Roadside Ditch Sediment Control Project

Chagrin River Watershed Partners, Inc.
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In cooperation with the Lake and Geauga County Soil and Water Conservation Districts, Lake and Geauga County Engineer, Lake County Stormwater Management Department, Innovative Turf Solutions and Absolute Contracting, Inc.

Final Technical Report: July 2012

Lake Erie Protection Fund Award – SG 415-11

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This project was funded in part through the Lake Erie Protection Fund. The LEPF is supported by the voluntary contributions of Ohioans who purchase the "*Erie….Our Great Lake*" license plate featuring the Marblehead lighthouse.

ABSTRACT
Chagrin River Watershed Partners, Inc. partnered with the Lake & Geauga County Engineer, Lake & Geauga County Soil and Water Conservation District, the Lake County Stormwater Management Department, Innovative Turf Solutions and Absolute Contracting, Inc. to provide training to local road departments to reduce sedimentation through improved roadside ditch erosion control best management practice (BMP) application. Over 61 participants representing 21 different public roadway and park district departments attended the October 21, 2011 training. The training included in-class presentation of BMP materials and field demonstration of product application techniques. Best management practice fact sheets and product demonstration of seed germination biostimulants, super absorbent hydro mulches, polyacrylamide tackifiers and straw wattles as alternative check dams were provided during the training. The innovative BMPs were installed at 3 demonstration sites for further performance evaluation. CRWP and Absolute Contracting, Inc. provided additional training to both Lake & Geauga County Engineer road department personnel prior to the November 2011 demonstration site installations in Lake and Geauga Counties. Lake and Geauga County SWCD staff monitoring of the BMP applications indicates that the innovative products provide more effective erosion control than conventional BMPs. Four additional BMP factsheets and demonstration site summary were provided to all participating roadway departments and are available on the CRWP website.

PROJECT BACKGROUND
The Chagrin River Watershed Partners, Inc. (CRWP) collaborated with the Lake and Geauga County Engineer, Lake and Geauga County Soil and Water Conservation Districts, the Lake County Stormwater Management Department, Innovative Turf Solutions and Absolute Contracting, Inc. to provide best management practice (BMP) training to local road departments regarding the stabilization of roadside ditches using innovative erosion control practices. The training and introduction of innovative erosion control practices and installation techniques provided to county, municipal and township road departments as well as park district personnel who also deal with roadside ditch management issues directly addresses the continuing management challenge between stormwater runoff conveyance and sediment discharge associated with roadside ditch maintenance and dredging operations. Promoting the broad use of effective erosion control BMPs to reduce sediment loading to Lake Erie tributaries directly meets the strategic objective within the Lake Erie Protection and Restoration Plan (LEPR) to reverse increasing nutrient loading to Lake Erie, in particular dissolved reactive phosphorus. Not only will broader use of more effective erosion control BMPs reduce nutrient and total suspended solids loading to Lake Erie, it will also have significant impact on the LEPR objective to protect, restore and enhance headwater streams that are often the direct recipients of roadside ditch discharge.

Limited training opportunities regarding innovative BMP technologies and installation techniques hinders the capacity of local governments to properly select cost effective, proficient BMPs that account for the difficult growing conditions associated with roadside ditches. Inadequate application of hydro mulches for erosion control and

improper use of silt fence and straw bales for sediment control occur frequently on roadside ditch maintenance operations. Proper BMP implementation training is critical to improving BMP selection and installation. Erosion control technology continues to evolve with innovative techniques and products targeted for immediate erosion control protection and rapid establishment of vegetation. This training project generated exposure to several new BMPs and promoted engagement between road department personnel and certified erosion control professionals regarding installation techniques, equipment needs and considerations for adjusting county and local road department standard operating procedures to include better products and more effective techniques.

METHOD

Although the training was a finite product, the tools, materials and contacts developed through the training provide the opportunity for continued interaction and field training as projects and issues arise within county and local jurisdictions. Utilizing the expertise of Innovative Turf Solutions, who specializes in erosion control and turf establishment through the use of hydro seeding applications using enhancement products such as biostimulants, water retention polymers and tackifiers and the installation expertise of Absolute Contracting, Inc. the project team made up of these private companies and representatives from the Lake and Geauga Soil and Water Conservation Districts (SWCDs) and CRWP created specific BMP application recommendations using biostimulants, wood fiber hydro mulch with water retention polymers and tackifiers for application using hydro seeding equipment. Recommendations for straw wattle use as check dams were also developed into a technical factsheet for road department personnel.

The BMP product and installation recommendations were developed during August and September 2011 and demonstrated to local road department personnel during the October 21, 2011 training session. Over 61 participants representing 21 different public roadway and park district departments attended the training. The training included in-class presentation of BMP materials and field demonstration of product application techniques using a Finn T-120 Hydro Seeder provided by Absolute Contracting, Inc. Product mixing and application techniques using the hydro seeder equipment was demonstrated with hands-on training for proper mixing of materials within the hydro seeder tank, which is a key pitfall to most unsuccessful applications of hydraulically applied mulches and super absorbent additive products. Best management practice fact sheets and product samples were distributed to each participant during the training session.

Figure 1. Absolute Contracting, Inc. providing field demonstration of wood fiber hydro mulch materials using a Finn T-120 hydro seeder during the October 21, 2011 training.

