

MIDDLE CREEK



INITIATIVE

STRATEGIC PLAN 2011-2013



January 2011

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Cover photograph: Tundra Swans at Middle Creek Lake, by Joe Kosack/PGC

Introduction

There is no easy way to get from the coastal marshes of Virginia and North Carolina to the tundra of northern Alaska and Canada. Tundra Swans, which make this journey of over 3,000 miles each spring, take the scenic route, spending two to three months migrating to their nesting grounds. There are several popular rest stops – each used for a period of weeks – on this “highway in the sky,” and Middle Creek is one of the first the swans encounter on their way north.

To people on long road trips, rest stops are a matter of convenience. For Tundra Swans they are the difference between life and death, both for the migrating birds and the young birds they will attempt to raise in the summer. Each swan is aiming to arrive on its nesting grounds at just the right time, with enough energy stored up to begin establishing a nesting territory immediately. A delayed nesting attempt risks running out of time during the short Arctic summer.

A Tundra Swan rest stop must provide safe harbors for night roosting and ample food to refuel for the next leg of the trip. Middle Creek – with its shallow lakes for roosting and proximity to farmland for feeding on waste grains – is a critical link in this series of rest stops.



Photo by Howard B. Eskin

Every February and March, the Middle Creek Wildlife Management Area hosts thousands of migrant Tundra Swans. Up to a quarter of the 100,000-strong eastern population will stop at Middle Creek in a given year, leading the site to be designated by the National Audubon Society as a Globally Significant Important Bird Area (one of only two in Pennsylvania).

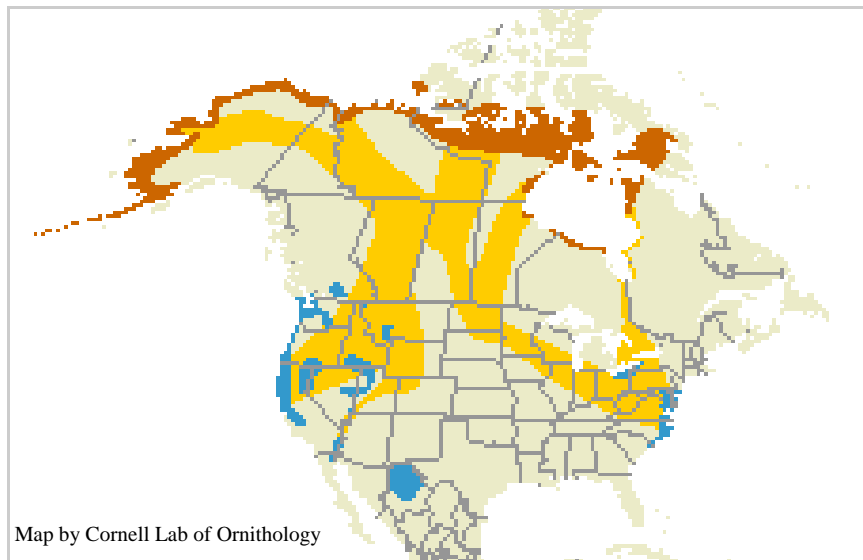
The spectacle of the majestic swans attracts thousands of human onlookers each year to the state-owned Middle Creek property. Most visitors see the swans coming and going from Middle Creek Lake, but miss the action just a few miles away, on the farms of Lebanon and Lancaster Counties where the swans feed and prepare for the next leg of their grueling migration.

The Middle Creek region’s farms are a local treasure, providing picturesque scenery, employment opportunities, and fresh produce. They also, unwittingly, provide the perfect complement to the migratory bird habitat at Middle Creek. Without this plentiful source of food nearby, the Tundra Swans would not come to Middle Creek each year, and would likely struggle to find another rest stop in the rapidly-developing mid-Atlantic region. The future of the Tundra Swan will be decided on the farm fields of Pennsylvania, and other rest stops just

Tundra Swans must arrive on their northern breeding grounds, like the Yukon Delta National Wildlife Refuge in Alaska (shown), with enough time and energy to complete their nesting cycle in the short Arctic summer.



From the eastern wintering grounds, Tundra Swans follow a mostly northwestern trajectory, with major staging grounds at Middle Creek, Lake Erie, and the prairie potholes of the Midwest. The timing of migration varies each year, and is greatly influenced by the availability of open water in late winter.

