

Bridgemats for Forestry in North Carolina:

2002 to 2008 Project Status Report



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Report Compiled by Tom Gerow Jr., RF
BMP Staff Forester, Forestry Nonpoint Source Branch
North Carolina Division of Forest Resources
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Tom Gerow, Jr. - BMP Staff Forester
Forestry Nonpoint Source Branch
North Carolina Division of Forest Resources
N.C. Department of Environment and Natural Resources
1616 Mail Service Center
Raleigh, NC 27699-1616

Main Phone: (919) 857-4801
Web site: www.dfr.nc.gov

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Executive Summary

Stream and ditch crossings are an inevitable component of forest harvests. As would be expected and shown by numerous research studies, stream crossings are often the most vulnerable location on a forest harvest in which a potential risk of sedimentation and accelerated erosion exists. Portable bridgemats are a readily-available and proven method of crossing streams and ditches in a relatively 'low-impact' manner that contributes to the protection of water quality from nonpoint source pollution, primarily sediment.

Other methods of crossing streams include culvert pipes and hardened-surface fords. While these methods have been extensively researched and documented for application on forest roads, they are not always an ideal choice for crossings by logging tractors and equipment in the woods. The cost and time investment required for installing a culvert pipe or ford crossing can far exceed the time needed to install a bridgemat crossing.

For more than 10 years, the N.C. Division of Forest Resources (NCDFR) has made available bridgemats for loggers to borrow. Between 2003 and 2008, bridgemats owned by the NCDFR were used on 239 logging jobs to establish or protect 306 stream crossings, and provide access to almost 8,500 acres of timberland harvest. Over this period, there have been many lessons learned regarding the administration of a bridgemat loan-program and the overall specification and use of bridgemats. Through a diversity of outreach and technology transfer actions, several states have modified or added their own program delivery to promote the use of bridgemats in their state.

The Basics of Bridgemats

The word 'bridgemat' is used to describe a heavy wooden timber or fabricated steel panel that can be situated across a stream or ditch channel to serve as a temporary bridge for access by logging equipment during forest harvesting activities. This term, bridgemat, was put into wide use by staff of the N.C. Division of Forest Resources (NCDFR) in 2002, in an attempt to more precisely describe the intended purpose of these heavy-duty panels as they apply to forestry and logging, and to avoid confusion. Other terms used at that time included: dragline mat, logging mat, skidder bridge, pontoon bridge, or bridge mat (2 words). Wooden mats that are manufactured and installed for temporary placement atop forest roads for log truck access are commonly called logging mats or road mats. And the term 'dragline mat,' while in existence for many decades, does not describe their intended use as temporary bridging when used for crossing streams during forestry and logging activities.



Figure 1: A set of three bridgemats installed for a skid trail crossing of a stream in central North Carolina.

Typically, two to four individual bridgemat panels are positioned into place for each temporary crossing. By using multiple panels, the logging equipment is provided a wide pathway for crossing the water channel. Additionally, by installing multiple panels tightly against each other, gaps between the panels are kept to a minimum. This prevents loose soil, tree limbs and other logging debris from falling into the water channel during the skidding or equipment travel.

Some benefits of using bridgemats instead of culverts or fords include (in no order):

- Less time to install and remove.
- Minimal direct contact with the water during installation and use.
- Very little, if any, soil disturbance at the crossing.
- No backfill material needed to be placed into the water channel.
- Bridgemats can be used again and again.
- Reduced cost and time needed for stabilizing the stream crossing after logging is completed.

Some hindrances to using bridgemats include (in no order):

- Initial capital cost to purchase.
- Cumbersome to handle, install, load and transport.
- Another piece of equipment for the logger to keep track of and maintain.
- May not always be suitable for heavy log truck crossings or wide channel crossings.
- Not a permanent crossing option.

Program Delivery

Since the mid-1990's, the NCDFR has provided bridgemats to loggers for establishing temporary crossings. Up until 2003, all bridgemats made available by NCDFR were those constructed of wood/timber beams, with panels ranging in lengths from 20 feet to 24 feet. In 2003, the NCDFR made its first purchase of fabricated steel bridgemats. This investment was deemed appropriate for several reasons:

- Longer life-cycle of steel bridgemats versus wood/timber bridgemats (three to four times longer).
- More durable and less susceptible to normal wear and tear damage.
- Introduce the concept of using steel bridgemats in new locations of North Carolina.