Following the training in October 2011, CRWP and Absolute Contracting, Inc. conducted additional training sessions in November 2011 for the Lake and Geauga County Engineer personnel involved with the installation of the three demonstration sites located on selected county roads maintained by the Lake and Geauga County Engineer Departments in their respective jurisdictions. The October training session and specifically the additional hands-on demonstration site trainings with the Lake County Engineer who operates their own hydro seeding equipment and the Geauga County Engineer who is considering the purchase of hydro seeding equipment proved to be instrumental in addressing specific concerns raised by road department personnel regarding the BMP recommendations and application of materials. This additional training specifically addressed additive mixing within the hydro seeding tank, time required for agitation of the additive products within the tank, rates for mixing additives and preventative measures to avoid nozzle, hose and pump clogging by the slurry mixes.

Figure 2. Lake County Engineer application of straw wattle and wood fiber hydro mulch at the Ledge Road demonstration site in Madison Township, Lake County.

Two of the selected demonstration sites are located in Lake County and the Lake County Engineer road maintenance staff performed the installation under the guidance of CRWP and Absolute Contracting, Inc. The third site is located in Geauga County and Absolute Contracting, Inc. with the assistance of CRWP completed the application of BMPs following the field training held for personnel from the Geauga County Engineer's office. CRWP documented the installation of all three demonstration sites and photo-documented the sites on a monthly basis from initial installation in November 2011 through May 2012.

Following the installation of BMPs, the Lake and Geauga County SWCDs began monitoring the sites within their respective counties for sediment discharge and vegetation establishment following rain events in November 2011. CRWP and the SWCDs designated monitoring locations to collect grab samples of stormwater runoff flowing through the roadside ditches to calculate estimated sediment discharge using the Ohio Sediment Stick. The Ohio Sediment Stick is a turbidity sampling device developed by the Lake County SWCD and field verified by the Ohio Environmental Protection Agency to provide estimations of sediment discharge. The Ohio Sediment Stick is a clear, acrylic 3-foot long; 1-inch diameter tube containing 1-inch graduated increments used to measure and calculate total suspended solids within concentrated flows from streams or in this case roadside ditches. A complete summary on the performance and evaluation of the three demonstration sites is detailed in the report titled *Summary of Roadside Ditch Stabilization Best Management Practice Demonstration Sites in Geauga and Lake Counties.* Monitoring of the three sites continued through May 2012.

The Geauga County site provided a definitive comparison between wood fiber hydro mulch using biostimulants, super absorbent water retention polymers and tackifiers and standard paper hydro mulch. The wood fiber mulch mix visibly outperformed the paper hydro mulch mix in providing protection of the fore slope, back slope and berm areas of the roadside ditch. Geauga SWCD collected runoff samples from 7 storm events and calculated sediment discharge from each treatment area. The wood fiber hydro mulch mix with tackifier and biostimulant additives reduced sediment loading by 33 – 69% per precipitation event with a calculated soil savings of 102 tons per year estimated for the Bass Lake Road site. Unfortunately due to workload and limited rain events during the spring of 2012, similar sampling of storm events by Lake SWCD was not conducted.

Figure 3 and Figure 4. Established vegetation on the fore slope, back slope and roadside berm (left, Figure 3) using wood fiber hydro mulch at the Bass Lake Road demonstration site in Munson Township, Geauga County. Failed vegetation with paper hydro mulch application at Bass Lake Road (right, Figure 4).

DISCUSSION

Upon completion of BMP monitoring, CRWP shared the results with Innovative Turf Solutions, Absolute Contracting, Inc. and the Lake and Geauga SWCDs and began to coordinate the development of specific BMP recommendations contained within factsheets for biostimulants, wood fiber hydro mulch, water retention polymers, tackifiers and straw wattles in June 2012. Following the collaborative effort by the entities listed above to develop the factsheets, CRWP distributed the factsheets in early July 2012 to all participants of the October 2011 training and any additional road or service departments within Lake and Geauga Counties that did not attend the training. Factsheets were also provided to the Stormwater Program Manager with the Ohio Department of Transportation (ODOT) Office of Environmental Services upon request following outreach discussions with the Stormwater Program Manager to expand the project deliverables beyond the Lake and Geauga County areas. The Stormwater Program Manager expressed interest in the possible evaluation of ODOT 659 standards &

specifications which provide guidance for erosion control and final seeding on roadway construction and ditch maintenance projects. Recommendations for expansion of Section 659.15 Wood Fiber Mulch application rates for 2:1 and 1:1 slopes and the addition of a section addressing biostimulants or seed germination enhancers are items for consideration.

In addition to the mailed series of four factsheets as outreach to local road departments, the recommendation factsheets and *Summary of Roadside Ditch Stabilization Best Management Practice Demonstration Sites in Geauga and Lake Counties* are linked to the CRWP http://www.crwp.org/Projects/roadside_ditch_sediment_control.htm, Lake SWCD and Geauga SWCD websites for broader distribution. In December 2011, CRWP provided a summary presentation of the October 2011 training session to public officials attending the CRWP Board of Trustees Meeting and the demonstration project results were presented to public officials attending the CRWP Board of Trustees Annual Meeting in May 2012. Additionally, the results for the demonstration project will be presented to public officials attending the Lake County Stormwater Management Department Annual Meeting in March 2013. Demonstration site results were not complete at the time of the March 22, 2012 Lake County Stormwater Management Department Annual Meeting for presentation at that time.