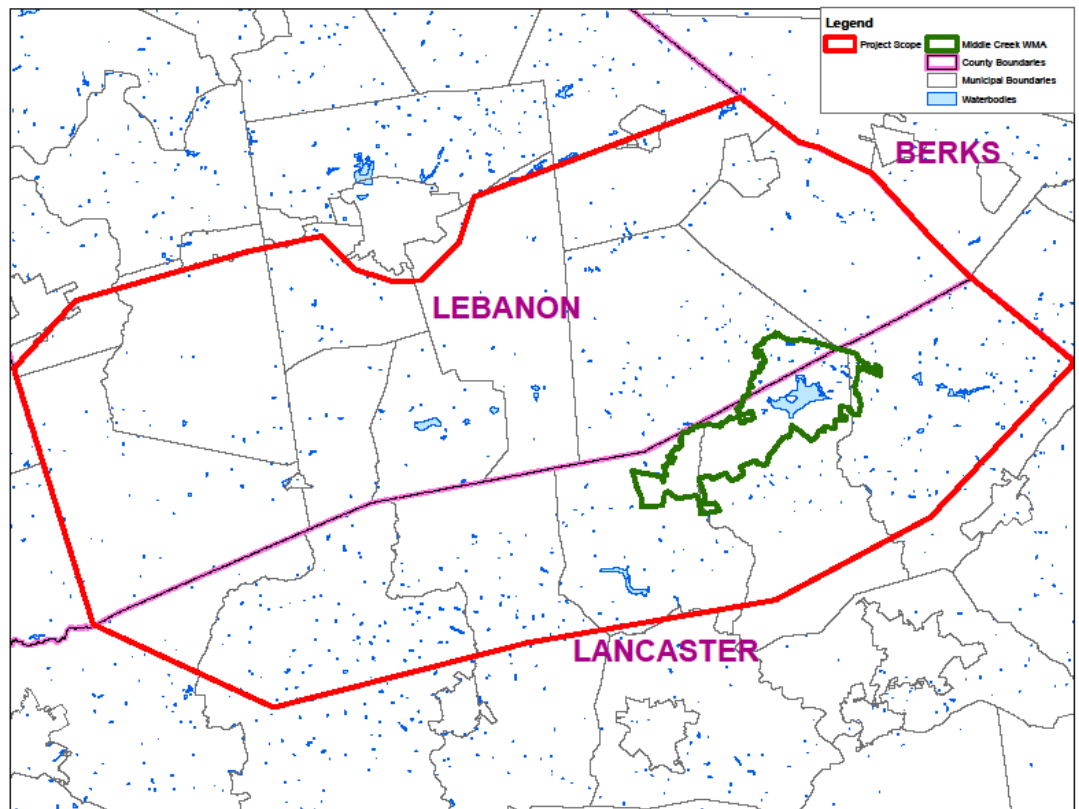


During the winter, Tundra Swans are found in wetlands near the mid-Atlantic coast. Alligator River National Wildlife Refuge in North Carolina (shown), with its tree-lined lakes, is one of several coastal refuges that harbor wintering populations of swans.



Scope and Vision

The geographic scope of the Middle Creek Initiative (MCI) includes southern Lebanon and northern Lancaster Counties, as outlined in red in the map below. As this plan details, it is intended that initial work will be focused on southeastern Lebanon County, before ultimately being rolled out to a wider area.



The Middle Creek Initiative's aspirations are noted in the group's vision statement:

We envision the spectacle of Tundra Swan migration at Middle Creek continuing for generations into the future, a sign of the health of the agricultural community that sustains both the birds and the region's residents. We see a bright future for the Middle Creek region; one in which farmers keep farming, agricultural businesses remain vibrant, and all residents continue to enjoy the high quality of life that defines the region.

Consistency with Local Planning

From its inception, the Middle Creek Initiative has valued the role of county and municipal planning in shaping a bright future for the region. This strategic plan is intended to assist in the achievement of goals stated in the Lebanon County Comprehensive Plan of 2007 (Appendix 1), and echoed in the plans and ordinances of many local municipalities. Put simply, MCI, Lebanon County, and local townships all have stated goals for maintaining agriculture as the primary land use in the areas detailed in this plan. Thus, the strategies developed by MCI to conserve wildlife habitat will also accomplish local planning goals.

MCI's plans will put in action many of the guiding principles for growth and resource conservation listed in the 2007 Lebanon County Comprehensive Plan, including:

Encourage distinctive, attractive communities with a strong sense of place.

Direct development toward existing communities and utilities to strengthen and revitalize them.

Discourage zoning that encourages sprawl.

Plan for economic growth and development that expands employment, sustains businesses and provides family-sustaining jobs.

Implement multifaceted strategies to enhance the agricultural and forestry industries through land protection, workforce training, and sustainable production and harvesting practices.

Protect the natural and cultural landscape that defines our local identity as Lebanon County.

