4 Watershed Management Goals

4.1 Drinking Water Protection Goals

4.1.1 Water Quality Goals

The enabling legislation for the Division of Water Supply Protection directs the agency "… *to assure the availability of pure water for future generations."*

Water quality in the Quabbin Reservoir depends on many watershed features, including natural characteristics, land use, and hydrology. A major tenet of watershed management is protection through ownership of watershed lands. Owning and managing watershed forest lands is recognized as the most direct and proven method of protecting long-term water quality.

The Division of Water Supply Protection continually assesses the quality of the water, and develops management strategies that assure the availability of clean water. DWSP has defined primary and secondary water quality goals for the system.

Primary Goals for Water Quality

- PREVENT WATERBORNE DISEASE.
- MEET THE SOURCE WATER COLIFORM CRITERION.
- MAINTAIN HIGH QUALITY SOURCE WATER.

Secondary Goals for Water Quality

- REDUCE/CONTROL NUTRIENT INPUTS TO THE RESERVOIRS.
- REDUCE RISK OF A CHEMICAL OR HAZARDOUS MATERIAL SPILL.
- CONTROL GENERAL POLLUTANT TRANSPORT INTO THE RESERVOIR.

These goals are used to make and evaluate all management decisions. The Division's Environmental Quality Section routinely collects samples from stations on tributary streams and from reservoir stations at Quabbin. The water quality data are reviewed as part of DCR's Watershed Management Program decision making process. Additionally, MWRA has a detailed water quality sampling program beginning at the Cosgrove Intake and throughout the water transmission and distribution systems. These data are used with the Environmental Quality Section's data to continually monitor the reservoir and watershed systems.

The maintenance of DWSP controlled land to provide the best watershed cover to protect water quality is the overall goal of the Land Management Plan. The main water quality concerns in land management are:

- **Limit pathogen introduction and transport to the reservoir and intakes**. This goal will be met primarily through continuation of the *Gull Harassment Program* and *The Aquatic Mammal Pathogen Control Program* as well as by maintaining a vigorous forest cover throughout the watershed (see section 5.4.4).

- **Limit turbidity and sediment transport.** Although the size of the Quabbin Reservoir and the location of the intakes prevent localized sediment transport from affecting drinking water quality during normal events, making sure the watershed can control sediment transport during and following major disturbances is a guiding goal of the Land Management Plan. In addition to addressing major events, control methods focus on preventing sediment transport from the road system and during active forest management activities.

- **Limit nutrient transport to the reservoir.** Although Quabbin Reservoir on the whole is oligotrophic (low in dissolved nutrients and rich in dissolved oxygen), there have been nutrient-related algae blooms in the past that affected taste and odor. Nutrient transport to the reservoir will be limited through protection of riparian zones and by maintaining vigorous forest growth throughout the watershed.

- **Maintain the low Total Organic Carbon (TOC) level in the reservoir.** One of the parameters that exemplify the high quality of water in the Quabbin Reservoir is its low TOC levels. While all the links between land management and TOC are not clear, the high percentage of forest cover appears to be associated with low TOC levels. Further research will gradually quantify the sources of TOC and its watershed-scale control.

4.1.2 Water Yield Goal

- WORK TO MAINTAIN CURRENT WATER YIELDS TO THE QUABBIN RESERVOIR

In the past, insufficient supply was a concern for the system, resulting in management efforts to increase yield, as well as proposals to divert waters from the Connecticut or Millers Rivers to increase the Quabbin supply. Significant effort was devoted to developing land management strategies that would increase water yield, including converting pine plantations back to fields (because grass cover uses significantly less water than maturing conifer cover, resulting in greater yield). Concurrently, the MWRA has devoted considerable efforts to managing demand; as a result, the overall system demand has significantly decreased (see Figure 2 above). Water demand in 2004 decreased to the level of the system demand in the 1920s, and demand is predicted to remain well below safe yield into the foreseeable future. Unless the system is greatly expanded, current yields are well above demand and there are currently no plans for yield enhancement under consideration.

4.2 Land Protection Goals

- CONTINUE WORKING TO LIMIT LAND USES ON THE WATERSHED TO THOSE THAT DO NOT THREATEN WATER QUALITY.

- PROVIDE CONTROL OVER NON-FOREST LAND USES, THE EFFECTS OF NATURAL EVENTS, AND HUMAN ACTIVITIES THAT THREATEN WATER OR OTHER NATURAL RESOURCES.

Control over harmful activities on the Quabbin Reservoir watershed is best achieved when the Commonwealth has actual ownership or other direct control over allowable activities on the land. DWSP has an active land acquisition program geared towards acquiring ownership or other rights on key parcels on the watershed - primarily those near principal tributaries and wetlands. Once acquired, these lands can then be managed to establish and maintain optimal cover types that provide for the long-term protection of water quality.