CONCLUSION

This training program is not expected to create wholesale change throughout the various entities involved with road maintenance operations; however, genuine interest and willingness to try new products and installation strategies were undertaken by some entities such as the Lake County Engineer and Kirtland Hills Service Department who utilized the type of BMP products and application techniques demonstrated during the training on roadside ditch maintenance operations within their jurisdictions. The Lake County Engineer used several of the recommended hydro mulch products on 5 additional roadside ditch restoration sites in Concord, Leroy, Painesville and Perry Townships. The Kirtland Hills Service Department contracted the use of wood fiber hydro mulch with additives for their chronically eroding Booth Road site, which stabilized the roadside ditch. Continued engagement with road superintendents and service department directors will be required over a sustained period of time to effectively change standard operating procedures and erosion control BMP application.

CRWP will continue to engage road departments on improving BMP application by providing on-site technical assistance to local road departments coordinated with the assistance of the respective County SWCD and continue dialogue with Ohio Department of Transportation and County Engineer offices to update performance standards to encourage the use and application of newer erosion control technologies to further reduce erosion of roadside ditches.

Summary of Roadside Ditch Stabilization Best Management Practice Demonstration Sites in Geauga and Lake Counties

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Demonstration Site Summary Report: July 2012
Lake Erie Protection Fund Award – SG 415-11

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ABSTRACT
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PROJECT BACKGROUND
Roadside ditches collect a wide range of pollutants from fecal coliform bacteria to petroleum hydrocarbons to heavy metals from roads, parking lots and construction sites. Unvegetated roadside ditches erode and are sources of sediment. Sediment is the dominant pollutant by volume in Ohio's streams and rivers. Unvegetated roadside ditch side slopes and bottoms contribute tons of sediment annually to local receiving streams. Most erosion occurs during large storm events that produce high flows within roadside ditches. Pollutants attach themselves to sediments and are transported downstream degrading the water quality of receiving streams, rivers and ultimately Lake Erie. Roadway departments, challenged by the need to control flooding and provide for motorist safety, are often confronted with how to best stabilize exposed soils within roadside ditches in a cost effective manner following dredging maintenance.

The Chagrin River Watershed Partners, Inc. (CRWP) in collaboration with the Geauga and Lake County Soil and Water Conservation Districts (SWCD), the Lake County Stormwater Management Department, the Geauga and Lake County Engineer, Innovative Turf Solutions, and Absolute Contracting, Inc. provided training to 21 different public roadway and service departments and park districts on innovative best management

technologies in the following four categories: biostimulants, wood fiber mulches and water retention polymers, tackifiers and straw wattle check dams. A majority of the public roadway personnel represented at the October 2011 field training were township and municipal road department representatives who routinely maintain hundreds of miles of roadside ditches within the Chagrin River watershed and throughout northeast Ohio in the Lake Erie basin. The training delivered focused best management practice information on innovative performance enhancing measures to improve stabilization of bare soils following the excavation of roadside ditches. As a follow-up to this training, three demonstration sites received selected best management practices (BMPs) from the four focus areas to evaluate performance and ease of installation.

Soils within roadside ditches are often compacted, poorly drained and may be nutrient deficient. These characteristics along with seasonal fluctuations in weather patterns and the fact that roadside ditches are first and foremost conveyances of stormwater runoff makes it extremely difficult to establish vegetative cover immediately following maintenance dredging operations. Products that seek to enhance BMP performance can provide critical support to a successful BMP implementation strategy that achieves efficient final stabilization within roadside ditches in a timely manner and effectively reduce the tons of sediment delivered annually to local receiving streams, rivers, culverts, bridge crossings and harbors throughout the watershed.

Cost of BMP products is often a limiting factor for government entities working with shrinking operational budgets. BMP product selection should be chosen on proven performance and affordable cost. When making comparisons, road departments should also consider expenditures for BMP replacement upon failed application, re-mobilization to failure sites and emergency repairs to failed culverts, bridges and other drainage structures caused by sediment accumulation. Better methods can help avoid the costs associated with erosion control failures.

Bass Lake Road Demonstration Site, Munson Township, Geauga County

The Bass Lake Road site compared an enhanced hydro mulch application containing biostimulant, water retention polymer and tackifier additives mixed with a 70/30 wood fiber hydro mulch to a paper mulch hydro mulch without enhancement additives. Each hydro mulch mix contained Ohio Department of Transportation (ODOT) Roadside Seed Mix and19-19-19 fertilizer applied at a rate of 300 pounds per acre.

Bass Lake Road is a county road maintained by the Geauga County Engineer. The BMP demonstration included 1,400 linear feet of road ditch on the northbound lane of Bass Lake Road between Mayfield Road (U.S. 322) and Bean Road in Munson Township immediately north of Munson School and towards Mayfield Road. The Geauga County Engineer design engineering staff assisted with selections of 2 zones of BMP treatment. Both treatment zones contained Wadsworth silt loam soils (*Soil Survey of Geauga County)* with centerline profile ditch slopes ranging from 1.1–1.3%. The entire 1,400 linear feet of road ditch was excavated by a Gradall smooth bucket. Excavation of the ditch was completed by October 12, 2011.

