program content of those facilities would be determined in the outyears, but the Master Plan approach provides growth potential in areas adjacent to all major science centers within the ORNL main research campus. At this point in time, it may be appropriate to relocate the service functions currently being performed in the 7000 Area into the Central Campus redevelopment in order to make that support more efficient in serving the Laboratory research mission and allow appropriate disposition of those aging facilities.

Infrastructure needs to support the long-range site development will be addressed as decisions are made on the ultimate growth locations. Utilities upgrades and distribution, as well as road access and parking improvements, will be provided as required.

3.5 MASTER PLAN COST AND SCHEDULE

Based on the Master Plan presented in Sect. 3.4, an analysis of the cost and schedule associated with implementation of identified planned projects is shown in Table 3.6. The cost tables in Appendix N provide detailed cost information for each project identified in the Master Plan. Cost and schedule information is necessarily preliminary; detailed construction project estimating will be completed as projects are initiated for design.

The preliminary cost estimates provided are based on the use of site- or region-specific cost factors for each of the primary projects expected to be accomplished during the planning period. These factors include (1) current operating costs of facilities, (2) transition costs of facilities, (3) routine annual S&M costs for transition facilities, (4) gross D&D costs for permanent disposition of surplus facilities, (5) construction costs for facilities to be built by DOE, the State of Tennessee, and the private sector, and (6) relocation costs for moving staff and associated equipment/furniture into new/refurbished facilities.

Traditional funding sources for infrastructure modernization include GPP and GPE budgets, programmatic Line Items, and DOE's MEL-FS Program. The funding levels for landlord GPP and GPE in Table 3.6 for the years FY 2002 through FY 2008 are the target funding levels provided by the Office of Science in April 2002. Also in April 2002, an interim Institutional GPP (IGPP) program was authorized for the years FY 2002, 2003, and 2004. Projections for IGPP funding are provided for each year in Table 3.6. The IGPP program will provide much-needed additional funding; however, additional landlord GPP, GPE, and MEL-FS Program funding is still needed to support the most desirable

Table 3.6. Projected funding requirements for ORNL site development
($ in millions)

FUNDING SOURCE	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
DOE Funding										
Landlord Line Item	7,620	10,816	12,230	24,385	31,225	28,050	26,600	23,400	20,600	18,200
Landlord GPP	7,029	6,200	6,400	6,500	7,200	7,800	8,000	9,350	13,200	10,800
Institutional GPP	2,250	3,870	5,540	5,200	4,825	3,515	3,200	3,800	2,100	1,100
Landlord GPE	1,413	2,549	2,820	1,900	1,900	2,000	2,000	6,140	7,231	7,179
Total	**18,312**	**23,435**	**26,990**	**37,985**	**45,150**	**41,365**	**39,800**	**42,690**	**43,131**	**37,279**
Programmatic Line Item	293,305	236,971	149,600	119,980	68,400	82,900	52,800	30,400	1,400	1,400
Programmatic GPP	2,810	9,523	9,563	8,170	7,325	500	1,350	500	0	0
Programmatic GPE	271	596	750	0	0	0	0	0	0	0
Total	**296,386**	**247,090**	**159,913**	**128,150**	**75,725**	**83,400**	**54,150**	**30,900**	**1,400**	**1,400**
State of Tennessee Funding										
Facilities Construction	8,000	2,000	2,000	8,000	6,000	0	0	0	0	0
Facilities Operation	0	206	212	436	672	692	713	734	756	779
Total	**8,000**	**2,206**	**2,212**	**8,436**	**6,672**	**692**	**713**	**734**	**756**	**779**
Private-Sector Funding										
Facilities Operation & Utilities	0	3,652	8,550	8,550	8,500	8,500	8,500	8,500	8,500	8,500
Total	**0**	**3,652**	**8,550**	**8,550**	**8,500**	**8,500**	**8,500**	**8,500**	**8,500**	**8,500**
DOE Operating Expense										
Facilities Consolidation	1,200	4,500	14,900	875	500	225	225	225	225	225
Facilities D&D	3,125	1,200	15,700	20,000	15,000	10,000	5,000	5,000	5,000	5,000
Facilities Operation	20,600	20,600	20,600	20,600	20,600	20,600	20,600	20,600	20,600	20,600
Total	**24,925**	**26,300**	**51,200**	**41,475**	**36,100**	**30,825**	**25,825**	**25,825**	**25,825**	**25,825**

development schedule for ORNL's Facilities Revitalization Project. ORNL has also established innovative arrangements to add funding from the State of Tennessee and the private sector to support modernization needs.