Acknowledge, enhance and protect the open space, farmland, scenic views, historic resources and critical environmental areas that are important to the county. Facilitate acquisition or preservation of key sites.

Think, communicate, and plan regionally; implement locally.

Share knowledge and strive for effective public communication.

Encourage continuous dialogue among municipalities, government agencies and school districts regarding community growth and resource conservation.

Encourage community and stakeholder communication and collaborative decision-making.

Develop partnerships among public and private sectors—public-public, public-private, and private-private—to make community planning and associated projects affordable.

MCI views this tight connection with county and municipal planning as essential to accomplishing its goals, and hopes to expand upon existing relationships to ensure successful outcomes for the region's residents, visitors and wildlife.

Conservation Target and Goals

Goals were developed for the MCI's lone conservation target, the **Tundra Swan**. This species was selected as a target for several reasons, including the species':

- Listing as a state "responsibility" species*
- Dependence on both natural and agricultural areas
- Ability to engage diverse audiences

*A state responsibility species is a species for which a high percentage of the total population can be found in Pennsylvania at some point in its life cycle, giving the Commonwealth a high responsibility for conserving the species. In the case of eastern population Tundra Swans, Pennsylvania has a high responsibility for the species during migration, due chiefly to the birds found at Middle Creek.

The strategies and objectives listed in this plan are designed to help meet the following goals:

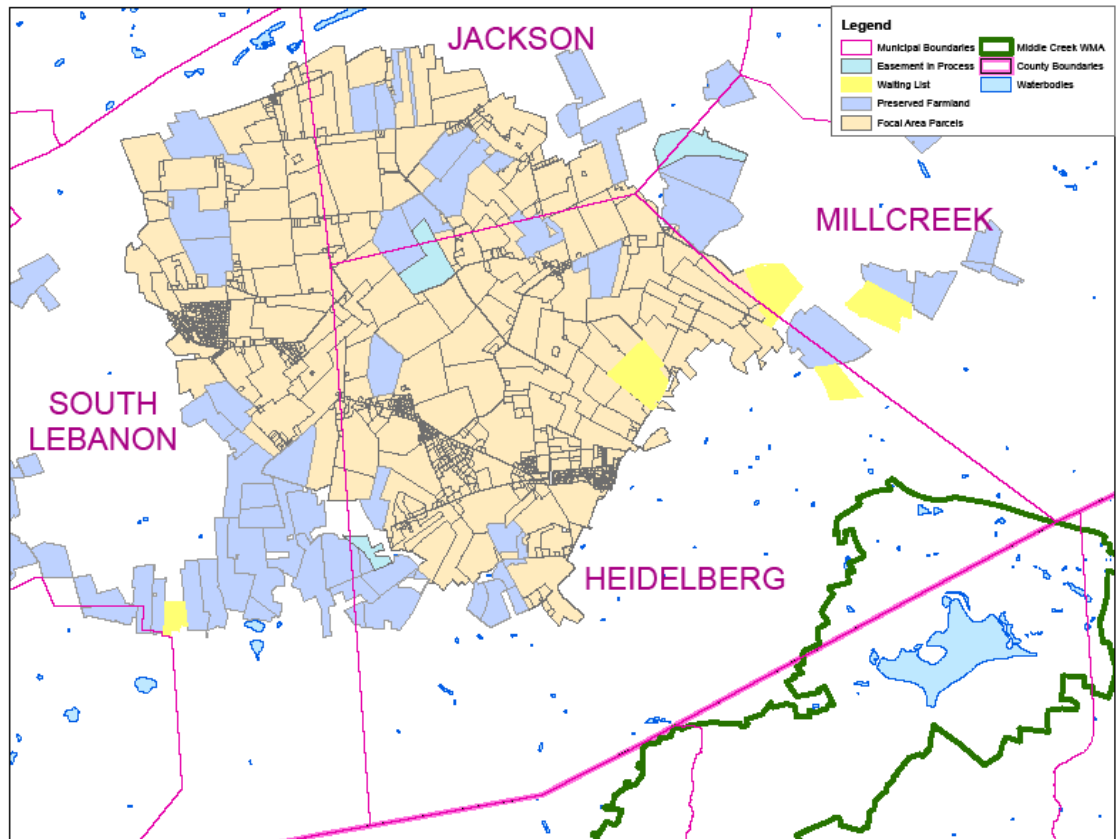
Keep the Tundra Swan peak migration count above the Global Important Bird Area threshold at least 7 times in any 10 year period.

This goal reflects our belief that if Middle Creek continues to serve as a major staging ground, it reflects well on the condition both of the refuge and the surrounding farmland. The birds are indicators of a healthy agricultural landscape.