The 700 linear foot southern treatment zone received the following BMP treatment on November 7, 2011. The southern treatment zone remained idle with exposed soils for 25 days before receiving hydro mulch and seed installation which allowed precipitation events to affect the soil surface by assisting in the formation of a crusted or sealed soil surface. In addition to weather induced hardening of the soil surface, excavation with a Gradall smooth bucket of soils containing silt or clay textures often results in a smearing of the soil surface, adding difficulty for seed penetration into the soil and root development following germination. The silt loam soils at this site were not graded or prepped prior to receiving treatment and the surface of the soil was crusted and not loose. Topsoil was not added to the roadside ditch surface prior to installation.

Southern Treatment Zone

- 2,500 pounds per acre Terra Mulch Blend 70/30 Wood Fiber Mulch
- 30 pounds per acre Land Tack Q Plus Tackifier
- 5 pounds per acre HydraSorb Water Retention Polymer
- 5 gallons per acre Hydra-Ultra Plus Biostimulant
- ODOT Roadside Seed Mix at a rate of 300 pounds per acre
- 19-19-19 fertilizer at a rate of 300 pounds per acre

Figure 1. Bass Lake Road, Southern Treatment Zone prior to BMP installation.

Figure 2. Bass Lake Road, Southern Treatment Zone receiving BMP installation on November 7, 2011.

The 700 linear foot northern treatment zone received the following BMP treatment on November 16, 2011. This treatment represents a “typical” roadside ditch stabilization measures. The northern treatment zone remained idle with exposed soils for 33 days before receiving hydro mulch and seed installation and had similar soil conditions as the southern treatment zone at the time of installation.

Northern Treatment Zone

- 2,500 pounds per acre Paper Mulch
- ODOT Roadside Seed Mix at a rate of 300 pounds per acre
- 19-19-19 fertilizer at a rate of 300 pounds per acre

Figure 3. Bass Lake Road, Northern Treatment Zone prior to BMP installation November 15, 2011.

Figure 4. Bass Lake Road, Northern Treatment Zone receiving BMP installation on November 17, 2011.

Both treatments were hydraulically applied as slurry using a mechanically agitated Finn T-120 hydro seeder provided by Absolute Contracting, Inc. A single-employee operation completed the installation and both treatment zones were installed by the same person, using the same equipment and application technique of opposing directional spraying for maximum penetration of seed into the crusted soil surface.

CRWP completed monthly site visits to observe and photo-document performance of the treatments. Geauga SWCD staff estimated sediment loss within each of the two treatment zones following selected precipitation events using the Ohio Sediment Stick. The Ohio Sediment Stick is a turbidity sampling device developed by the Lake SWCD and field verified by the Ohio Environmental Protection Agency. The Ohio Sediment Stick is a clear, acrylic 3-foot long, 1-inch diameter tube with 1-inch graduated increments used to measure total suspended solids within concentrated flows for estimation of sediment discharge. The Geauga SWCD measured flow rates and ditch cross-sectional area in each zone to calculate estimated sediment discharge in pounds per day in conjunction with readings taken from the Ohio Sediment Stick following precipitation events.

DISCUSSION: ENHANCED HYDRO MULCH

The southern treatment zone received the application of 70/30 wood fiber hydro mulch at 2,500 pounds per acre, water retention polymer, tackifier and biostimulant additives and established complete grass cover on the fore slope and back slope of the ditch by April 2012 (Figure 5) while the 2,500 pounds per acre paper mulch application without

additives in the northern treatment zone failed to establish grass cover leaving the fore slope and back slope unprotected through June 2012.

In addition the wood fiber hydro mulch and tackifier protected the southern treatment zone fore slope and back slope from November 2011 through March 2012 until full germination was completed by mid-April 2012. The paper mulch application on the northern zone dissolved and washed from the soil surface following the first two rain events in late November 2011 and the fore slope and back slope soils were left unprotected by mid-December 2011. Germination of seed failed in the northern section and the fore slope and the back slope showed significant signs of rill erosion and loss of sediment. Each treatment zone experienced failure within the centerline of the ditch due to high flows and lack of accompanying velocity control measures such as check dams or erosion control matting.

The above average temperatures for the 2011-2012 winters reduced snowpack and subjected the site to periodic rain events. The warmer than usual winter also enabled some germination of seed in the months of December 2011 and January 2012 as shown in Figure 6.

Figure 5. Bass Lake Road, Northern Treatment Zone April 27, 2012 full germination of fore slope, back slope and berm.

Figure 6. Bass Lake Road, Northern Treatment Zone January 2012 germination. Note hydro mulch coverage of soil surface.

Figure 7 shows the unprotected fore slope and back slope in the northern treatment zone. The close-up photograph of the back slope, Figure 8, shows rill erosion forming and rocks in the soil indicating the depth of erosion occurring on the surface of the back slope.

Figure 7. Bass Lake Road, Northern Treatment Zone April 27, 2012 showing failed germination on fore and back slope.

Figure 8. Bass Lake Road, Northern Treatment Zone close up photo of back slope showing rill erosion and rock pedestals.

Ohio Sediment Stick measurements collected by Geauga SWCD indicate that the southern treatment zone generated significantly less sediment than the northern treatment zone during sampled precipitation events.