A summary of the NCDFR's most recent purchases of bridgemats is shown in Appendix A, while Appendix B summarizes the status of each set of NCDFR bridgemats, as of year-end 2008.

The most significant leap forward in program delivery during this reporting period was the addition of bridgemats to provide statewide availability to meet customer needs. Statewide bridgemat availability has been achieved for approximately 4 years, as a result of successive years of bridgemat purchases.

Between 2003 and 2008, bridgemats owned by the NCDFR were used on 239 logging jobs to establish or protect 306 stream crossings, and provide access to almost 8,500 acres of timberland harvest. The total estimated harvest acreage of those tracts in which NCDFR bridgemats were used exceeds 14,400 acres. Therefore, the bridgemats were used, on average, to access about 60 percent of the harvested acres of these tracts of timber. A summary of bridgemat use by month is shown in Appendix C.

Loggers and timber buyers continue to access and support the bridgemat loan project, based on direct customer communication and from input by field staff. Increasingly, we are seeing that many loggers borrow our bridgemats to supplement other bridgemats that they already have in-use on the logging job. This observed trend is positive, as the incorporation of using bridgemats as a normal part of doing business appears to be strengthening among loggers and the forest industry in North Carolina.



Tracking Bridgemat Usage

Consistently tracking the usage, location and general whereabouts of all bridgemats is vital to administering a successful and functionally reliable bridgemat loan project. A one-page tracking form developed in 2002 continues in use by agency field staff to track the location and usage of the bridgemats. This form is included in Appendix D for reference.

Tracking forms are kept up to date and maintained in a central filing system. Frequent reminders are given to field staff responsible for completing and submitting these forms. Making spot visits or site inspections when the bridgemats are being used allows field staff to keep tabs on how the bridgemats are holding up and provide technical assistance to the logger if needed. Documenting bridgemat use and condition through photographs also proves helpful.

The metrics associated with use of the bridgemats is recorded, and reported to multiple state and federal water-quality agencies. The metrics for North Carolina include the number of crossings; the total tract acres; and the number of acres being accessed by the bridgemats. This type of information is valuable when a program is requested to show a tangible, measurable impact ‘on the ground’ of how much the bridgemats are being used, which can be extrapolated to estimate how their use contributes to nonpoint source pollution prevention and the implementation of forestry Best Management Practices (BMPs). While such information cannot estimate the *effectiveness* of bridgemats, the tracking mechanism can satisfactorily monitor and document the *implementation* of bridgemats.

Follow-up & Future Project Plans

All of the goals outlined in the previous (2003) bridgemat program status report have been accomplished. The bridgemat loan-project will be maintained for loggers in North Carolina, as the bridgemats remain viable for use. No large purchases of bridgemats are planned for the foreseeable future. However, individual purchases may still be made, as funding is available, to meet specific needs to protecting water quality.

Going forward, future project goals related to bridgemats include:

- **Measuring Effectiveness**

There is a desire to quantify the degree to which bridgemats prevent sediment and other nonpoint source pollution. Working with the USDA-Forest Service Southern Global Change Program, this aspect of evaluating bridgemats will be incorporated as part of a more comprehensive, multi-year BMP effectiveness monitoring study that was begun in 2005. Water samplers will be installed on active logging jobs that are using bridgemats to collect and analyze the water quality on the upstream and downstream sides of the bridgemat location. We plan to begin this phase of the study in 2009 and monitor several different sites in central North Carolina.

- **Installing Demonstration Areas**

With additional sets of bridgemats being retired, and an increasing desire to diversify program delivery at North Carolina’s State Forests, an effort will be needed to relocate and install older bridgemats as permanent interpretive exhibits.



Trouble-Shooting & Lessons Learned

Over several years of use and multiple purchases of bridgemats constructed of both wood/timber beams and fabricated steel, a number of trouble-shooting issues have had to be addressed. This section summarizes some of these issues to share the knowledge gained from our experiences.

Steel Bridgemats

- **Top Sheeting Gauge**

On the original 2003 order for steel bridgemats, the NCDFR specified a top-sheeting steel thickness that proved to be too thin (3/16-inch gauge). The top sheeting was not sufficient to support the heavy loads of the skidders and log trucks. As a result, the top sheets cupped and become deformed (Figure 2), which contributed to the breakage of the weld bonds along the edges of the top sheets affixing them to the underlying I-beams (Figure 17). On subsequent orders of steel bridgemats, the minimum top sheeting gauge was specified at 1/4-inch. No deformation or cupping of the top sheeting has been observed on those newer bridgemats that have a 1/4-inch thick top sheet.