Currently the Global IBA threshold is 1,900 Tundra Swans simultaneously or 9,500 over a season, and Middle Creek has well exceeded this number in most recent years. This threshold may change in the future if the species' population changes, as it is based on a percentage of the total population. The goal also allows for some natural annual variations in weather and migration routes, realizing that in some years it is possible that Middle Creek will host fewer birds even if on-site conditions are ideal.

By 2020, increase acreage of permanently protected farmland within the defined Focal Area to 5,000 acres. Annually, protect more than four times as much land in Focal Area as is developed.

Tundra Swan feeding locations are not randomly distributed across the landscape; the largest concentration of feeding sites is to the northwest of the lake, occupying portions of Heidelberg, Jackson and South Lebanon Townships. The best way to ensure that these lands remain available as feeding grounds during migration is to permanently protect them through conservation easements or other methods. A Focal Area for land protection was established (see map on page 6) based on our current knowledge of swan feeding locations. The boundary is subject to change if new information is gathered, but it currently includes 11,392 acres, including 1,348 acres of protected lands.



The area with most known Tundra Swan feeding locations is roughly five to ten miles to the northwest of Middle Creek Lake. Only about a tenth of the land in the designated Focal Area is currently protected by conservation easements.

Unprotected parcels within the Focal Area are shown in tan. Protected farms, both inside and outside the focal area, are shown in blue. A few farms on the county waiting list for preservation are depicted in yellow; these are qualifying farms with willing landowners that have never received offers from the county because higher-ranking farms have used all available funds.

The defined Focal Area includes lands in Heidelberg, Jackson, and South Lebanon Townships, with a small sliver of land in Millcreek Township.

Threats

During their life cycle, Tundra Swans are exposed to a wide variety of threats, ranging from acute, localized issues to those of national, international and global significance. Middle Creek is a spring migration staging location for Tundra Swans, so the MCI threat analysis dealt only with threats to the swans during this phase of their life cycle. It is recommended that, as the group's programming expands, MCI reach out to others working on Tundra Swan conservation throughout North America to explore potential collaborative efforts that could improve the chances of effective species conservation.

MCI identified several threats or potential threats affecting Tundra Swans staging at Middle Creek. While all of these threats warrant consideration, all evidence points to the loss of feeding grounds to residential and commercial development as the clear number one threat. The majority of the strategies within this plan are designed to address this threat over the near- and long-term. Threats, including some minor threats or potential future threats, are discussed further in Appendix 2. MCI will need to monitor threats as time and periodically review threat rankings to ensure that its strategies remain focused on the most important threats.

Two Tundra Swans (front) with a Trumpeter Swan (back). Efforts to restore Trumpeter Swan populations in eastern North America have been successful and populations are increasing steadily. It is possible that the species will someday be present at Middle Creek alongside Tundra Swans. A warming climate may also make Middle Creek more attractive as a wintering site for Tundra Swans, if ice and snow cover decrease.



Photo by Hal Korber/PGC

Strategies and Objectives

Strategy 1. Use conservation easements to permanently protect farmland in the defined Focal Area for migrant Tundra Swans.

Objective 1. Maximize effectiveness of the existing Lebanon County Agricultural Land Preservation Program (ALPP), administered by the Lebanon County Conservation District (LCCD), throughout the county. For qualifying farms in the Focal Area that are likely to rank highly, this remains the preferred method of land protection.

Action A. Member organizations, as appropriate, advocate continued and enhanced funding of program to allow for protection of “wait list” properties and new qualified applicants.

Action B. Establish new and/or expanded Agricultural Security Areas (ASAs), since being located within an ASA is a prerequisite for protection via ALPP.

Objective 2. Establish an alternative means of preserving farmland through the donation and/or purchase of conservation easements to be held by the Lebanon Valley Conservancy (LVC). Complete first land protection project in Focal Area by end of 2012, and at least three total by end of 2013. Enhance capacity of LVC to engage landowners, raise needed funds, complete deals, and monitor easements in perpetuity.

Action A. Create partnership with The Conservation Fund, whose staff specializes in structuring land deals, finding the proper funding sources for each property, and turning projects over to local groups for long-term stewardship.

Action B. Secure public funding sources (non-county) to jumpstart acquisition process.

Action C. Create marketing and communications plan to build on LVC’s involvement at Middle Creek and increase unrestricted revenue.

Objective 3. Prioritize parcels within Focal Area for land protection.

Action A. Based on our best understanding of swan feeding habits, use GIS analysis to create a list of tiered priority parcels. Formula should include property size, contiguity with already protected lands, proximity to known swan hot-spots, perceived development threat; note presence on waiting list for ALPP and ASA status.