The location, marking, and maintenance of the boundaries of DWSP watershed lands are important land protection activities, since clear boundaries allow for better control over illegal activities that could threaten watershed integrity. Effective resolution of boundary encroachments is an integral part of boundary maintenance.

The control of potentially harmful activities on watershed lands requires a human presence on those lands, both to identify and locate those activities, and to provide effective enforcement of rules and regulations. This presence is provided by DWSP personnel, and is a principal responsibility of the DWSP Watershed Rangers. This presence allows for the timely discovery and resolution of potentially harmful human activities (e.g., illegal dumping) and natural events (e.g., fires) on the watershed.

Effective monitoring and control also depends on a good road system that allows quick access to all parts of the watershed lands. However, since gravel roads can also be a source of sediments for streams and water bodies, watershed road maintenance strives to disconnect roads from water sources through a variety of Conservation Management Practices, in order to minimize these potential adverse impacts.

Finally, land protection goals can sometimes be best served through the designation of restricted use areas, on which management and other human activities are more tightly limited than on routinely managed areas. Such designations are appropriate on sites where the topography, hydrology, vegetation or other characteristics limit the potential benefits of active management, as well as sites where rare habitats or species have been identified and require special limits on management.

4.3 Land Management Goals

4.3.1 Goals for DWSP-Controlled Forested Areas under Active Management

- IMPROVE THE ABILITY OF THE WATERSHED FOREST TO RESIST AND RECOVER FROM DISTURBANCE (INCLUDING WIND, FIRE, INSECTS, DISEASES AND CLIMATE CHANGE).
    - CREATE AND MAINTAIN DIVERSE FOREST COMPOSITION (SPECIES, AGE, TREE SIZE, AND FOREST STRUCTURE; WITHIN STANDS AND IN THE MOSAIC OF CONDITIONS ACROSS THE LANDSCAPE).
    - MAINTAIN THE ABILITY OF THE FOREST TO ESTABLISH REGENERATION AT LEVELS OF DENSITY AND DIVERSITY THAT ARE SUFFICIENT TO PROVIDE LONG-TERM DRINKING WATER PROTECTION.
    - MAINTAIN AND ENHANCE OVERALL FOREST VIGOR.
    - ENCOURAGE LONG-LIVED SPECIES THAT ARE WELL SUITED TO THEIR SITES.
    - DISCOURAGE INVASIVE PLANTS THAT MONOPOLIZE FOREST UNDERSTORIES.
- PROMOTE NUTRIENT ASSIMILATION, FILTRATION, AND STREAM TEMPERATURE REGULATION BY MAINTAINING PLANT SUCCESSION AND VIGOROUS FOREST GROWTH.

- PREVENT SOIL DEGRADATION AND EROSION OF NUTRIENTS AND SEDIMENTS BY COMPLYING WITH OR EXCEEDING ENVIRONMENTAL REGULATIONS FOR TIMBER HARVESTING, AND BY MATCHING HARVEST SYSTEMS WITH SITE CONDITIONS.

- CONDUCT MANAGEMENT IN A MANNER THAT ENSURES THAT THE BENEFITS OF MANAGEMENT OUTWEIGH NEGATIVE IMPACTS. LIMIT REGENERATION CUTTING TO NOT MORE THAN 25% OF THE FOREST OF ANY GIVEN SUBWATERSHED DURING ANY GIVEN 10 YEAR MANAGEMENT PERIOD.

- ALIGN SILVICULTURAL OBJECTIVES WITH HYDROLOGIC CONDITIONS.

- ADDRESS SECONDARY OBJECTIVES, INCLUDING THE CONSERVATION OF BIOLOGICAL DIVERSITY WHERE THEY ARE COMPATIBLE WITH THE PRIMARY OBJECTIVES FOR DRINKING WATER SUPPLY PROTECTION.

The Division has determined that diverse, vigorous forest cover provides unparalleled water quality and should be maintained on the vast majority of its lands. The chief value of this green infrastructure is to dissipate the energy of rain and snow melt and slow the passage of water across the land and through the soils, thereby reducing erosion and allowing vegetation, soils, organic debris, and wetlands to filter out pollutants before they reach the reservoir.