Bass Lake Road, Munson Twp., Geauga Co. - Northern Treatment Zone

Date	Precipitation Inches	TSS Reading mg/l	Rate cfs	Sediment Load lbs/day	Tons/year
11/23/11	1.00	21.6	0.06	6.81	1.24
11/29/11	0.70	54.0	0.20	57.31	10.46
12/5/11	0.40	112.9	0.28	169.10	30.86
12/15/11	0.16	165.0	0.22	195.10	35.61
12/21/11	0.70	209.8	0.22	247.40	45.15
3/8/12	0.41	411.4	0.18	406.33	74.16
5/8/12	0.42	13.5	0.03	2.23	0.41

Bass Lake Road, Munson Twp., Geauga Co. - Southern Treatment Zone

Date	Precipitation Inches	TSS Reading mg/l	Rate cfs	Sediment Load lbs/day	Tons/year
11/23/11	1.00	15.0	0.04	3.11	0.57
11/29/11	0.70	54.0	0.13	38.91	7.10
12/5/11	0.40	112.9	0.14	84.11	15.35
12/15/11	0.16	112.9	0.10	61.48	11.22
12/21/11	0.70	84.1	0.21	96.56	17.62
3/8/12	0.41	411.4	0.11	238.31	43.49
5/8/12	0.42	16.7	0.03	2.53	0.46

The costs for the southern and northern treatment zones are based on November 2011 pricing. Each treatment zone extended for 700 linear feet with an average width of 10 feet for a total of 7,000 square feet of treatment area per treatment zone. Seed and fertilizer costs are the same amount for both treatment zones.

Southern Treatment Zone: Total Cost $378.36

- 2,500 pounds per acre Terra Mulch Blend 70/30 Wood Fiber Mulch at $40.00 per 50 pound bale, $0.045 per square foot, for a total of $315.00
- 30 pounds per acre Land Tack Q Plus Tackifier at $3.88 per pound, $0.002 per square foot, for a total of $18.66
- 5 pounds per acre HydraSorb Water Retention Polymer at $17.43 per pound, $0.002 per square foot, for a total of $14.00
- 5 gallons per acre Seasafe Hydra-Ultra Plus Biostimulant at $38.22 per gallon, $0.004 per square foot of treatment for a total of $30.70

Northern Treatment Zone: Total Cost $238.00

- 2,500 pounds per acre Paper Mulch at $30.00 per 50 pound bale, $0.034 per square foot for a total of $238.00

An increase in cost of approximately $140.00 for the addition of innovative BMP materials provided successful erosion control, seed germination and establishment of vegetation over traditional BMP hydro paper mulch materials. Sediment discharge measurements taken within each treatment zone during the same precipitation events at the Bass Lake Road site show that the wood fiber hydro mulch mix which included advanced tackifiers and biostimulants provided a 33 – 69% reduction in sediment loss compared to the paper hydro mulch application. The seven measured precipitation events estimate a soil savings of 102 tons of sediment per year for the southern treatment zone which received the advanced BMPs.

Morley Road Demonstration Site, Concord Township Lake County

The Morley Road demonstration site located in Concord Township between Pinecrest Road and Carriage Hills Drive focused on the use of straw wattles as alternative check dams to standard rock riprap. This demonstration site evaluated the installation, performance and longevity of straw wattle check dams. Straw wattles are tube-shaped structures installed perpendicular to the flow within the ditch, and are used to dissipate runoff velocities and filter sediments from stormwater runoff. The flexibility of the wattle allows the practice to fit any cross-sectional shape found in roadside ditches.

This demonstration site also included the installation of hydraulically applied wood fiber hydro mulch using two different biostimulant additives, Seasafe Hydro-Ultra Plus and Quick Stand. The southbound roadside ditch was treated with Seasafe Hydro-Ultra Plus and the northbound roadside ditch was treated with Quick Stand. Each biostimulant was mixed into the hydro mulch mixtures. Each hydro mulch mixture contained the same type and amount of wood fiber mulch, water retention polymer and tackifier additives, seed and fertilizer.

Biostimulant additives can be either synthetic compounds or naturally occurring organic materials like humic acid, seaweed extract or fish emulsion. Naturally occurring biostimulants contain hormones, vitamins, amino acids and mineral nutrients that naturally stimulate germination and growth. Seasafe Hydro-Ultra Plus is a biostimulant containing concentrated sea kelp that promotes growth through absorption of natural plant hormones. Quick Stand is a biostimulant that uses organic humectants (substances to reduce moisture loss), coconut alkanolamide (fatty acid) and okra extract to enhance germination and yield of applied seed.

Morley Road is a county road maintained by the Lake County Engineer. The roadside ditches along this particular section of Morley Road presented several challenges. The ditch centerline profile slopes for the north and southbound roadside ditches range from 2.7-3.0%. The *Soil Survey of Lake County, Ohio* describes the soils located at the site as Lordstown channery silt loam soils. Channery soils contain thin fragments of rock that can cause difficulty in seed germination and vegetation establishment. Additionally, the site contains constant ground water seepage from the underlying bedrock, which maintains saturated back slope and fore slope conditions within the roadside ditch. Although this is helpful in maintaining moisture in the seed bed, it also allows for heaving of the soil during winter months which presents an additional challenge for dormant season seed application. Heaving can reduce a dormant seed's contact with the soil and expose seed to erosive forces during flow events within the ditch. A final challenge at this location is the presence of non-native Phragmites (*Phragmites australis*) that is a common source of blockage in roadside ditches and often out competes bluegrass, fescue and ryegrass seeding applications following routine dredging and restoration of urban and rural roadside ditches. The Lake County Engineer removed the standing portions of Phragmites during dredging maintenance of the ditches, however, the roots and rhizomes of the plant remained and chemical treatment was not applied to the Phragmites for either the north or southbound lane ditches.