Action B. Coordinate landowner outreach for highest ranking parcels among LCCD, LVC and TCF.

Objective 4. Establish working relationships between the MCI and members of the Plain Sect community.

Action A. Identify community leaders and farmland preservation advocates. Enlist assistance in discussing farmland protection options with Plain Sect farmers.

Strategies and Objectives (cont'd)

Action B. Secure private funding sources to enable protection of properties when a landowner will not qualify for or will not accept public funding.

Strategy 2. Ensure that all of MCI's conservation actions are based on sound science by monitoring Tundra Swan habitat use over time to allow for course corrections if conditions change.

Objective 1. Improve knowledge of Tundra Swan habitat use while at Middle Creek by collecting and analyzing information on swan feeding locations and habits.

Action A. Conduct flyover surveys to document exact locations of swan flocks and allow for digital analysis of landscape features.

Action B. Pilot a roadside driving survey that could be carried out several times annually to monitor any changes in preferred locations.

Action C. Digitize all swan location information gathered for use in analysis and land protection prioritizations.

Action D. Create a long-term monitoring plan based on lessons learned from initial flyover and roadside surveys in 2011 and/or 2012.

Objective 2. Determine if additional focal areas for land protection should be established, in both Lebanon and Lancaster Counties. If so, define those boundaries based on swan locations and farmland protection status.

Action A. Analyze all monitoring information through 2012 and determine if other clusters of swan feeding activity exist. If these clusters occur in areas with little protected farmland, consider establishing additional focal areas.

Strategy 3. Engage municipalities in farmland preservation and compatible land use planning.

Objective 1. Prioritize municipalities for outreach based on importance to swans, compatibility of existing zoning ordinances, and municipal readiness.

Action A. Gather and digitize zoning ordinances in swan feeding areas outside Focal Area.

Action B. Analyze areas of highest concern based on growth projections, farmland protection status, and zoning.

Objective 2. Engage all top priority municipalities in re-evaluating their ordinances and plans based on the Audubon's Path to Success or similar model. Coordinate with any planned outreach from the Lebanon County Planning Department

Action A. Modify Audubon's Path to Success model for use in Middle Creek region, creating a menu of options for municipalities to use in strengthening farmland protection and meeting the objectives of their municipal and county plans.

Action B. Conduct training of any MCI representatives who will engage in outreach activities as volunteers, or secure funding to hire a subcontractor to perform outreach activities.

Strategies and Objectives (cont'd)

Strategy 4. Ensure the future of agriculture in the Middle Creek region. Develop an Agricultural Community Initiative that will address the needs of the region's farmers

Objective 1. Coordinate with community leaders, agricultural business owners, and others, to identify key areas of need that are not currently being adequately addressed by others. Determine if MCI could reasonably address any of these needs, or if other partners can be encouraged to take the lead.

Action A. Create subcommittee of MCI to investigate and make key contacts.

Measuring our Success

In order to ensure our strategies are effective and allow us to react to any changes in conditions or unexpected results, we must regularly measure our progress towards reaching intermediate steps on the way to our ultimate goals. This process involves setting up in advance the important indicators we will track and a schedule for collecting and analyzing information. Indicators are established only at key junctures, and are not required for every objective.

We will also measure our progress towards our overall goals (pg. 5). The Pennsylvania Game Commission's ongoing swan counts will be used to monitor annual populations and compare to the Global IBA threshold. The amount of land protected within the Focal area will be measured by adding new parcels protected by LCCD, LVC, and others, to the existing data set (as shown on map, pg. 6).

Strategy 1. Use conservation easements to permanently protect farmland in the defined Focal Area for migrant Tundra Swans.

Objective 1. Maximize effectiveness of the existing Lebanon County ALPP.

Objective 2. Establish an alternative means of preserving farmland through LVC. Complete first land protection project in Focal Area by end of 2012 and at least three total by end of 2013.

Measurement 1.2.1: Partnership with The Conservation Fund

Indicator: Completed MOU or similar agreement.

Benchmark: MOU completed

Beginning: September 2011

Frequency: One time only

Measurement 1.2.2: Land protected in Focal Area

Indicator: Number of agreements, acres protected

Benchmark: one completed by Dec. 2011, three by Dec. 2012 (acreage benchmark to be added after parcel prioritization is complete)

Beginning: December 2011

Frequency: Every six months

Objective 3. Prioritize parcels within Focal Area for land protection.

Objective 4. Establish working relationships with the Plain Sect community.