Figure 2: Gaston County, 2007. A set of NCDFR bridgemats purchased in 2003, exhibiting cupping of the 3/16-inch thick top sheeting. These bridgemats also have had steel plates welded over the center handling access holes (read below).

- **Center Handling Access Holes**

On the original 2003 order for steel bridgemats, the NCDFR specified that two square holes be fabricated into each bridgemat panel, in the center of the bridgemat. The intent was to provide a location for a knuckleboom log-loader to pick-up the bridgemat when loading and unloading. However, soon after delivery and use by loggers, many complained and questioned why the bridgemats had holes in them. The holes were pointed out as potential tripping-hazards when walking. Several individuals pointed out that by having these holes in the bridgemats, they defeated the purpose of keeping soil and debris from falling into the stream when skidding across them. As a result, several of our District Offices welded heavy-gauge steel plates over the holes to alleviate further concerns. Subsequent purchases of steel bridgemats by the NCDFR have not had any access holes incorporated into their design or construction.

Wood/Timber Bridgemats

- **Species Selection**

On the 2005 order for wood/timber beam bridgemats, the NCDFR broadened the species of wood that was allowable for use in the construction of the bridgemat to include not only oak, but also hickory. The intent was to potentially lower the cost and manufacturing time for the bridgemats by allowing a slightly more diverse species choice. The purchase cost proved to be much lower than expected. However, after only 4 years of use, this decision proved to not work out as well as hoped. Nearly all of the bridgemats purchased on that 2005 order have suffered from structural cracks in the beams that render the bridgemat unsuitable for any use, even light-duty vehicle access or pedestrian use. This major structural failure contrasts sharply with older wood/timber beam bridgemats that the NCDFR purchased in previous years, and in some cases are approaching 10 years old. Those older solid-oak bridgemats have some deterioration of the wood, but the deterioration is mainly limited to the ends of the beams. Only a few of the older oak bridgemats have suffered a major structural failure, due mainly to internal wood decay. It is clear that any future purchases of wood/timber bridgemats for this project will specify oak species of wood to be used, and in fact, a requirement to have wood preservative applied by the manufacturer may be pursued.

Unique Applications

Extra-Wide Crossing, Alamance County: January 2007

In January 2007, a logger approached the NCDFR Hillsborough District Water Quality Forester seeking a solution to a skidder crossing of a major stream on a tract of timber he was harvesting. After the logger consulted with the forester and the US Army Corps of Engineers, he managed to construct an extra-wide crossing using a set of NCDFR bridgemats and a set of bridgemats he owned. Without using bridgemats, this wide crossing could not have otherwise been accomplished with such minimal environmental impact. There was no other viable logging road or skid trail access on the opposite side of this stream.



Figure 3: The logger used NCDFR bridgemats for the center span on this crossing and used his own bridgemats on the approachway.



Figure 4: The logger got approval to install the two temporary log abutments in the creek channel to support the bridgemats.

Riverbend, Moore County: September 2008

In September 2008, torrential rains from the remnants of Tropical Storm Hanna soaked a large area of central North Carolina. In the small community of Riverbend, located near the town of Vass in Moore County, the only access road for approximately 80 residents was washed away from flood waters. The road's existing twin-culvert crossing of a perennial stream failed, severing the road. During the late-night hours after the storm had passed, personnel from nearby NCDFR offices retrieved a set of bridgemats assigned to the Rockingham District Office, transported them to the site and installed the bridgemat across the severed road section. This quick action provided temporary vehicle access for the community. After approximately one week of use, the bridgemats were replaced with a more substantial temporary portable bridge from another NCDFR office. The work completed by the NCDFR and the usage of the bridgemats was well-publicized in print and television news media.



Figure 5: NCDFR personnel installing bridgemats on the same night that the road was severed from a failed culvert crossing.



Figure 6: NCDFR bridgemats installed as temporary vehicle access for Riverbend in Moore County, NC

Hiking Trail Crossing, DuPont State Forest: October 2005

An alternative use for a retired bridgemat panel exists at DuPont State Forest, in which a single panel is now used for a hiking trail stream crossing. Figure 7, at right, illustrates the panel installed for this purpose.