The northbound and southbound lane roadside ditches were excavated by a Gradall smooth bucket on November 9 and November 14, 2011, respectively. The Lake County Engineer installed BMP treatments on both roadside ditches on November 15, 2011, allowing for only a few days of exposed soil conditions. This short timeframe enabled the hydro mulch mix to be applied to the fresh excavation of the roadside ditch soils.

Both hydro mulch mixes contained the following components: ODOT Roadside Seed Mix and19-19-19 fertilizer at a rate of 300 pounds per acre. The only difference in hydro mulch mix between the southbound and northbound lanes was the biostimulant additive. The 800 linear foot southbound lane received hydro mulch mix containing Seasafe Hydro-Ultra Plus biostimulant at a rate of 5 gallons per acre and the 812 linear foot northbound lane received a hydro mulch mix containing Quick Stand biostimulant at a rate of 5 gallons per acre. The hydro mulch slurries were applied using the Lake County Engineer's TurfMaker 800 Hydroseeder. It is important to note that the hydro mulch material was sprayed onto the ditches from an elevated position from atop the TurfMaker 800.

Southbound Ditch Treatment

- 2,500 pounds per acre Terra Mulch Blend 70/30 Wood Fiber Mulch
- 30 pounds per acre Land Tack Q Plus Tackifier
- 5 pounds per acre HydraSorb Water Retention Polymer
- 5 gallons per acre Seasafe Hydra-Ultra Plus Biostimulant
- ODOT Roadside Seed Mix at a rate of 300 pounds per acre
- 19-19-19 fertilizer at a rate of 300 pounds per acre

Figure 9. Morley Road, Southbound Treatment Zone prior to BMP installation.

Figure 10. Morley Road, Southbound Treatment Zone following BMP installation November 15, 2011.

Northbound Ditch Treatment

- 2,500 pounds per acre Terra Mulch Blend 70/30 Wood Fiber Mulch
- 30 pounds per acre Land Tack Q Plus Tackifier
- 5 pounds per acre HydraSorb Water Retention Polymer
- 5 gallons per acre Quick Stand Biostimulant
- ODOT Roadside Seed Mix at a rate of 300 pounds per acre
- 19-19-19 fertilizer at a rate of 300 pounds per acre

Figure 11. Morley Road, Northbound Treatment Zone prior to BMP installation.

Figure 12. Morley Road, Northbound Treatment Zone BMP installation November 15, 2011.

Freshly excavated or dredged ditches often require check dam structures to progressively dissipate the velocity of flowing water to prevent failure of the fore slope or road berm. Rock riprap check dams are the traditional type of check dam specified for roadside ditch stabilization projects. One alternative to rock riprap check dams is the wattle. At this demonstration site, straw wattles were selected for installation. Wattles are tube-shaped erosion control practices filled with straw, coconut fiber, or composted material. Each wattle is wrapped with ultra-violet degradable polypropylene netting or 100% biodegradable materials like burlap or jute. Wattle materials are lightweight, easily transportable and can be tailored to necessary lengths at the job site or preassembled at the service yard for later installation on any shaped ditch or swale.

Wattles reduce the velocity of concentrated flows, thereby reducing erosion within the ditch or swale. Wattles are not intended to trap large quantities of sediment, but rather slow down the flow of water as runoff moves through its fiber matrix. Wattles can and do trap sediments within their fiber matrices and they can also trap sediments in the bottom of the ditch if the wattles create a pooled area of water immediately upslope of the wattle location. The pooled or pocket of standing water forces coarse sediments to drop out of suspension from the runoff prior to passing through or over the wattle check dam.

Wattle diameter varies per manufacturer, but typically available sizes are 9, 12 and 20 inches in diameter. Pre-manufactured lengths vary as well with most 9 inch wattles assembled in 25 foot lengths. Length can be adjusted by simply cutting the polypropylene netting at the desired length and re-tying the netting at each end securely with heavy twine or plastic locking ties.

Straw wattles selected for the Morley Road site were 9-inch diameter wattles. The southbound ditch wattle spacing averaged 70 feet between wattles over the 800 linear feet of treatment and the northbound ditch wattle spacing averaged 65 feet over the 812 linear feet of treatment. Wattles were placed to completely cover the width of the ditch with the

ends of the wattle extending up the fore slope and back slope a minimum of six inches in elevation above the centerline of the wattle to ensure water does not route around the ends of the wattle causing erosion or gully formation along the fore slope or back slope. The ends of each wattle were turned slightly upstream creating an over-widened u-shaped configuration. Wood stakes were placed through the center of the wattle at 2 foot spacing with a stake placed a minimum of 2 feet from each end of the wattle. Wood stakes 24-30 inches in length were used to secure the wattles within each ditch. Before each wattle was installed, a two inch trench was excavated by hand with a mattock for wattle installation. Following wattle placement and staking, the excavated soils were backfilled and compacted against the backside (downstream side) of the wattle to ensure water could not flow underneath the wattle.

