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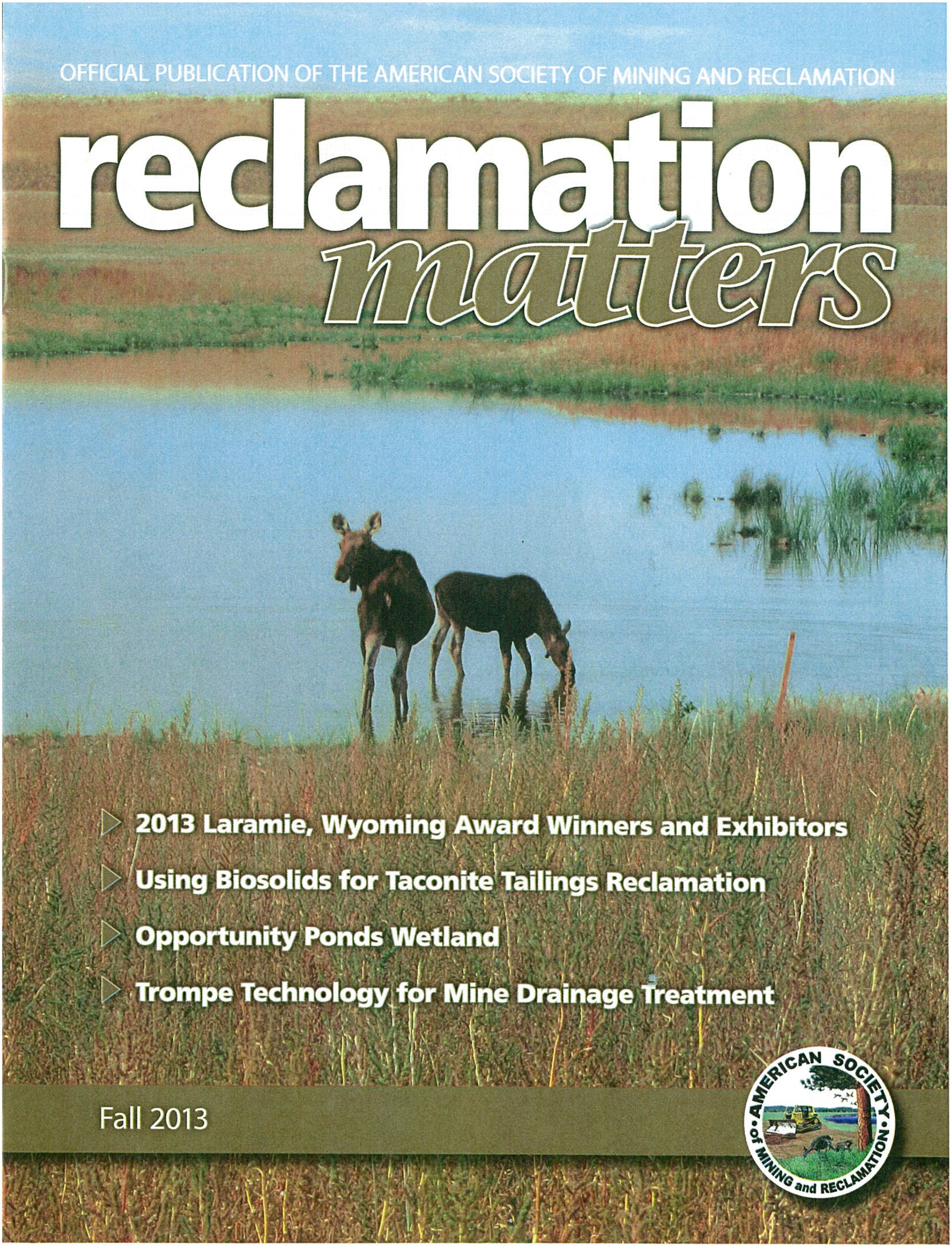