In a well-maintained watershed protection forest, rain and snow are intercepted by a complex canopy structure of varying heights, densities, and tree species. Young stands vigorously capture and sequester inorganic nutrients as they grow. Impacts from exceptional rainfall or snowmelt events are moderated by the enormous infiltration and water storage capacities of forest soils rich with organic matter. Furthermore, when the ability of the forest to regenerate itself is maintained continuously, the presence and/or rapid recovery of young trees, shrubs, and herbs provides uninterrupted protection against erosion of sediments and nutrients following disturbance, even when the overstory is severely impacted. Similarly, when snow and ice damage the younger components of the forest, the maturing overstory resists this damage and provides seed to replenish the damaged understory.

The desired future condition for the watershed protection forest is a mosaic of tended and untended patches incorporating both inherent and planned diversity, which together enhance long-term forest stability. It is important to recognize that watershed forests are varied in terms of potential to sequester nutrients and excess water. Rich mesic forests adjacent to watercourses have a greater capacity than upland areas to consume nutrients and water and provide high shade. However, upland areas also require an understory and permeable soils for the maintenance of infiltration capacity. In all cases plant succession needs to proceed without excessive interference by herbivores and invasive plants in order to assure the rapid replacement of forest cover when it is reduced by disturbances.

The watershed protection forest has to cope with a wide variety of natural disturbances. Hurricanes have historically been the most catastrophic of these disturbances, although less frequent then smaller storms and insects and diseases. Plant abundance, diversity and vigor are key attributes that allow a forest to resist and recover from storms, diseases, insects, fire, human pollution and climate change. Where regeneration has been slowed by past land use practices or herbivore impacts, enrichment planting can 'jump-start' the development of abundance and diversity. Overall forest vigor is improved with treatments that favor long-lived trees well suited to their sites, thus producing a low-maintenance forest cover capable of providing perpetual, reliable filtration for drinking water sources.

The long term goal of this watershed forest management plan is to develop a highly diverse, vigorous, multiple age-class forest condition (O'Hara, 1998). This low maintenance watershed forest will make it

possible to maintain high water quality with minimal intervention. The development of such a forest at Quabbin is a long process for several reasons. Plant succession was severely impaired by excessively high deer populations for the first five decades of this water supply's history. Since the initiation of deer population control (in 1991) and the renewal of forest regeneration and general plant succession, Quabbin foresters have been able to start the process of diversifying the structure and composition of this water supply protection forest. While regeneration is now possible, the residual effects of protracted and excessive browsing will remain apparent in the absence of mid-canopy forest and the dominance of species resistant to browsing (e.g., white pine and black birch), for decades to come.

DCR's goal is to move to a multi-aged, species-diverse structure and composition as quickly as possible; the timing, however, is limited by staff size, self-imposed and general regulations on management practices, invasive plants, insects, and diseases, and the pace of plant succession and growth. The vast size of the Quabbin watershed, fluctuations in both economic and public values and uncertainties about the effects of global climate change are among the factors that conspire to make the exact timeline for achieving this goal very difficult to predict. However, this plan for the coming decade will outline objectives (section 4.2) based on our most recent experiences of what is possible and our conservative interpretation of the state of the science of watershed forest management.

4.3.2 Goals for Non-Management Areas with Forest Cover

- MAINTAIN ACCESS IN ORDER TO FACILITATE EMERGENCY RESPONSE TO FIRES, RECREATIONAL ACCIDENTS, AND TO MANAGE INVASIVE SPECIES INCURSIONS.

- PREVENT THE SPREAD OF FIRE, TO THE EXTENT POSSIBLE, INTO OR OUT FROM THESE AREAS UNLESS THESE FIRES ARE PERCEIVED TO BE BENEFICIAL.

- CONTROL THE ESTABLISHMENT AND SPREAD OF INVASIVE SPECIES IN THESE AREAS ACCORDING TO PLANS FOR INVASIVE SPECIES CONTROL ADOPTED FOR ALL DWSP PROPERTIES.

- MANAGE WILDLIFE POPULATIONS WITHIN THESE AREAS ACCORDING TO WATERSHED-WIDE OBJECTIVES ESTABLISHED FOR THESE SPECIES.

- INVENTORY AND PROTECT ENDANGERED SPECIES AND HABITATS WITHIN THESE AREAS WITH GUIDANCE FROM THE NATURAL HERITAGE AND ENDANGERED SPECIES PROGRAM.

Approximately 33% of DWSP properties surrounding Quabbin Reservoir have been identified as areas where active, conventional forest management will not occur, either because it is impractical (steep slopes, islands) or prevented by regulation (wetlands,) or because the area has been deliberately reserved from management in order to meet other objectives (Pottapaug Natural Area, portions of Quabbin Park). The goals for these non-management areas vary somewhat from site to site.