Figure 3.33 is a needs chart for landlord funding to support the timely implementation of infrastructure modernization at ORNL. The FY 2001 through FY 2003 figures for general plant projects and general-purpose equipment reflect current budget guidance from the Office of Science. FY 2004 through FY 2011 reflect requirements, originally identified in the FY 2000 *ORNL Strategic Facilities Plan*, which have subsequently been updated to reflect the impact of actual budgets. The Line Item project requirements reflect all funding for each Line Item being budgeted in the first year of the Line Item schedule.

A high-level schedule of major modernization projects is shown in Fig. 3.34.

4. CONCLUSIONS AND RECOMMENDATIONS

The vision to establish ORNL as a 21st Century Laboratory and to ensure that the Oak Ridge Reservation (ORR) serves as an integrated science, education, industrial, and technology complex is vital to the future mission of the Laboratory. UT-Battelle has established a comprehensive and innovative approach to accomplish this vision and has the support and cooperation of DOE, the State of Tennessee, and stakeholders. With completion of the ORNL Integrated Facilities Master Plan and attainment of goals for the ORR, present missions will be successfully achieved while preparing for changing national goals and interests and reduced federal budgets.

4.1 LAND AND FACILITIES PLAN CONCLUSIONS

The ORR is a unique and irreplaceable resource for DOE to use for its national science and technology missions. Availability of the land on the ORR for future DOE projects requiring large land areas (e.g., SNS, Fusion Energy, environmental research, safety, and security) is a primary concern.Future use is to include a mixture of activities that are compatible with and contribute to ongoing and anticipated DOE missions. According to current plans, the reservation will be used to support many of the same programs it currently supports while adapting to changing national goals and interests and reduced federal budgets. Portions of the reservation will be used to promote the development of private-sector enterprises in ways that are consistent with and complementary to DOE missions. As outlined in Sect. 2, input from discussions with DOE programs as part of the DOE Land Use Planning Process indicates that most of the ORR land, except for areas around ETTP, will be needed for future DOE missions during the next 5 to 20 years. Land use planning for the ORR should identify and prioritize needs for preservation of reservation land to meet the requirements of existing and future scientific facilities, environmental research, education, and other compatible uses.

ORNL currently has one of the oldest physical plants in the DOE laboratory system, which requires efforts to maintain, renovate, and rehabilitate general-purpose buildings and utility systems, as well as to provide new mission-related facilities for expanded scientific endeavors. As outlined in Sect. 3, ORNL has developed a Master Plan for site development that supports the Laboratory's expected mission needs during the planning period; establishes a safe, high-quality, energy-efficient work environment for research and support staff in a research campus setting; and addresses the long-term maintenance and ultimate disposition of "retired" facilities in an environmentally acceptable manner. This plan will result in the consolidation of ORNL space from the current occupied levels of more than 4.8 million square feet to just over 3.2 million square feet, with the consolidated staff residing almost exclusively at the main ORNL site. Considerable resources will be required for the consolidation, deactivation, disposition, and surveillance and maintenance of excess facilities. The Master Plan outlines a phased approach to facilities modernization, with the primary emphasis during the planning period placed on establishing the East Campus infrastructure, constructing and refurbishing critical mission-oriented research facilities, and moving staff from Y-12 to the main ORNL site. The second phase will include completion of the East Campus core construction, continuing consolidation of off-site staff at the main ORNL site, and primary development of the ORNL West Campus for life and environmental sciences research.