- 2013 Laramie, Wyoming Award Winners and Exhibitors
- Using Biosolids for Taconite Tailings Reclamation
- Opportunity Ponds Wetland
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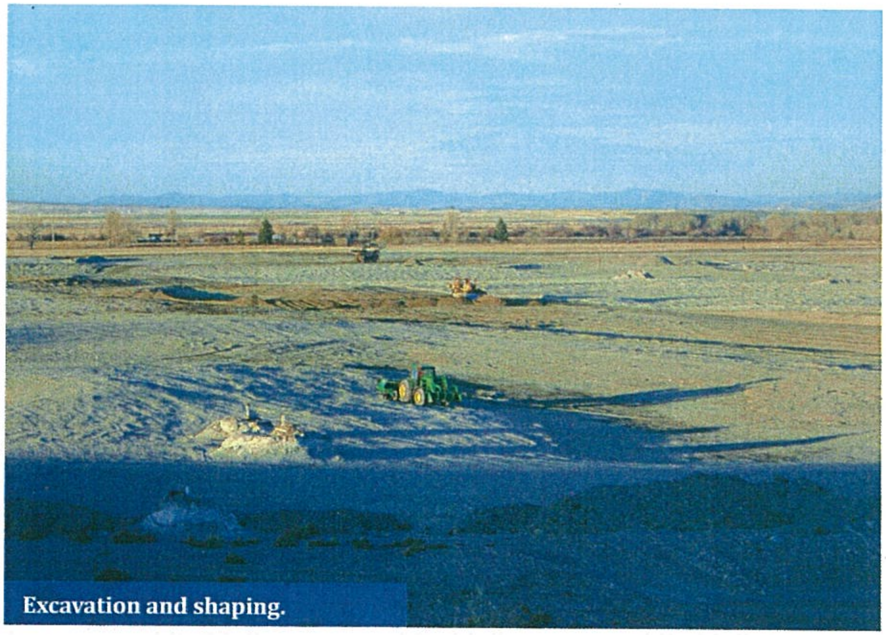
Fall 2013

OPPORTUNITY PONDS WETLAND – A 500-ACRE WETLAND MITIGATION PROJECT


Excavation and shaping.

Introduction

What does it take to create a wetland out of a borrow pit in the Rocky Mountains of Montana? Planting over two million wetland plants in three years provided many lessons on establishing native wetland vegetation in an area with a short growing season, poor soils, and lots of local wildlife eager to gobble up the plantings as soon as they were in the ground. With so many factors challenging our efforts, we quickly learned how critical it is to control the factors we could control. Planting at the right time and only using well adapted high quality planting stock, excellent planting techniques, and proper hydrologic placement meant the difference between life and death for the suite of over 35 native species selected for this site.

The project site is south of Highway 48 between Warm Springs and Anaconda in southwest Montana. The excavation of two areas resulted in creation of the proper surface water and shallow groundwater conditions for supporting wetland vegetation. The goal of this project is to utilize wet areas resulting from excavation to create a mitigation wetland. The excavated site was shaped to mimic nearby wetland reference sites, and planting was designed to create plant communities similar in species composition and community arrangement to native wetlands in the area.

The climate of the site is semi-arid, with long, cold winters and periods of strong winds. The average precipitation is about 14 inches per year, about half of which typically occurs in May and June. The growing season is short with the last frost typically occurring early in June and the first frost late in August. Common emergent wetland vegetation in the vicinity includes sedges and rushes. Shrub communities consist primarily of willows, water birch, and extensive patches of aspen. Wetlands in the vicinity of Opportunity Ponds provide valuable habitat for white tail deer, moose, and water birds.

Construction

Groundwater is the primary water source for the Opportunity Pond Wetland. Our dependence on groundwater at an excavated site in an arid environment demands careful planning, very accurate excavation and planting, and – especially important – the ability and willingness to refine plans based on the actual conditions found during construction.

For the Opportunity Ponds project, the design team used historic groundwater data to develop a minimum groundwater elevation map for the wetland design. The excavation plans ensured that groundwater was intercepted by using the contours as the design water surface elevation. The plans were then adjusted in the field in each of the wetland cells (defined by dikes) such that the intercepted groundwater established a hydrologic gradient from un-saturated soil, to saturated soil, to surface water. This gradient provides a variety of water regimes that facilitate the establishment of a diverse wetland plant community.