Measurement 1.4.1: Regular communication with Plain Sect community leaders

Indicator: Number of communications regarding farmland preservation

Benchmark: Leaders are in contact with MCI four or more times per year

Beginning: June 2012

Frequency: Every six months

Note: In this section, some strategies and objectives have been shortened to save space. Please refer to the Strategies and Objectives section on page 8 to see the entire text.

Measuring our Success (cont'd)

Strategy 2. Ensure that all of MCI's conservation actions are based on sound science by monitoring Tundra Swan habitat use.

Objective 1. Improve knowledge of Tundra Swan habitat use.

Measurement 2.2.1: Enhanced data availability for swan feeding locations

Indicator: Swan feeding locations collected annually

Benchmark: Swan feeding locations digitally updated based on 2011 monitoring and subsequent repeats of similar surveys

Beginning: June 2011

Frequency: annually

Objective 2. Determine if additional focal areas for land protection should be established, in both Lebanon and Lancaster Counties. If so, define those boundaries based on swan locations and farmland protection status.

Strategy 3. Engage municipalities in farmland preservation and compatible land use planning.

Objective 1. Prioritize municipalities for outreach based on importance to swans, compatibility of existing zoning ordinances, and municipal readiness.

Objective 2. Engage all top priority municipalities in re-evaluating their ordinances and plans.

Measurement 3.2.1: Engagement of municipalities

Indicator: Number of priority municipalities engaged

Benchmark: All priority municipalities reached in some manner by December 2013

Beginning: December 2012

Frequency: Every three months

Measurement 3.2.2: Municipal action

Indicator: Number of municipalities implementing portions of Path to Success

Benchmark: Half of all municipalities engaged in Path to Success take implementation actions within a year

Beginning: December 2012

Frequency: Every three months

Re-assessment Schedule and Considerations

It is recommended that MCI create an annual work plan that is based on achieving the actions listed in this plan within the three-year timeframe. The work plan lists specific actions that must occur, the person(s) or organization responsible for the action, and the deadline for completing the actions. The 2011 work plan is presented on page 14. The work plan should be reviewed quarterly to ensure appropriate progress is occurring.

If additions or changes to the work plan are proposed during the year, the following questions should be considered prior to making the change:

- Does the change or addition support the vision and goals of the MCI?
- Does the change or addition support one or more of the objectives in the strategic plan?
 - If not, have conditions changed, making the creation of a new objective necessary?
- Can items on the existing work plan still be accomplished if a new item is added (adding to the work plan), or would the new item require that other planned work be postponed or cancelled (substituting items in the work plan)? Consider allocation of time, money and other resources.
- Could the change or addition otherwise impact objectives in the strategic plan or items in the work plan (for instance, by using a funding source for a different purpose, or changing public perception of the MCI, etc.)?

Answering these questions will ensure that the committee members are aware of all consequences of the proposed change or addition prior to making a decision.

In December 2011 and December 2012, MCI will review progress on the current strategic plan and create the work plan for the following year.

In January 2013, the group will begin the process of updating the strategic plan for 2014 and beyond. It is recommended that a subcommittee be formed at that time to review the current project status and determine any necessary strategic changes. Key goals for the next strategic plan will include determining the best approach to including Lancaster County in the MCI, and creating action plans for any additional farmland protection focal areas that are identified.

2011 Work Plan

Strategy 1. Use conservation easements to permanently protect farmland in the defined Focal Area for migrant Tundra Swans.

Objective 1. Maximize effectiveness of the existing Lebanon County ALPP.

1.1.A.i. Identify critical times for public input into county budgeting process.

1.1.A.ii. Create defined talking points so that member organizations are highlighting similar arguments for renewed or enhanced funding by two months before public comment period.

1.1.A.iii. Member organizations, as appropriate, submit public comments in writing and/or in person at board meetings. Organizations may also contact supporters and encourage them to submit comments supportive of farmland preservation funding.

1.1.B. Determine interest of landowners not currently enrolled in an ASA by December 2011.

Objective 2. Establish an alternative means of preserving farmland through LVC. Enhance capacity of LVC.

1.2.A.i. Hold preliminary meeting with The Conservation Fund by March 2011.

1.2.A.ii. Formalize partnership by creating a Memorandum of Understanding or similar document by September 2011 outlining the roles played by The Conservation Fund, MCI, and MCI member organizations.

1.2.B.i. Evaluate applicability of all major non-county public funding sources by September 2011.

1.2.B.ii. Complete at least one non-county public funding application by December 2011 (or have application substantially underway if program deadline is in first half of 2012).

1.2.C.i. LVC, with assistance from other MCI members, will devise marketing and communications plan by December 2011.

Objective 3. Prioritize parcels within Focal Area for land protection.