The Enhanced Operational Discipline includes the task of upgrading the Laboratory's infrastructure and providing effective stewardship of facilities and operations resources. The development of a management process to enhance research and support operations through Facility Use Agreements, Complex Managers, Facility Core Teams, and integrated operations has been initiated. The system

will define work processes and ownership, establish responsibilities and authorities, and develop continuous improvement targets for work processes.

ORNL faces an enormous challenge in the deactivation and disposition of its nonstrategic facilities. Many of these facilities are large and complex, and some contain multiple hazards. The estimated cost of facilities consolidation and S&M during the time frame of the ORNL *Strategic Facilities Plan* (FY 2001–FY 2011) is $113 million. The estimated cost for ultimate D&D of ORNL's nonstrategic facilities is $126 million. Under the present schedule and budget projections, most D&D activities will be conducted after FY 2011.

4.2 LAND AND FACILITIES PLAN RECOMMENDATIONS

4.2.1 Oak Ridge Reservation

1. Land must be preserved for future DOE programs. (The ability and/or opportunity to acquire another land area such as the ORR is not feasible.)

2. Research and scientific values are critical and must be reflected in land use planning.

3. Buffer zones must be considered. (They are required by environmental Records of Decision, safety basis documents, security requirements, etc.).

4. Future land use should incorporate provisions for potential Fusion Energy programs.

5. Future biomass opportunities, in existing programs and as a program itself, should be considered.

6. Future Carbon Sequestration program opportunities should be considered.

7. Energy Efficiency programmatic requirements must be considered in land use planning, even if it is not a DOE-EE facility/program.

8. The Environmental Management (EM) strategy for waste management must be considered in planning.

9. The funding mechanism for management of the reservation should be resolved. ORNL should not be "tin cupping" the National Nuclear Security Administration (NNSA) and EM for resources to support this DOE asset. There is an immediate and growing threat to personnel safety and property and concern regarding wildfire potential to the entire site as a result of dead and dying trees.

4.2.2 ORNL Facilities

1. DOE funding for the MEL/FS Line Item Program must be increased in order to meet Facility Revitalization objectives. Specifically, increased funding for the Research Support Center line item is needed so that this project can be completed in FY 2004 rather than FY 2005. If not, major disruptions to the entrance to the Laboratory will exist for approximately the next three years.

2. DOE customers must be prepared to support relocation costs. Four divisions continue to occupy facilities at the Y-12 National Security Complex: the Nuclear Science and Technology Division, the Life Sciences Division, the Engineering Science and Technology Division, and the Fusion Energy Division. Programs supporting these divisions must be prepared for decreased levels of scientific productivity during periods of physical relocation. Additional program resources may also be needed to move high-value program-dedicated equipment.

3. DOE support in revising an MOU concerning the disposition of facilities at Y-12 is critical to reducing ORNL's cost of exiting from Y-12. Buildings 9102-1, 9102-2, 9105, 9108, and 9201-3 have already been transferred from ORNL to Y-12. Further transfers are being vigorously pursued.

4. An increase in GPP and GPE budgets is needed. Since FY 1997, GPP and GPE funding have been approximately half of the FY 1995 level. As ORNL facilities continue to age, requirements in these areas continue to grow, and projected funding levels are clearly well below the level needed. Although the addition of Institutional GPP funding will help, an increase in GPP and GPE funding levels by DOE to pre-FY 1996 levels is still critical.

5. Strong support is needed for the ORNL Science Laboratory Infrastructure budget request associated with disposal of excess facilities. ORNL has numerous facilities that are not part of the DOE-EM cleanup baseline. These facilities may not represent large ES&H risks, but they are no longer needed to fulfill DOE missions and are expensive to maintain in a safe shutdown condition.

6. Resources necessary to address legacy issues should be provided. ORNL has targeted four legacy items to be addressed in FY 2003: cleanup of legacy materials, upgrade of nonreactor nuclear facilities and consolidation of hot cells, facilities modernization, and disposition of vacant space. The estimated cost to begin to address these items in FY 2003 is $10 million, $7.2 million of which has already been included in the Indirect Cost Stack. We will allocate this cost via a rate applied to direct labor hours (excluding SNS). We anticipate that this legacy tax will be required for a minimum of five years. This separate legacy tax not only provides incremental resources but also ensures that these legacy challenges remain highly visible to both our internal and external customers. It is essential that DOE recognize and acknowledge the institutional nature of this legacy effort.