Machine-control technologies using digital site design information combined with automatic control of dozer blades through the use of GPS-based positioning technology provided fine-scale accuracy during final shaping. This resulted in final contours that provided proper hydrology


Construction complete ready for planting.

for plant communities and eliminated time-consuming surveying and staking.

Capitalizing on the natural slope of the land and the groundwater gradient, contour dikes (e.g., cross-slope dikes) were constructed at key positions within the wetlands area to break the area into wetland cells. Islands and depressions were added to increase habitat diversity.

Fine-grained cover soil material was applied to provide a favorable growth medium. De-watering activities were stopped after construction and soil placement were completed, then the hydrology of the site was allowed to reach equilibrium. This gave us a better picture of what the final hydrology would be and aided in modifications of the planting plan to match that hydrology.

Revegetation

A diverse wetland mix was seeded as each cell was completed, prior to shrub planting. Immediately following seeding, monitoring plots were set up to provide information about individual species seeding success and to guide adaptive management activities. By using this information, seed mixes were modified to reduce cost and increase success. For example as a result of our monitoring Baltic rush was removed from the wetland seed mix because we found that it would likely colonize the site naturally.

The species of container-grown plants selected for planting were those species observed within the vegetative communities near the site, and were differentiated based upon the hydrologic regime or indicator status (i.e., water depth, inundation tolerance) and documented plant association. Plants were situated in niches along the hydrologic gradient so that each particular species was located at the appropriate elevation in relation to the ground-surface water level.

Poor quality plant material is one of the most common causes for failure of wetland plantings. Therefore, we developed strict specifications for container plants to ensure optimum plant survival. Specifications required that plants be grown from seed or cuttings (both collected from the Upper Clark Fork River Basin). Submission of data sheets listing the collection locations, amount of raw seed collected, and collection date were required to document seed sources. The use of plants and seed native to the area ensured that the plant material would be adapted to site conditions, which was a major reason why we achieved high survival rates.

Plants were required to be well shaped, vigorous, and healthy, with a well-branched root system, and also free from disease, harmful insect and insect eggs, sun-scald injury disfigurement, and abrasion. Herbaceous plants and willows were grown in 10 cubic inch containers, and shrub containers had a volume of 60 cubic inches. We specified the 60-inch containers for shrubs in the upland planting zones because the greater root depth ensures contact with consistent soil moisture. The willows did not require deep containers because we specified that they be planted in the lower portion of the shrub zone where they would have consistent contact with soil moisture.

All plants were required to have fibrous roots established, enabling them to be easily removed from containers while maintaining their shape and intact root mass. Specifications called for all plants to be hardened off (grown in climatic conditions similar to the planting site) prior to delivery, and willows to be stored in coolers in a dormant condition until planted. We conducted nursery inspections at four key points in the plant production cycle to verify compliance with the specifications: 1) completion of crop sowing; 2) comple-


Nursery production of plants.


Morning yoga for planting.

tion of germination; 3) completion of potting up to larger size (for shrubs); and 4) one-month prior to delivery.

All woody plants were inoculated (in the nursery) with mycorrhizal fungi, and the grower was responsible for verification of successful mycorrhizal colonization. Mycorrhizal plants, with their enhanced ability to take advantage of available moisture and nutrients, are especially important on this site with its low fertility soil and droughty conditions. Plants were delivered in a covered truck and shipped in cardboard boxes labeled with both botanical and common names and the quantity of plants in each box.

All plant deliveries were coordinated with planting oversight staff and staged to meet the needs of the planting crews and minimize the need to hold plants on site. We assessed plant quality on delivery, and rejected unacceptable plants (those not meeting the specifications listed above), which were then replaced by the nursery. The combination of detailed plant specifications, nursery inspections during plant production, and careful inspection of arriving plants assured the excellent plant quality that contributed significantly to successful plant establishment.

