



Gravel beds and reclaimed water--a winning combination to increase tree survival rates

By Ashley Steevens, city of Mankato

A new idea

The city of Mankato has used bare root tree stock in its spring tree plantings for more than 20 years. Historically, tree mortality was in an acceptable range. Tree mortality peaked in 2011 when more than 50 percent of the city's bare root tree plantings were lost. Although several factors contributed to this mortality, staff realized there had to be a way to increase the survival rate of these young trees.

Since 2007, the University of Minnesota, Department of Forest Resources has been working on researching and promoting community gravel beds as an option for reforesting urban landscapes, an option that is more cost-effective, offers a more diverse choice of trees and results in very good survival rates. What's more, the Fargo Park District also saw mortality rates drop from 50 percent to 5 percent with the implementation of the gravel bed, which convinced the city of Mankato to give this method a try.

Project feasibility and design

The next step was determining project feasibility, cost effectiveness and maintenance. To be successful, it was important to place the gravel bed in a location where trees could be undisturbed yet also have a water source nearby. An idea was to place the gravel bed at the wastewater treatment plant where it could also be irrigated with reclaimed water. This concept has worked well with a city park that is also near the plant, allowing for convenient access to the irrigation system.

Since the city has a Title 22 water reuse certification, which includes irrigation as one of the potential uses on the certificate, it was possible to use reclaimed water to irrigate the trees. Mankato, a state leader in wastewater treatment, treats its water to a higher level thanks to a partnership with a local energy company. This partnership benefits the environment because an extremely low phosphorous is discharged into the Minnesota River.



City of Mankato gravel bed is located near the wastewater treatment plant so it can be irrigated with reclaimed water.

As far as cost effectiveness, gravel bed construction and tree stock were affordable with the total project costing \$4,000--about \$57 per tree. Compared to other planting options, which cost more than \$100 per tree, staff determined this cost was reasonable. By planting bare root trees in a gravel bed, staff expected an increase in plant health and survival. This would provide access to tree stock all season long and is cost effective for fall plantings.

Once the location and water source were determined, the next focus was on design. With gravel beds, the sky is the limit when it comes to design. Staff decided to use a hard surfaced base so most of the trees could be removed with a skid loader. However, there are other removal options, such as pulling by hand, digging with a shovel, or use a rock sifting bucket attachment. Since asphalt is less expensive and a task that could be performed by staff, it was used as the gravel bed's base. Interlocking concrete blocks

were used for the sides of the gravel beds because they are cost effective and allow for easy access and future expansion.

Maintenance was designed to be easy. Today, the gravel bed is fairly self sustainable with a water timer installed to ensure the bed is watered as scheduled. In addition, by using reclaimed water there is no additional fee for water use, and hoses are expected to last more than one year. The gravel bed is routinely monitored to ensure hoses remain unclogged, holes do not develop and trees are watered as needed. For example, if there is extreme heat, trees are watered more often.

Planting the gravel bed

Mankato's gravel bed was constructed late summer 2013 directly behind the city's reclaimed water station because there was easy access to hydrants. The following spring, the gravel bed was used for the first time. Seventy trees were planted. Staff and volunteers placed gravel across the root system row by row, working their way out of the gravel bed. Once planting was complete, the reclaimed water hydrant was connected to the water timer. Soaker hoses were weaved throughout the trees so that each hose was adjacent to at least one side of each tree. The irrigation water timer was initially set for 15 minutes six times a day throughout the summer.



Soaker hose was weaved throughout the trees to irrigate the bed.

Tree removal

Trees were removed from the gravel bed in the fall of 2014. Removal was easy. Staff simply removed one of the sides of the gravel bed and used a skid loader with a pallet fork attachment to remove trees from the gravel. Staff learned that as the team got further into the bed, it was important to have a place to stock pile some of the gravel to keep it out of the way of work being done. To do this, staff had to switch the bucket and the pallet forks on the skid loader. In addition, it was discovered that it was important to load trees into the truck in the reverse order of which they would be planted. This helped ensure trees were easily accessible without uncovering the root systems. Once trees were removed, they were loaded into pick-ups and root systems were covered with mulch. Staff thoroughly watered the trees with reclaimed water.



To remove the trees, staff removed one of the sides from the gravel bed and used a skid loader with a pallet fork attachment to lift the trees out of the gravel. Another staff member shook the gravel off the root system (pictured is Tim Sechler, public utilities) and loaded the tree for transport.

Outcomes and benefits

Since the initial year of gravel bed planting was successful, the efforts were expanded into this year's growing season. Size of the gravel bed doubled, and 119 trees were planted with room to spare. A goal is to obtain additional trees for the 2016 growing season so the gravel bed can be fully planted.

Throughout the process, several lessons were learned:

- Volunteers are a valuable resource while planting the gravel bed. There are future plans to involve volunteers in the planting of gravel bed trees into the boulevards and parks as well.
- Soaker hose will only last approximately two years due to line pressure and sun exposure.
- Mankato's gravel bed can be irrigated 10 minutes at a time five times a day during the peak of summer.
- An enclosed trailer or trailer with solid sides may be a better option than one ton pick-ups for transporting trees since this helps maintain the mulch on the root system throughout the day much easier. This may also reduce how often mulch needs to be watered to keep root systems moist.
- River birch did very well in the gravel bed. Moving them had an impact, however, because they did not do well in the boulevards. Staff suspected this particular tree species may have been removed too late. As a result, staff moved them in mid-September instead of October to see if it would make a difference. Results are expected to be known next year.



Today, Mankato's gravel bed can hold approximately 150 trees.

The greatest benefits seen from Mankato's gravel bed include cost effective tree availability throughout the growing season, decreased mortality and transplant shock and the ability to perform a cost effective tree planting program in spring and fall to respond to tree replacement requests timely.

For more information about the city of Mankato's gravel bed, contact Ashley Steevens, Natural Resources Specialist, at 507-387-8580 or asteevens@mankatomn.gov. To learn more about Mankato's Title 22 certification and reclaimed water, contact Mary Fralish, director of public utilities, at 507-387-8665, or mfralish@mankatomn.gov. A recommended publication, "All you need to know about community gravel beds" by the University of Minnesota, Department of Forest Resources can be found online at <http://trees.umn.edu/products/>.