7. Disposition of legacy material must be addressed. A major vulnerability was identified that is associated with legacy material in ORNL facilities. Legacy materials range from remote-handled reactor components, to small quantities of chemicals used and created at the bench, to furniture and excess laboratory and infrastructure equipment. These materials present safety issues, mission impacts, and, in some buildings, are a critical path item in executing facility revitalization. A major focus in FY 2003 is to identify and implement "breakthrough" disposition methods that will reduce costs and shrink time lines. A significant cost savings could be realized if some of these materials could be disposed of in the EM CERCLA Disposal Cell.

8. Resources for transition of waste management responsibilities should be provided. DOE-EM is seeking an accelerated transfer of responsibilities for currently generated wastes to ORNL. This transfer of responsibilities, if not accompanied with commensurate resources, could be the single largest new overhead cost driver facing the Laboratory in FY 2003. We need DOE-SC's support in ensuring appropriate resources are transferred along with this responsibility.

9. Consolidation of nonreactor nuclear facilities should be pursued. We have initiated a reorganization plan at ORNL that includes the consolidation of the ten nonreactor nuclear facilities into a single "Nonreactor Nuclear Facilities Complex" that will be managed in an "owner/tenant" model. A key objective to be accomplished in FY 2003 will be to gain DOE approval on a consolidation strategy to reduce the number of nuclear facilities. A second aspect of this plan is to secure $7 million in base program funding for the ongoing maintenance and operation of the Bethel Valley Hot Cell complex. We need DOE-NE support for these critical resources; otherwise, long overdue upgrades to these nuclear facilities will continue to be delayed.

10. The Facility Management Model to enhance support for R&D operations and improvements in maintenance of Laboratory infrastructure should be aggressively pursued.
11. The Facility Information Management System should be updated and maintained with current and accurate data.

12. Detailed plans, patterned after the *Central Steam Plant 10-Year Plan*, should be developed for each site utility system.

13. Integrated planning of infrastructure revitalization activities with EM Program remediation, decontamination, and demolition activities should be enhanced.

5. REFERENCES

Awl, D. J., L. R. Pounds, B. A. Rosensteel, A. L. King, and P. A. Hamlett. 1996. *Survey of Protected Vascular Plants on the Oak Ridge Reservation*. June.

Comprehensive Integrated Planning Process for the Oak Ridge Operations Sites. 1999. ORNL/M-6717. September.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States*. FWS/OBS-79/31. U.S. Fish and Wildlife Service, Washington, D.C.

DOE (U.S. Department of Energy) 1989. *Oak Ridge Reservation Site Development and Facilities Utilization Plan*. DOE/OR-885. Oak Ridge, Tennessee. June.

DOE Land and Facility Use Policy. DOE P 430.1. December 21, 1994.

DOE 1995. *Environmental Monitoring Plan for the Oak Ridge Reservation*. DOE/OR-1066R1. United States Department of Energy Oak Ridge Field Office, Oak Ridge, Tennessee. May.

DOE 1996a. *Comprehensive Land-Use Planning Process Guide*. Office of Field Management. March.

DOE 1996b. *Charting the Course, The Future Use Report*. DOE/EM-0283. Office of Environmental Management, Office of Field Management. April.

DOE 1997. *DOE Emergency Management Guide, Hazards Surveys and Hazards Assessments*. DOE G 151.1-1. August.

DOE 1998. *DOE Oak Ridge Reservation Emergency Plan*. EMPO-500. April.

DOE 1999. *Wetland Mitigation Plan for Bear Creek Valley, Oak Ridge, Tennessee*.DOE/OR/011850 D1. November.

Durr, P. C. PTRL Environmental Services. Letter Report to P. D. Parr, Oak Ridge National Laboratory, Oak Ridge, Tennessee. September 1999.