1.3.A.i. Draft parcel prioritization formula and share with group for comments by June 2011. (Audubon)

1.3.A.ii. Revise parcel prioritization formula and complete analysis by December 2011. (Audubon)

1.3.B.i. As part of [1.2.A.ii] above, determine roles for each organization in landowner outreach by September 2011.

Objective 4. Establish working relationships with the Plain Sect community.

1.4.A.i. Investigate any existing relationships within MCI by June 2011. (all)

1.4.A.ii. Consult any outside experts, including others who coordinate conservation programs with Plain Sect communities in Pennsylvania.

1.4.A.iii. Reach out to select community members for introductory meetings by December 2011.

1.4.B.i. Compile list of possible private funding sources for acquisitions by December 2011.

Note: In this section, some strategies and objectives have been abbreviated to save space. Please refer to the Strategies and Objectives section on page 8 to see the entire text.

2011 Work Plan (cont'd)

Strategy 2. Ensure that all of MCI's conservation actions are based on sound science by monitoring Tundra Swan habitat use.

Objective 1. Improve knowledge of Tundra Swan habitat use.

2.1.A.i. Conduct at least one flyover survey of Middle Creek region during February/March 2011. Gather pictures and GPS locations of swan flocks.

(Audubon)

2.1.B.i. Pilot potential roadside survey protocols during February/March 2011. Gather locations of swan flocks and habitat information. (Audubon)

2.1.C.i. Digitize swan locations from 2011 monitoring by June 2011. (Audubon)

Strategy 3. Engage municipalities in farmland preservation and compatible land use planning.

Objective 1. Prioritize municipalities for outreach based on importance to swans, compatibility of existing zoning ordinances, and municipal readiness.

3.1.A.i. Gather zoning ordinances from entire project area by September 2011.

3.1.A.ii. Begin digitizing zoning ordinances; complete __ municipalities by December 2011.

3.1.B.i. Initial analysis (without complete zoning) completed by December 2011.

Objective 2. Engage all top priority municipalities in re-evaluating their ordinances and plans.

3.2.A.i. Create subcommittee to review Path to Success model. Have first meeting by June 2011.

3.2.A.ii. Create draft Path to Success for Middle Creek region by December 2011.

3.2.B.i. Determine through discussions with L.C. Planning Department preferred procedures for engaging municipalities.

Acknowledgements



Lebanon Valley Conservancy, Inc.



Lebanon County Planning Department



Audubon
PENNSYLVANIA



The Middle Creek Initiative is a collaborative effort based on the voluntary participation of representatives of a number of local organizations, including those whose logos appear to the left. The creation of this plan is a testament to the dedication of these individuals and organizations to the future of this region.

Many people had a hand in the development of this plan, too many to list them all here. Swan biologists, municipal planners, and land conservation specialists all provided guidance. All of the MCI members graciously contributed their time and talents to this plan. Special thanks go to group leader Tisha Walmer of the Lebanon Valley Conservancy, who organized meetings, set agendas, and kept the group motivated and focused.

Stephanie Orndorff of Audubon Pennsylvania provided mapping services and support. Additional data for mapping were provided by the Pennsylvania Game Commission and Lebanon County Planning Department.



Photo by Brian Byrnes

This planning project was financed in part by TogetherGreen, a National Audubon Society program supported by Toyota, through a fellowship awarded to Brian Byrnes of Audubon Pennsylvania. Both Brian and the MCI are appreciative of this generous support.

Additional Resources

Audubon Important Bird Areas

National Audubon Society IBA Program: <http://web4.audubon.org/bird/iba/>

Middle Creek site description:

<http://iba.audubon.org/iba/viewSiteProfile.do?siteId=910&navSite=state>

Local Planning

2007 Lebanon County Comprehensive Plan.

www.lebcounty.org/Planning/Pages/CompPlan.aspx

Local organizations of interest

Lebanon Valley Chamber of Commerce: lvchamber.org

Middle Creek W.M.A.

Pennsylvania Game Commission. Middle Creek homepage:

<http://www.portal.state.pa.us/portal/server.pt?open=514&objID=613318&mode=2>

Pennsylvania Society for Ornithology. Site guide:

<http://www.pabirds.org/SiteGuide/PASitePage.php?SiteID=136>

MCI Member Organizations

Audubon Pennsylvania: pa.audubon.org

Lebanon County Conservation District: www.lccd.org

Lebanon County Planning Department:

www.lebcounty.org/Planning/Pages/Home.aspx

Lebanon Valley Conservancy: www.lebanonvalleyconservancy.org

Pennsylvania Game Commission: www.pgc.state.pa.us



Photo by Brian Byrnes

Appendix 1.