Even though the bridgemat panel is no longer considered viable for use during logging, it remains rugged enough and suitable to accommodate occasional pedestrian use and horseback riders. In addition to this hiking trail application, old sets of bridgemats are available and being considered for use as a permanent display exhibit at the State Forest.



Figure 7: Retired bridgemat used on a hiking trail.

Outreach

Since the previous status report, a number of outreach and educational projects have been completed. These projects are summarized in this section.

Bridgemat Installation Brochure

In 2005, a third revision was completed of a brochure describing the basic steps involved with handling, installing and removing bridgemats for stream crossings. The brochure, entitled “How to Use Bridgemats for Stream Crossings,” is an updated version that includes photos of steel bridgemats, unlike the previous two editions. This brochure is available to view and download from the NCDFR Web site:

<http://dfr.nc.gov/publications/WQ0305.pdf>

Bridgemat and Stream Crossing Videos

Also in 2005, the NCDFR produced two Best Management Practice (BMP) training videos for use in the North Carolina ProLogger Program. Both videos were incorporated into the 2005-2006 ProLogger continuing education module. The two videos are:

- Video 1 - “Forestry Stream Crossings with Bridgemats”
- Video 2 - “Forestry Stream Crossings”

The ProLogger Program is owned and operated by the North Carolina Forestry Association and reaches an estimated 1,400 loggers annually. To maintain ProLogger status, a person must complete a three-day Base Course and maintain annual continuing education. More information about ProLogger is available from the Web site www.ncforestry.org.

In addition to being used at the ProLogger workshops, these two videos (which are recorded on a single DVD or VHS tape) were requested and distributed statewide and nationwide. Increased awareness of the two videos was made possible via e-mail and associated ‘listing’ services that reached a broad network of forestry, water resources and soil conservation professionals. At least 140 copies of these two videos were distributed to 23 states and the District of Columbia, necessitating a second production run soon after the initial batch was received from the video production contractor.

Carolina Log’n Demo

During the 2005 Carolina Log’n Demo, hosted by the North Carolina Forestry Association, a set of NCDFR bridgemats were set up as a stationary exhibit near the entryway to this biennial logging equipment show. An estimated 1,500 people, mostly loggers, attended. While the bridgemats were not actually installed across a stream channel, their presence at the show clearly indicated that bridgemats should be viewed as another standard piece of equipment for loggers.



Figure 8: NCDFR bridgemats at the 2005 Carolina Log’n Demo.

Bridgemat Demonstration Sites

Two demonstration stream crossing sites to illustrate the general function of bridgemats have been established at Rendezvous Mountain Educational State Forest, in Wilkes County. Each of these crossings uses wood/timber beam bridgemats that have been retired from active service on logging jobs as a result of



natural deterioration of the wood. A self-explanatory interpretative exhibit sign was created by agency staff for installation at these, and future, bridgemat demonstration areas. Additional retired sets of wood/timber beam bridgemats await installation as permanent demonstration exhibits at:

- Clemmons Educational State Forest, in Johnston County
- DuPont State Forest, in Transylvania County
- Holmes Educational State Forest, in Henderson County
- Mountain Island Educational State Forest, in Gaston County

As additional bridgemats are pulled from active duty service, they will likely be assigned for demonstration exhibit purposes to one of the North Carolina's ten State Forests.

TreeLine Newsletter Article

Agency staff prepared two bridgemat-related articles that were printed in the North Carolina Forestry Association's monthly statewide newsletter, the *TreeLine*. In March 2004, an article entitled "Bridgemats are a Key Tool for Protecting Water Quality" detailed the basic concept of using bridgemats. The second article was printed in August 2005, entitled "Bridgemats Now on Loan Statewide from NCDFR," and announced the availability of bridgemats across the state. The *TreeLine* is provided to each of the estimated 4,200 members of the North Carolina Forestry Association.

Technology Transfer

Several other state forestry agencies have investigated or initiated their own adaptation of providing bridgemats to loggers in their respective states as a direct result of communication and information provided to them by the NCDFR. This transfer of knowledge and technology can modestly be considered a resounding success, as many colleagues from other states indicated their interest in bridgemats, but prior to learning of North Carolina's efforts, and using the NCDFR as a source of knowledge, they did not feel comfortable with putting their interest into action 'on the ground.' A summary of technology transfer to other states as a result of NCDFR assistance is provided in this section.