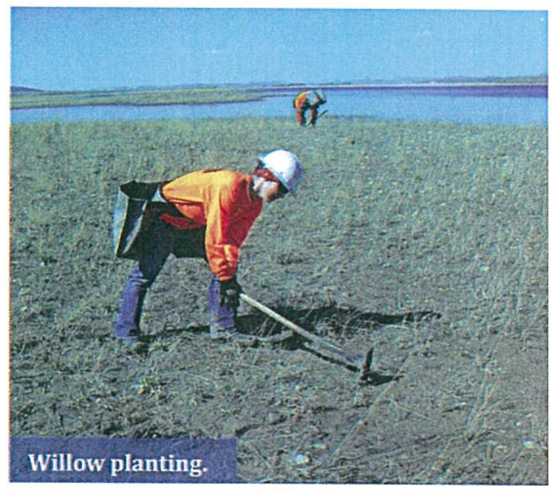
Project Oversight

Each wetland cell was divided into discrete planting units so plant numbers could be determined based upon area. As the planting proceeded, we tracked quantities planted in each planting unit to ensure that the each species would be well-distributed across all wetland cells. Boundaries of planting zones were marked on the ground and we then reviewed and modified them to reflect actual hydrology. The "on the ground" modifications resulted in proper placement of plant material based upon site conditions, and ultimately resulted in high survival rates.

We conducted a sampling procedure for plant installation, randomly sampling 20 plants twice a day to verify that plants were installed at proper hydrologic zones, spacing, and depth, and with good soil contact and proper vertical alignment. We immediately discussed any planting quality issues with the planting contractor and led a discussion with the entire planting crew at the next morning meeting.

We developed a plant placement chart to illustrate proper planting zones for all species in relation to the water elevation. We prepared detailed planting prescriptions to guide the planting contractor including the size of patches to plant, optimum hydrologic conditions, tolerance to inundation and salts and other factors to ensure proper placement of each species.

We held two 1-day plant installation training sessions each planting season. These sessions covered proper use of planting tools, safety, care of plants, placement of plants and proper planting techniques. The training sessions also presented the background for the project and the potential benefits to the site, wildlife and future generations of Montanans. This ensured that all planters were aware of proper planting techniques and the need to adhere to them. Many of the planters and crew leaders were students or recent graduates with backgrounds in environmental studies or biology. In response to requests from many of the crew, we held question and answer sessions to provide a venue for increasing crew member understanding of the importance of the project. The value of these sessions was clearly demonstrated through the enthusiasm of the crew, quality of the workmanship and the success of the revegetation efforts.


Willow planting.

The revegetation contractor implemented some innovative employee support actions to ensure the success of the

Rotary planter.

project. The potential for injuries on the project was significant and the crew size was as high as 80 planters. Therefore, the importance of safety was highly stressed. Group stretching and yoga was led by a trained staff member following each daily tool box safety meeting. This resulted in no lost time accidents on the project. Crew-members were also supplied with back-pack hydration systems and lunches were delivered to crews in the field each day. The extra cost of these actions was more than recovered by savings from increased productivity, safety and worker morale.