Lebanon County Comprehensive Plan

The Executive Summary of the 2007 Lebanon County Comprehensive Plan is found on the following pages.

Appendix 2.

Threat Analysis

The Tundra Swan faces a number of threats throughout its life cycle, which includes lengthy migrations twice annually. With a relatively low continental population of just over 180,000 birds (approximately 100,000 in the Eastern Population), the Tundra Swan is vulnerable to the loss of habitat and other threats during the breeding, migration, and winter seasons. Swans are especially at-risk due to their habit of traveling in large flocks for most of the year; even highly localized threats can impact substantial portions of the population.

On the breeding grounds of northern Alaska and Canada, energy development is a primary threat, with the ability to impact large swaths of otherwise untouched land. Global climate change will also cause significant changes to Tundra Swan breeding habitat in the coming decades.

Wintering grounds on the East Coast have been degraded over the past few decades, with enormous losses of aquatic vegetation that used to make up most of a swan's diet. With swans now mainly dependent on agricultural lands for foraging, they are now threatened by the conversion of these lands to other uses, including residential development. Hunting is permitted in some states, and must remain tightly regulated to avoid population-level impacts. The ingestion of lead shot used in hunting of swans and many other species has been shown to cause lead poisoning in swans.

Siltation, invasive species, conversion of wetlands to agriculture, and residential and commercial development are among a host of localized threats at some of the major staging grounds used by Tundra Swans during migration. The loss of any staging site is of great concern, as this puts greater strain on individual birds, forcing them to search for alternate sites that may be of lesser quality or require longer flights.

While each of these issues must be adequately addressed in order to ensure a healthy future for Tundra Swans, for the purposes of this plan the Middle Creek Initiative focused solely on threats to the migrant Tundra Swans that pass through Middle Creek each spring. As MCI's efforts become more established, it is recommended that the group reach out to others working on Tundra Swan and waterfowl conservation throughout North America to better coordinate conservation actions, learn from past experiences, and maximize the effectiveness of outreach efforts.

At Middle Creek, six threats were identified to Tundra Swans:

- Residential and commercial development of feeding grounds;
 - Development in watershed (causing decreases in water quality);
 - Disturbance or loss of roosting habitat to development;
 - Pollution;
 - Unmanaged Tourism; and
 - Potential future changes in agricultural practices (e.g. biofuel production).
- For these threats, the geographic scope, severity, permanence, and urgency of action was evaluated (see table on page 22).

Threat Analysis (cont'd)

Far and away, the leading threat at this time is residential and commercial development of feeding grounds used by Tundra Swans while they are at Middle Creek. While the pace of development slowed with the economic downturn, it is expected that this is just a temporary hiccup in what has been a steady trend towards suburban sprawl throughout the region. With the planned installation of a sewer system in Heidelberg Township, development will be a financially-attractive option for landowners and developers again. Currently, much of the critical swan feeding area is appropriately zoned for agriculture, but we cannot depend wholly on zoning to protect agriculture in this region.

While all of the other threats deserve attention and must be monitored for changes in status, none currently constitutes an urgent threat to Tundra Swans at Middle Creek, in the opinion of the MCI. A threat that is of particular interest moving forward is the potential of changes in agricultural practices in the region, for example the conversion of farms to biofuel production or changes in crops or harvesting technology. Tundra Swans have proven to be somewhat adaptable to changing circumstances, as evidenced by their switch to feeding in agricultural fields. It is unclear, however, how they might react to other changes in the agricultural production system. Biofuel production is not likely to be a major factor in Pennsylvania in the near future, but it warrants MCI keeping a close eye on it, and monitoring any potential impacts on swans.

Based on the results of the threat analysis, this strategic plan focuses almost exclusively on addressing the threat of residential and commercial development of swan feeding grounds. As MCI begins to address this threat with on-the-ground conservation actions, it must continue to monitor and periodically evaluate other threats, and address them as needed.

Threat	Scope (geographic)	Severity	Permanence	Urgency
Residential or commercial development of feeding grounds	Broad to Medium	Medium	High	High
Development in watershed (causing decreases in water quality)	Broad	Low	Medium	Medium
Disturbance or loss of roosting sites to development	Limited	Medium to Low	Medium	Low
Pollution (water quality decreases)	Broad to Medium	Medium to Low	Medium	Medium to Low
Unmanaged Tourism	Limited	Low	Low	Low
Potential future changes in agricultural practices	Medium	Low	Medium	Low

As part of its threat analysis, MCI assessed the scope, severity, permanence and urgency of all threats to Tundra Swans at Middle Creek.