Florida Division of Forestry: 2007

A bridgemat loan program was established in Florida based upon information provided by the NCDFR. Wood-timber beam bridgemats were acquired by the Florida Division of Forestry. Photographs from North Carolina were also used in Florida as an educational and information tool to demonstrate to loggers how bridgemats can be effective for crossing streams or ditches. Below is an excerpt cited from an information leaflet created by the Florida Division of Forestry:

SKID TRAIL BRIDGEMATS AVAILABLE FOR LOAN

Do you need to skid over a small stream and want to minimize the impact to water quality? Borrow a bridgemat set. Each set consists of 3 sections that form a bridge 12 ft. wide x 24 ft. long which is suitable for skidders to cross. The mats are available for loan at no cost to the landowner. The use of these mats has been proven to provide an easy to build and remove stream crossing that results in little or no impact to water quality.

Maine Forest Service: 2006/2007

Steel bridgemats were obtained by the Maine Forest Service based upon design schematics used by NCDFR for its bridgemat purchases in prior years. Maine Forest Service successfully placed their bridgemats into service in early 2007, as noted below via this excerpt of an email from their project coordinator:



----- Original Message -----

Subject: Maine Steel Bridge Mats
Date: Wed, 31 Jan 2007 13:03:07 -0500
From: Martin, Chris
To: Tom A.Gerow

Hi Tom,

Thought you might like to know we installed our first set of steel bridge panels last week based upon NCDFR's design... ..A couple of lessons we learned last week.

1. Have tie-down strap protection against the metal edges of bridge panels, possibly a piece of tire. (wasted three web straps)

2. If possible have operators remove one or two uprights on bunk trailer for easier loading and unloading.

3. Bridge panels are heavy but the equipment yesterday seemed to handle them OK. Operator familiarity will definitely increase ease of use. (broke 4 U-bolts on one of the forwarder's bunks)

Their placement saved the operator from a 4000 foot skid thus reducing additional NPS risk and possibly other smaller stream crossings within an important Endangered Atlantic salmon watershed.

Thanks again for all your assistance on this!

Chris

In addition, the Maine Forest Service established a cost-share program in 2007 to “assist with financing for the purchase of environmentally friendly equipment to protect and improve water quality in and around logging operations.....Other miscellaneous purchases includes metal bridges, wooden bridges, bottomless arches, and other sediment and erosion control products.” (*Cost share information cited from Technical Release Number 07-R-26, August 2007, Forest Operations Review. Published by the Forest Resources Association.*)

Oklahoma Department of Agriculture, Food and Forestry: 2008/2009

The NCDFR provided information requested by this Oklahoma agency related to their purchase of bridgemats for the first time. The purchase is expected to occur in 2009. This will be the first known application of engineered wood ‘glu-lam’ style of bridgemats used for stream crossings in the Southeastern United States.

Texas Forest Service: 2007/2008

The BMP video developed by NCDFR entitled “Forestry Stream Crossings” (which includes a discussion of using bridgemats) has been used by the Texas Forest Service for logger and forester training workshops. In a communication with a Texas Forest Service representative in February 2009, he indicated that the BMP video has reached more than 400 loggers along with several foresters or other forestry-related professionals. Based on the success of the video and positive feedback from their customers, the Texas Forest Service requested, and received, permission to evaluate the use of another NCDFR-produced BMP training video for future workshops. That video, entitled “BMPs for Logging Skid Trails,” may be put into use in Texas by mid- to late-2009. The skid trail BMP video was previously incorporated into the North Carolina ProLogger annual continuing education module for their 2006-2007 training year.

Vermont Department of Forests, Parks and Recreation: 2007

After receiving a copy of the two stream crossing BMPs videos from North Carolina, and exchanging information, this Vermont agency produced a video entitled “Better Stream Crossings Using Portable Skidder Bridges.” Their how-to video demonstrates the process of manufacturing a wooden timber-beam



bridgemat and illustrates their installation. As noted in a letter received from that agency: “The Vermont Agency of Natural Resources, through its newly created Forest Watershed Program, is spearheading an initiative to encourage loggers and forest landowners to consider using portable skidder bridges.”