Appropriate length straw wattles were cut on site from 25-foot long rolls, re-tied to secure each end, trenched, backfilled and staked by hand. Each wattle installation took less than 5 minutes to install by the Lake County Engineer road maintenance personnel.

Figure 13. Individual straw wattle.

Figure 14. Straw wattles in series.

DISCUSSION: HYDRO MULCH, BIOSTIMULANT AND STRAW WATTLES

The hydro mulch applications to the south and northbound roadside ditches provided effective coverage of the soil surfaces through the winter months; however, spring germination was compromised by several factors. Heaving soils within the back slope and fore slope created conditions favorable for seed detachment and transport. Areas with significant signs of soil heaving had less germination than areas experiencing less ground water saturation and associated soil heaving. An abundance of rock fragments exposed on the back slope and fore slope may have also contributed to the lack of proper seed-soil contact sites for adequate germination.

Application technique is as important as product use and in this case the aerial spraying of the hydro mulch slurry on to the ditch soil surface from on top of the hydro seeder equipment may not have allowed the seed and biostimulant material to penetrate into the soil to ensure adequate seed-soil contact. Walking the road berm and applying a direct stream of slurry material with the hose nozzle tip in an opposing (criss-cross) sweeping

motion helps to drive or "seat" the seed and hydro mulch material and accompanying additives into the soil. This was one major difference observed between the Bass Lake Road application site and the Morley Road site, both of which received similar hydro mulch slurry mixes but exhibited different germination success.

Neither biostimulant appeared to have an advantage over the other at this application site. Although seed germination did occur in the spring of 2012, the ODOT Roadside Seed Mix was quickly over taken by the resurgence of Phragmites within each ditch. The biostimulant additives likely provided a nutrient boost to both the applied seed and existing root system of the Phragmites possibly creating more favorable conditions for stimulated Phragmites recovery.

The straw wattles performed very well throughout the 6 month monitoring period, November 2011 – May 2012, and continued to function through June 2012. Only two of the 22 straw wattles became dislodged from their staking. No wattles were undermined or experienced routing of flow around the ends. The wattles provided stable centerline overflow points without downstream scour. Several of the wattles were able to trap sediments within the straw fiber matrix and created pools immediately upstream that also trapped a significant amount of sediment within the ditch bottom preventing that sediment from further downstream transport.

Figure 15. Straw wattle trapping sediment. Drainage is flowing from top to bottom in picture.

Figure 16. Phragmites growth within Morley Road southbound ditch June 2012.

Maintenance was not performed on any of the straw wattles over the 6 month monitoring period. However, maintenance is an important component of successful BMP performance. CRWP provided monthly inspection of the site to ensure the wattles did not require maintenance. Short-term inspection following installation and following the first major precipitation event is recommended to ensure the wattles remain firmly anchored in place and are not compromised by flows routing around the ends of the practice. Once vegetation is established wattles can be removed or can remain to

decompose in place. If wattles have trapped sediments, those sediments should be removed from the ditch and the area immediately stabilized with seeding and mulching.

Material costs for wattles range from $18 to $30 per 25-foot roll depending on the type of material used to construct the wattle. November 2011 pricing for 9-inch diameter straw wattles totaled $18.00 per 25-foot roll for a material cost of $1.38 per linear foot.

Labor hours allocated for installation, monitoring and maintenance should be factored into the overall cost of BMP application. Labor for straw wattle installation and handling will be considerably less than labor for hauling and installation of rock check dams which require multiple pieces of equipment for installation and handling as opposed to simple hand labor for straw wattle installation. Labor costs for removal of the wattles may be avoided if the wattles are left to biodegrade in place. However, sediment removal and disposal are still necessary in areas where sediment accumulates in front of the wattle.

Ledge Road Demonstration Site, Madison Township Lake County

The Ledge Road demonstration site located in Madison Township north of Ross Road and south of State Route 528 also demonstrated the use of straw wattles as check dam alternatives to standard rock riprap and hydraulically applied wood fiber mulch using only the water retention polymer and tackifier additives. Biostimulants were not included in the Ledge Road applications.

The Ledge Road site was chosen in part for the underlying silt loam soils found in its roadside ditches. Pierpont and Platea silt loam soils (*Lake County Soil Survey*) are poorly drained soils and are comparable to other similarly formed poorly drained silt loam soils such as the Darien, Ellsworth, Mahoning and Wadsworth soil series commonly found in Cuyahoga, Geauga and Lake Counties.

Both the southbound and northbound lane roadside ditches were excavated by a Gradall smooth bucket on November 9, 2011 with both roadside ditches receiving BMP treatment installation on November 10, 2011 completed by the Lake County Engineer. The southern portion of both the southbound and northbound lanes received straw wattle check dams that were spaced an average of 40 feet apart. The centerline profile ditch slope is 7.3% within the southern portion of the demonstration site. Selected straw wattles were 9-inch diameter wattles and were installed by Lake County Engineer road maintenance personnel as detailed above in the Morley Road description.