DuVall, G. D. and P. A. Souza. 1996. *An Evaluation of Previously Recorded and Inventoried Archeological Sites on the ORR, Anderson and Roane Counties, Tennessee*. ORNL/M-4946. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Environmental Sciences Division. 1998. *Environmental Sciences: Research, Assessment, and Technology to Understand and Meet the Challenges of the Future*. ORNL/M-5911C. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Hughes, J. F., S. D. Thompson, L. W. McMahon, M. L. Coffey, W. Koncinski, T. W. Joseph, C. E. Mulkey, S. Lyttle, and G. Sweeden. 2001. *Oak Ridge Reservation Annual Site Environmental Report for 2000*. DOE/ORO/2119. September.

The Keystone National Policy Dialogue on Ecosystem Management, Final Report. 1996. The Keystone Center, Colorado. October.

Mann, L. K., P. D. Parr, L. R. Pounds, and R. L. Graham. 1996. *Protection of Biota on Nonpark Public Lands: Examples from the U.S. Department of Energy Oak Ridge Reservation*. Environmental Management. 20: 207-218.

Mitchell, J. M., E. R. Vail, J. W. Webb, A. L. King, and P. A. Hamlett. 1996. *Survey of Protected Terrestrial Vertebrates on the Oak Ridge Reservation*. ES/ER/TM-188. May.

The Nature Conservancy. 1995. *Oak Ridge Reservation, Biodiversity, and the Common Ground Process, Preliminary Report on the Oak Ridge Reservation.*

Neilson, R. P. and D. Marks. 1994. "A Global Perspective of Regional Vegetation and Hydrologic Sensitivities from Climate Change." *Journal of Vegetation Science.* 5:715-730.

Oak Ridge National Laboratory Institutional Plan, FY 2002–FY 2006. 2001. ORNL/PPA-2001/2. Oak Ridge National Laboratory, Oak Ridge, Tennessee. December.

Oak Ridge National Laboratory Land and Facilities Plan. 2000. ORNL/TM-2000/237. December.

Oak Ridge Reservation Management Plan. 1999. ORNL/M-6614. February.

Peterson, M. J. July 31, 2000. Biological Monitoring and Abatement Program, Quarterly Progress Report, Second Quarter, 2000. Oak Ridge National Laboratory.

Phase I Environmental Report for the Advanced Neutron Source at Oak Ridge National Laboratory. 1992. ORNL/TM-12069. Oak Ridge National Laboratory, Oak Ridge, Tennessee. February.

Pounds, L. R., P. D. Parr, and M. G. Ryon. 1993. *Resource Management Plan for the Oak Ridge Reservation. Volume 30: Oak Ridge National Environmental Research Park Natural Areas and Reference Areas—Oak Ridge Reservation Environmentally Sensitive Sites Containing Special Plants, Animals, and Communities.* ORNL/NERP-8. Oak Ridge, Tennessee. 20 pp.

Smith, J. G., M. J. Peterson, M. G. Ryon, and G. R. Southworth. March 22, 2000. Biological Monitoring and Abatement Program, Oak Ridge National Laboratory, Progress Report for October 1, 1999–March 31, 2000.

Soles, R. E., Executive Director, U.S. MAB Secretariate. Letter to R. I. Van Hook, Oak Ridge National Laboratory, Oak Ridge, Tennessee. December 6, 1988.

Souza, P. A., G. D. DuVall, and N. Tinker. 1997. *DOE Oak Ridge Operations Office Cultural Resource Management Plan, Anderson and Roane Counties, Tennessee.* ORNL/M-5080. Oak Ridge National Laboratory, Oak Ridge, Tennessee. September.

Souza, P. A., G. D. DuVall, N. Tinker, and M. J. Hart. 2001. *Cultural Resource Management Plan, Department of Energy Oak Ridge Operations Office, Anderson and Roane Counties, Tennessee.* Oak Ridge, Tennessee. July.

Washington-Allen, R. A., T. L. Ashwood, S. W. Christensen, H. Offerman, and P. Scarbrough-Luther. 1995. *Terrestrial Mapping of the Oak Ridge Reservation: Phase I.* ES/ER/TM-152. Oak Ridge National Laboratory, Oak Ridge, Tennessee.