Virginia Department of Forestry: 2006

A cost-share program was established for loggers in which a portion of the costs for stream crossing BMPs in select areas of the state would be shared with the Virginia Department of Forestry, as explained in press release number VDOF06010 dated March 7, 2006: “If the stream crossing includes the purchase of a portable bridge, the 50 percent [cost shared] funding level increases to a maximum of up to \$4,000 of the actual cost.”

Bridgemat Examples

A number of different bridgemat variations have been observed in use across North Carolina and elsewhere, including wood/timber and steel bridgemats. Photos of those observed for use on logging jobs are offered in this report simply to show the diversity of examples that one could consider if purchasing or constructing bridgemats.



Figure 9: Wayne County, 2003. Note the side-rail incorporated into the bridgemat. Installing a side-rail guard will limit where or how each panel can be positioned over the crossing, since there is now a definite “inside” and “outside” of each bridgemat.



Figure 10: Maine 2007, photo provided by Maine Forest Service. Note that their bridgemat design also includes side-rail guards, but of a different configuration than those seen in the photo at left.

A word about side-rail guards: As seen in both photos above, the purchaser of those bridgemats decided to incorporate a side-rail guard along one edge of the bridgemat. The benefits of having a side-rail guard are not clear, since the large mass of a skidder tire, or even a log truck tire, could easily surmount and drive over such a minimal side-rail. If the side-rail were to break and produce a piece of steel sticking up, it could puncture a tire. One supporting theory in favor of a side-rail guard is to keep skidders or log trucks from sliding off the bridgemats when used in wet, slick, icy or snowy conditions. However, there has been no documented evidence or examples shared with this report’s author of such a situation having occurred, although that is not to say that it has not happened. Ultimately, if a logger feels more comfortable using bridgemats that have a side-rail guard installed, then there should be no reason not to install one for his/her own peace of mind when buying or constructing bridgemats. However, as noted in Figure 9, by installing a side-rail guard, you are limiting how each bridgemat panel can be situated atop a crossing, and potentially increasing the installation time. The NCDNR has chosen to not have side-rail guards incorporated into its steel bridgemats. This decision is based primarily to allow greater ease for the logger in orienting the bridgemats for use, promote uniform wear of bridgemat panels, and because there is an absence of compelling evidence that the side-rail guards provide any substantial increase in operating safety.



Figure 11: western North Carolina. This bridgemat appears to consist of one single panel, with tapered ends. No other information is known, but it is yet another example of the variety of ways to cross a stream by using a portable bridge.



Figure 12: Duplin County, 2001. This open-grid bridgemat panel allows log trucks to cross a DOT roadside ditch. Not only does this bridgemat avoid the need of filling in the road ditch with a culvert or with logs, but the open-faced configuration helps to 'shake off' any caked-on mud from the truck's tires prior to entering the public roadway.



Figure 13: Alexander County, 2004. A set of wood/timber beam bridgemats being constructed in the woods by a logging company for their use.



Figure 14: Iredell County, 2005. Steel I-beams are welded together to create this panel crossing. The equipment operator indicated that this panel works well for skidder crossings, but is not used at all for log trucks. Although this layout is an option, it would not appear to be a first-choice solution to constructing a bridgemat, due to potential structural and flexing issues, given the orientation of the I-beams.



Figures 15 and 16: Johnston County, 2008. A shipment of new, 25-foot long steel bridgemats is received by the NCDFR and being unloaded for staging. On this bridgemat order, the addition of a steel plate along the sides of each end-ramp of the bridgemat was specified, effectively boxing-in this area within the I-beam flanges (see inset photo, above left). This is an attempt to strengthen the end-ramps and reduce the crimping damage we have observed when a grapple-skidder grabs the end for handling or moving the bridgemat. The addition of a boxed-in end-ramp may also increase the rigidity of the bridgemat.



Figure 17: NCDFR Rocky Mount District Office, 2007. This bridgemat is part of the first order of steel bridgemats purchased by NCDFR in 2003. In this photo, the crimping damage on the I-beam flanges, along the end-ramp, is visible. Also, a number of bridgemats from this purchase order exhibited a breakage of the welds that bonded the top sheeting with the structural I-beams, as seen above. After welding to re-connect the top sheet, the bridgemats were placed back into service and remain in-service in 2009.

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Appendix A : Summary of Bridgemat Purchases Made by NCDFR, 2002 to 2008.