The 590 linear foot southbound lane and 625 linear foot northbound lane roadside ditches received the same ODOT Roadside Seed Mix, 19-19-19 fertilizer hydro mulch mix containing wood fiber mulch, water retention polymer and tackifier additives. The hydro mulch slurries were applied using the Lake County Engineer's TurfMaker 800 Hydroseeder. It is important to note that the hydro mulch material was sprayed onto the ditches from an elevated position from atop the TurfMaker 800.

Southbound & Northbound Treatment

- 2,500 pounds per acre Terra Mulch Blend 70/30 Wood Fiber Mulch
- 30 pounds per acre Land Tack Q Plus Tackifier
- 5 pounds per acre HydraSorb Water Retention Polymer
- ODOT Roadside Seed Mix at a rate of 300 pounds per acre
- 19-19-19 fertilizer at a rate of 300 pounds per acre

Figure 17. Ledge Road, Northbound Treatment Zone prior to BMP installation.

Figure 18. Ledge Road, Northbound Treatment Zone BMP installation November 10, 2011.

DISCUSSION: HYDRO MULCH AND STRAW WATTTLES

The Ledge Road site provided less conclusive results on performance of erosion control and sediment runoff reduction by the hydro mulch application. Field observations estimated germination only covering between 65-80% of the fore slope and back slope in most portions of the roadside ditches. A majority of the centerline did germinate with an estimated 90% of the ditch centerlines having established vegetation by the end of May 2012.

The straw wattles appear to have controlled flows throughout the winter allowing the hydro mulch, tackifier and seed material to remain in place within the centerline of the ditches enabling the seed to effectively germinate and grow in the spring of 2012. All 16 installed straw wattles remained functional from November 2011 to May 2012. During May and into June 2012, several of the straw wattles began to show signs of breaking apart. Polypropylene netting on several wattles near the ends of the practice broke apart and partially decomposed straw material is being transported downstream.

Two observations may provide further insight into poor performance at the Ledge Road site. The lack of germination along the berm and fore slope could be attributed to washout of the seed from these areas. Both the berm and fore slope are comprised of loose gravel ranging in size from 2-10 mm and the crown of the road sheds heavy sheet flow and in some areas concentrated flow to the berm and fore slope. Small washouts of

the loose gravel material were observed on both the southbound and northbound lanes. Proper binding of the wood fiber mulch, seed and fertilizer material to the loose gravel by the tackifier may not have been successful due to application technique. The hydro mulch mix was applied from the top of the hydro seeder equipment and essentially floated onto the soil surface. As in the Morley Road demonstration site, loss of hydro mulch material and lack of germination may be a symptom of poor application techniques. Generating appropriate penetration of the seed into the soil and firm attachment of the mulch material, tackifier and additives to the surface of the berm and ditch slopes may be an important step to ensuring higher germination rates and vegetation yields. There are several other factors that can also affect germination, however, so this is not a conclusion that application technique alone is responsible for appropriate germination and vegetation establishment.

CONCLUSION

The erosion control industry continues to grow at an accelerating rate with innovative products and new application techniques being developed on a regular basis. Some of these advancements are ideal for assisting with roadside ditch stabilization.

Innovations in water retaining wood fiber mulches and super absorbent polymers can provide superior erosion control protection over traditional straw mulching and hydraulically applied paper mulch materials. Advanced tackifiers that bind soil particles, especially clays, in place preventing detachment of soil particles from rain splash impact and high flow velocities have an important role to play in roadside ditch stabilization and restoration. Innovative additives such as biostimulants can be used as effective components of stabilization since they greatly enhance erosion control protection by shortening the germination time and increasing yields on applied seed. Check dams are a proven BMP for runoff velocity dissipation and straw wattle check dams offer an easily installed, effective alternative to rock riprap check dams. Straw wattles are also an acceptable replacement for the misuse of silt fence or straw bales to treat concentrated flows within ditches.

The results and lessons learned from the demonstration sites illustrate that hydro mulch materials, water retention and biostimulant additives can assist in effectively establishing vegetative cover within roadside ditches under difficult weather and soil conditions when proper application techniques are applied. Although effective, the use of innovative BMPs does not eliminate the necessity for good site preparation, proper installation and timely maintenance of BMPs to control roadside ditch erosion.

Generally, roadside ditch maintenance projects have less square footage of exposed soils to protect than roadway replacement projects or soil disturbing activities involving development. Slight increases in cost, as minimal as $0.02 per square foot, to invest in higher performing BMPs can arguably offset the costs of long-term maintenance to stormwater infrastructure due to erosion and sedimentation.

Proper application techniques from nozzle tip selection, hydro seeder tank agitation time allowance, directional spraying with downward trajectory as well as straw wattle spacing,

placement and staking all require training and skill development and are important to successful application of BMP materials.

Timing of application also plays a significant role in effective control. Soil protection measures should always be applied as soon as possible, however, if roadside ditch soils are subjected to weather that creates crusted or hard surfaces and additional soil preparation will not be completed then selection of advanced BMPs is more appropriate to ensure vegetation establishment in a timely manner.

The introduction to, use and review of innovative best management practices by road maintenance departments and all other soil-disturbing industries is an important part of a soil erosion control strategy by local communities within the broader context of watershed and water resource protection.

Additional factsheet and project summary information is available at:
http://www.crwp.org/Projects/roadside_ditch_sediment_control.htm