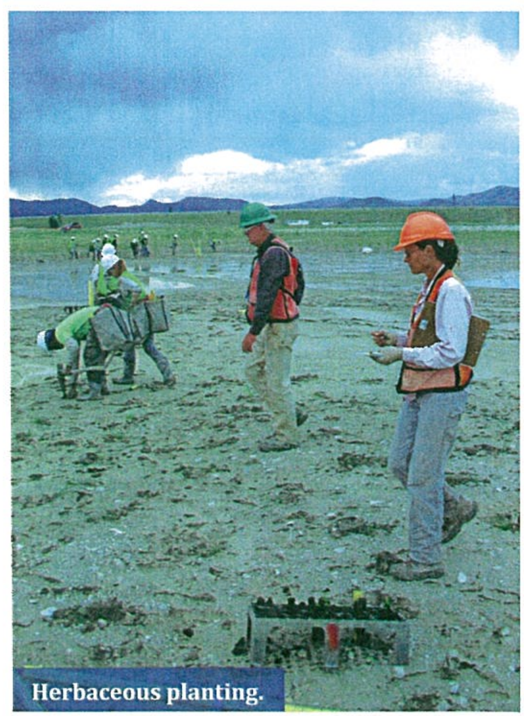
Plant Installation

With over two million plants to put into the ground and a short growing season in which to work, plant installation had to be fast and efficient while still maintaining quality. Planting methods were chosen based on container size (deep rooted versus smaller containers) and accessibility (saturated zones versus upland areas). The planting crew used the following machine and hand planting methods.

- Rotary Planter: This is an excavator-mounted planter that has a revolving magazine with a capacity of 50 plants and 3 rings. It is controlled by the operator so three different species can be loaded and the operator can choose the best species to plant in any specific spot. The planter is designed for use with deep rooted container plants. It can be used around the perimeter of the site where access does not require driving through saturated soil. Advantages of this technology are speed of planting and ability to dig holes with adequate depth for the deep rooted shrubs in rocky soils.
- Mini-excavator with auger: This is for sites not accessible with the rotary planter so deep rooted shrubs were installed in holes excavated with the auger.
- Two-man auger: Some sites were not accessible with the rotary planter or mini-excavator. For these sites, two-man augers were used to dig holes for deep rooted shrubs.
- Tree planting hoes: Hand planting using "hoedads" was the most efficient method for willows and emergent plants that were grown in small containers. Hand planters could access the saturated and inundated areas, and the "hoedad" is well-designed for use with the 10 cubic inch containers.
- Dibble bars: Dibble bars (round metal tools used to make a hole for planting containerized plants) were only used for installing herbaceous plants in areas with fully saturated and inundated soils. They are not recommended for areas with fine soils because the sides of the planting hole can become compacted resulting in air pockets.

Planting started in early May of each year with woody plants. It is beneficial to plant woody species before the spring flush of root growth. That way the plants are in the ground ready to take off as soon as the temperate warms. The planting crew hand planted willows in natural appearing bands in the lowest and most moist areas of the shrub zone. Deep rooted shrubs were planted in the appropriate hydrology for each species using the "Rotary Planter" or hand planting in holes excavated by power augers. We worked closely with the crew to assist them in proper placement of plants and any needed on-the-ground modifications to the planting plan.

Herbaceous planting started the second week in June and was completed by mid-August each year. Bulrushes were planted first to give the maximum time to establish healthy root systems and minimize potential damage by geese. Herbaceous plants were installed by hand, starting with bulrushes in areas of standing water. Sedges and rushes were planted in patches



Herbaceous planting.


Establishing herbaceous vegetation.

of appropriate hydrology, and remaining grass species were planted in moisture conditions suitable for their establishment and long-term survival.

Revegetation Results

We measured plant survival by establishing circular plots in representative patches within each planting zone immediately following installation. A stake was placed in the center of each plot, the location was recorded using a handheld global positioning system (GPS) unit, and the number of installed plants within each plot was recorded.

The results of the monitoring show that herbaceous and bulrush plantings are rapidly spreading and increasing in density. Shrub and willow survival is 80% after two full growing seasons and plant densities are well within the long term shrub spacing goals. Many of the shrubs are also sprouting from the ground and increasing in density of stems per acre above the planted density. The created wetland area is seeing heavy use by waterfowl and big game. Ducks, geese, phalaropes, avocets and long billed curlews are all common. Whitetail deer and moose are using the site and even a mountain lion has been observed.

Monitoring and Maintenance

We continue to monitor and maintain the site. Documenting observations of wildlife, especially any state-listed sensitive species, will provide needed information in determining the wildlife habitat value of the site, which is critical to meeting the wetland functional objectives. Collection of yearly data from established shrub survival plots and reporting shrub survival rates and visual assessment of herbaceous vegetation (seeded and planted) will also be valuable in showing the development of vegetation. Continuing to take yearly photos of established photo points will provide visual documentation. Based upon monitoring and observations, areas of poor vegetation establishment will be mapped (with GPS) and the resulting maps will guide actions to remedy problems and re-establish healthy vegetation on the problem areas.