Year	Quantity of Bridgemat Panels*	Type	Length	Cost	Competitive-Bid Manufacturer	Inventory Control Numbers
2003	21	Steel	25 foot	\$46,670.19	KM Machine Company: Biscoe, NC	158760 thru 158780
2005	15	Steel	30 foot	\$63,777.00	DAMCO, Inc.: New Bern, NC	164947 thru 164961
2005	9	Wood	25 foot	\$8,055.00	South Eastern Timber: Coral Springs, FL	169321 thru 169329
2008	15	Steel	25 foot	\$64,590.00	KM Machine Company: Biscoe, NC	178589 thru 178603

* When used, bridgemats are allocated in 'sets' consisting of 3 individual bridgemat panels per set.
 Note the substantial increase in price for steel bridgemats between 2003 and 2005 - this is due directly to the worldwide increase in steel prices.

Funds for the purchase of bridgemats were provided through the:

- Albemarle-Pamlico National Estuary Program (APNEP)
www.apnep.org
- U.S. Environmental Protection Agency Nonpoint Source (NPS) Pollution Control Section-319 Grant Program as administered by the N.C. Division of Water Quality
<http://www.epa.gov/region4/water/nps/index.html>; <http://h2o.enr.state.nc.us/>



Appendix B: Status and Inventory of NCDFR Bridgemats as of December 2008

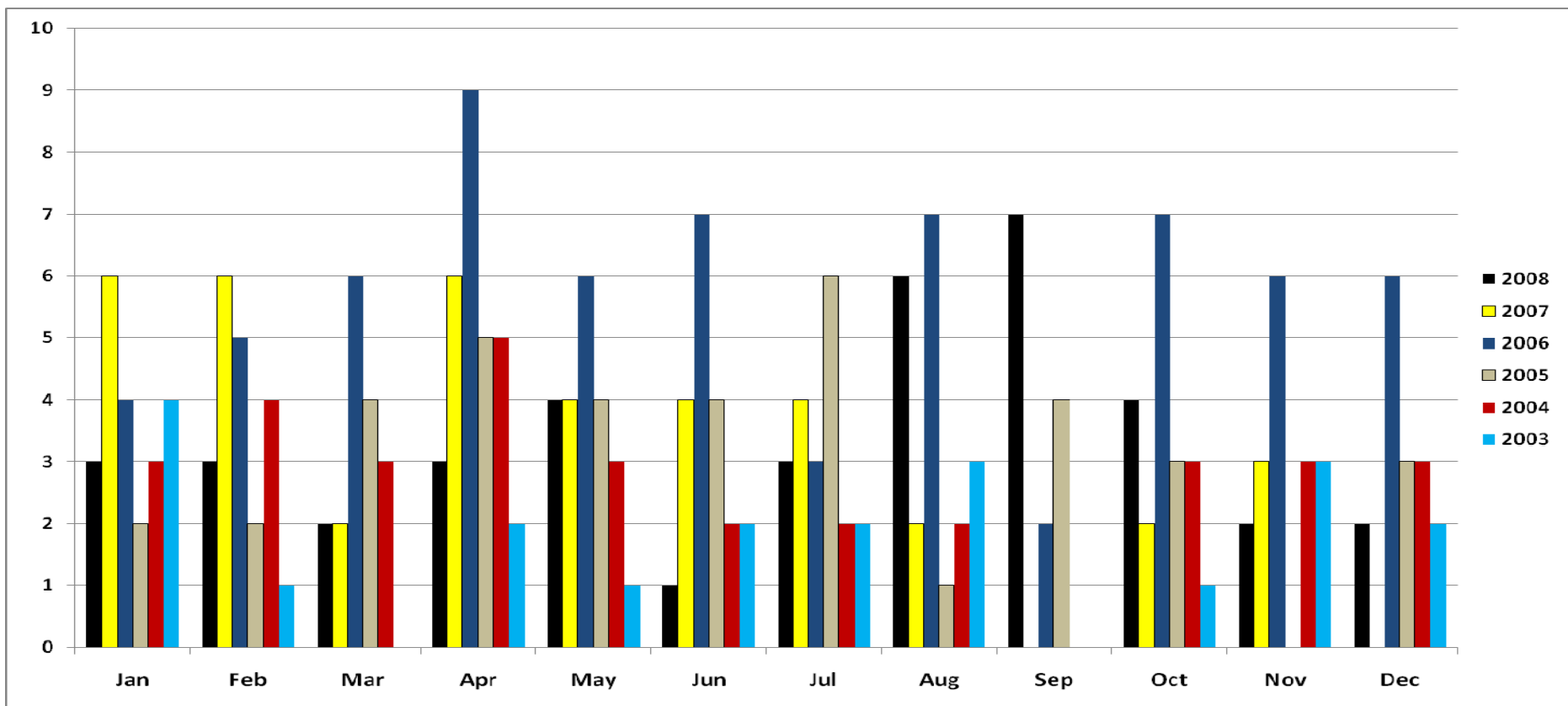
Inventory Control Numbers (FAS)	Type, Length (feet)	Assigned District	Status
158760,761,762	Steel, 25ft	Piedmont Region (R-II)	Available
158763,764,765	Steel, 25ft	Mount Holly (D12)	In use, Gaston Co.
158766,767,768	Steel, 25ft	Asheville (D1)	Available
158769,770,771	Steel, 25ft	Fayetteville (D6)	Available
158772,773,774	Steel, 25ft	Rockingham (D3)	Available
158775,776,777	Steel, 25ft	Lenoir (D2)	Available
158778,779,780	Steel, 25ft	Rocky Mount (D5)	In use, Northampton Co.
164947,948,949	Steel, 30ft	New Bern (D4)	Available
164950,951,952	Steel, 30ft	Elizabeth City (D7)	Available
164953,954,955	Steel, 30ft	Mount Holly (D12)	Available
164956,957,958	Steel, 30ft	Whiteville (D8)	In use, Columbus Co.