4.3.3 Management Goals for Non-Forested Areas

- ENSURE THAT THE MAINTENANCE OF NON-FORESTED HABITATS HAS NO NEGATIVE IMPACT ON WATER QUALITY, THROUGH THE USE OF STRICT CONSERVATION MANAGEMENT PRACTICES, INCLUDING THE MAINTENANCE OF FORESTED BUFFERS ALONG ADJACENT WATER RESOURCES.

- PROTECT AND ENHANCE THIS DIMINISHING HABITAT FOR SPECIES OF WILDLIFE THAT ARE CONSIDERED UNCOMMON, RARE OR UNIQUE ON A REGIONAL OR STATEWIDE BASIS.

- MAINTAIN THIS IMPORTANT COMPONENT OF THE AESTHETIC DIVERSITY OF THE LOCAL LANDSCAPE, WHERE APPROPRIATE AND NOT IN CONFLICT WITH WATER RESOURCE PROTECTION.

- PREVENT THE ESTABLISHMENT AND PURSUE THE ACTIVE REDUCTION OF ALIEN, INVASIVE PLANT SPECIES THAT MAY BE OR BECOME ASSOCIATED WITH THESE HABITATS.

- PRESERVE IMPORTANT HISTORICAL AND CULTURAL RESOURCES WITHIN THESE AREAS.

There are limited areas on DWSP-controlled properties surrounding Quabbin Reservoir that are not maintained in forest cover, including Administration Areas (parking lots and grounds around office buildings, shops and storage facilities), Recreation Areas (fishing areas, Quabbin park, scenic lookouts), Quabbin Cemetery, areas kept open as a component of the Water Supply Infrastructure (dam faces, emergency spillways), limited fields maintained for the promotion of biological diversity (fields in Gates 15, 17, 20, 29) and Rights-of-Way (power lines, public roads).

4.4 Wildlife Management Goals

- MITIGATE ADVERSE IMPACTS OF WILDLIFE ON WATER QUALITY, WATER SUPPLY INFRASTRUCTURE AND OTHER WATERSHED RESOURCES.

- PROTECT UNCOMMON, RARE, AND OTHERWISE SIGNIFICANT WILDLIFE SPECIES AND HABITATS WHEREVER THEY EXIST ON DIVISION LANDS.

- ASSESS AND MITIGATE IMPACTS OF WATERSHED MANAGEMENT ACTIVITIES ON WILDLIFE THROUGH A PROCESS OF NOTIFICATION, SITE VISITS, REVIEW OF RECORDS AND LITERATURE, AND RECOMMENDATIONS TO APPROPRIATE MANAGEMENT STAFF.

- ACTIVELY MANAGE HABITATS IN ORDER TO SUPPORT SELECTED WILDLIFE SPECIES THAT ARE CONSIDERED TO BE UNCOMMON, RARE, OR UNIQUE ON A REGIONAL OR STATEWIDE BASIS.

The primary goal of the wildlife program on the Quabbin watershed is to protect the water supply from adverse impacts caused directly or indirectly by wildlife. The Division is required by state and a federal law as well as agency mandates to protect species considered to be rare, uncommon, threatened or endangered. In general, the Division works to protect important wildlife and their habitats while minimizing or eliminating adverse wildlife impacts on other watershed resources. In certain circumstances, where applicable, active management to enhance wildlife habitat may occur.

Certain wildlife species within the Quabbin watershed can negatively impact water quality, water supply infrastructure and other critical resources in certain areas, directly or indirectly. Mitigating these impacts will be a top priority during the period of this management plan.

Broad scale, active wildlife management, especially to manage the deer population is conducted as part of this plan for the protection of the drinking water supply, Furthermore, the Division recognizes that its other land management activities may impact certain wildlife species or habitats. It is the Division's goal to avoid adversely impacting significant and especially uncommon wildlife species or their habitats while

conducting these activities. This will be accomplished primarily through inventory and survey work to locate rare species and habitats, active coordination with MassWildlife's Natural Heritage and Endangered Species Program, and proper precautions using management guidelines and Conservation Management Practices (CMP's).

While directly protecting rare or endangered wildlife will be a priority, the Division recognizes that its management activities have the potential to impact more common wildlife. Another goal, therefore, is to assess the impacts of these land management activities on the broad wildlife communities at Quabbin, and thereby minimize adverse impacts. This will be accomplished through long-term monitoring programs and an in-house review process for all planned management activities.

On certain portions of the watershed it may be feasible and desirable to proactively manage the habitat for the benefit of wildlife. This level of land management is a step beyond habitat protection and is focused on either habitats or wildlife species that are rare or of special concern on a regional or statewide basis. These management activities might include prescribed burns to enhance a field or meadow, selective removal of exotic plants, deployment of nesting platforms for certain species of birds, or the creation of brush piles or rock piles for cover in suitable habitat.