Lessons Learned

We learned a number of important lessons in the implementation of this project. Most are related to the fact that re-


Establishing shrub vegetation.

vegetation projects have a multitude of uncontrollable variables, and it is critical to invest in quality control and quality assurance of those which can be controlled.

- We could not control where the actual hydrology of the site would equilibrate, but could control where we placed the planting unit boundaries to match on-the-ground hydrology. Plants were initially placed in planting zones according to the design, but there were many areas where water levels differed from the design. To ensure optimum plant survival, we worked with the agency oversight and the planting contractor to revise plant placement based on current hydrologic conditions rather than the designed water levels.
- We knew form previous experience that bulrush establishment would be a challenge, especially along the edges of larger ponds where geese tend to congregate. Although we planned the bulrush plantings as early as possible to give plants time to establish before the midsummer flocks of geese appeared, we still observed significant goose damage. We modified the plan, requiring bulrushes to be grown in larger containers which helped establish root systems that could withstand goose browse. In future wetland restoration projects, we may concentrate bulrush plantings along smaller inundated and permanently saturated areas and away from larger water bodies.
- During the first week of planting, there was a cold spell with temperatures below 20 degrees F. Many of the shrubs in the holding area and staged on the site were damaged. This caused reduced survival. For the next year's plantings we moved planting dates later in the spring and provided protection for staged plants to protect them from frost damage. ■

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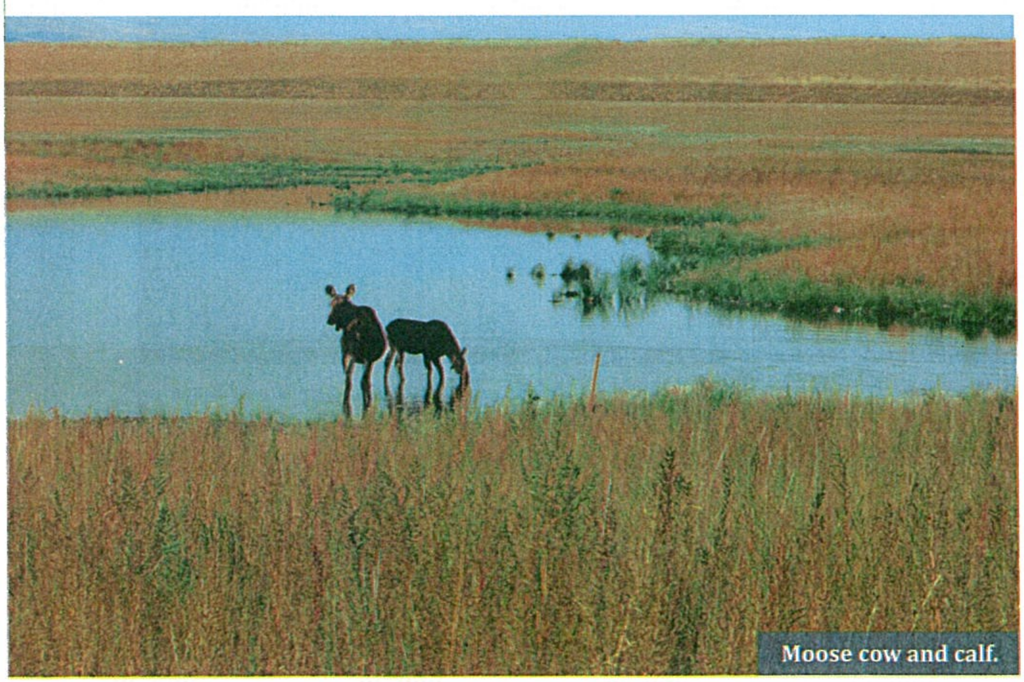
Moose cow and calf.


Long Billed Curlew.