4.5 Biological Diversity Protection Goals

- MAINTAIN AN UNDEVELOPED, FORESTED CONDITION ON MOST OF THE DIVISION'S LAND HOLDINGS.
- WORK TO IDENTIFY ALL UNCOMMON OR RARE SPECIES PRESENT ON DIVISION LANDS, AND PROVIDE HABITAT CONDITIONS AND LEVELS OF PROTECTION RECOMMENDED FOR PERPETUATING THESE SPECIES.
- MEET OR EXCEED STATUTORY REQUIREMENTS FOR THE PROTECTION OF THESE SPECIES, INCLUDING THOSE IN THE FEDERAL ENDANGERED SPECIES ACT OF 1973 AND THE 1990 MASSACHUSETTS ENDANGERED SPECIES ACT, AS WELL AS THE 1986 WILDLIFE HABITAT AMENDMENT TO THE MASSACHUSETTS WETLANDS PROTECTION ACT.
- MAINTAIN LIMITED ACREAGE OF EARLY SUCCESSIONAL FORESTED AND NON-FORESTED HABITATS ON DIVISION LANDS AT QUABBIN (SEE SECTIONS 5.2.3.9 AND 5.5.4.3) .
- IDENTIFY AND CONTROL INVASIVE SPECIES ON DIVISION PROPERTIES.
- MAINTAIN FOREST RESERVES ON A PORTION OF THE DIVISION'S HOLDINGS.

The Division's greatest single contribution to regional biodiversity is the maintenance and management of large areas of undeveloped, forested habitat. Forests can contribute to soil and water conservation, and provide habitat for a range of indigenous plants and animals, aesthetic values, and recreational opportunities. The protection from development that results from DCR ownership contributes significantly to the long-term viability of a variety of organisms and natural communities.

Rare and uncommon species contribute to the biological complexity of a landscape or region. Efforts to identify and protect rare or endangered species or habitats occur continually on Division land. In 2000, the University of Massachusetts, Department of Natural Resources Conservation provided a report to the Division on rare, unique, and exemplary natural communities on the Quabbin watershed. Future studies

to locate and classify rare natural communities may be initiated. Actions to protect and enhance these species and habitats will provide critical protection of important components of biodiversity.

The Division owns several hundred acres of non-forested habitat including administrative areas, former plantations that were converted to fields in the 1980s to increase water yield, and scrub/shrub meadows. Some of these habitats will be maintained in an early successional stage through mowing and/or the use of fire in order to provide habitat for an array of organisms that depend on non-forested areas. As discussed previously, in order to ensure biological representation of indigenous species, a range of habitat conditions must be present. Early successional forested habitat has been clearly identified as a rare habitat type within the state (MassWildlife, pers. comm., Dettmers and Rosenberg 2000). By its nature, early successional forested habitat is dynamic both spatially and temporally. It must either be continually created or maintained at that successional stage or it will mature into older forest. Even-aged forest management techniques will be used to create and/or maintain this habitat in selected portions of Division holdings, following careful review of proposed area.

Invasive species are commonly recognized as a major threat to native flora and fauna and biodiversity. In extreme cases, invading exotics can out-compete and exclude native vegetation, resulting in a monoculture of the invasive plant. The result is a tremendous loss of native plant and associated animal diversity. The Division will strive to identify, control and where possible, eliminate invasive species from Division lands, within the limits imposed by water quality protection or limitations of resources and personnel.

The primary reason for incorporating forest reserves into land management planning is to ensure representative examples of biodiversity indigenous to an area are protected (Norton 1999). Forest reserves are important because they contribute to the full range of biodiversity and are important to a wide spectrum of species requiring undisturbed habitat. In addition, forest reserves can act as a reference or "control" site in which to assess the impact of management activities. Reserves also provide a different aesthetic opportunity and have a different character than managed forests. The Division has set aside a series of small and larger reserves totaling in excess of 10,000 acres within the Quabbin properties, as detailed in Section 5.5.4..

4.6 Cultural Resources Protection Goals

- IDENTIFY SIGNIFICANT CULTURAL RESOURCES ON WATERSHED LANDS.
- PREVENT DEGRADATION OF CULTURAL SITES AND RESOURCES.

Cultural Resources are part of our collective heritage and human experience, and are often fragile and non-renewable. The goal of Federal and State preservation legislation, as well as that of the DCR Cultural Resource Management Program, is to protect cultural resources out of respect for the past, for the education and enjoyment of future generations, and for the insight these resources may provide into our long-term relationship with our surroundings.