164959,960,961	Steel, 30ft	Elizabeth City (D7)	Available
169321,322,323	Wood, 25ft	Sylva (D9)	Available
169324,325,326	Wood, 25ft	Sylva (D9)	Out of Service, retired
169327,328,329	Wood, 25ft	Lenoir (D2)	In use, Wilkes/Yadkin Co.
178589,590,591	Steel, 25ft	Sylva (D9)	Available
178592,593,594	Steel, 25ft	Lexington (D10)	In use, Stokes Co.
178595,596,597	Steel, 25ft	Sylva (D9)	Available
178598,599,600	Steel, 25ft	Hillsborough (D11)	Available
178601,602,603	Steel, 25ft	Rocky Mount (D5)	Available
<i>unknown (3 panels)</i>	<i>Wood, 20ft</i>	<i>DuPont State Forest (ex-D1)</i>	<i>Retired, awaiting disposition</i>
<i>unknown (3 panels)</i>	<i>Wood, 25ft</i>	<i>Rocky Mount (D5)</i>	<i>Disposed due to rot</i>
<i>unknown (3 panels)</i>	<i>Wood, 25ft</i>	<i>Rendezvous Mtn. State Forest (ex-D9)</i>	<i>Retired, demonstration (Purlear)</i>
<i>110377,378,379</i>	<i>Wood, 25ft</i>	<i>DuPont State Forest (ex-D1)</i>	<i>Retired, hiking trail (1 panel)</i>
<i>110954,955,956</i>	<i>Wood, 25ft</i>	<i>Rendezvous Mtn. State Forest (ex-D2)</i>	<i>Retired, demonstration (BMP road)</i>
<i>114142,143,144</i>	<i>Wood, 25ft</i>	<i>Lexington (ex-D11)</i>	<i>Disposed 8/30/06 due to rot</i>
<i>114521,522,523</i>	<i>Wood, 25ft</i>	<i>Mountain Island State Forest (ex-D12)</i>	<i>Retired, awaiting disposition</i>
<i>158071,072,073</i>	<i>Wood, 25ft</i>	<i>Clemmons State Forest (ex-D8)</i>	<i>Retired, awaiting disposition</i>



Appendix C: Monthly Summary of Bridgemat Usage, 2003 to 2008

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	total
2008	3	3	2	3	4	1	3	6	7	4	2	2	40
2007	6	6	2	6	4	4	4	2	0	2	3	0	39
2006	4	5	6	9	6	7	3	7	2	7	6	6	68
2005	2	2	4	5	4	4	6	1	4	3	0	3	38
2004	3	4	3	5	3	2	2	2	0	3	3	3	33
2003	4	1	0	2	1	2	2	3	0	1	3	2	21
Totals	22	21	17	30	22	20	20	21	13	20	17	16	239

Interestingly, there does not appear to be any major correlation between the time of year and increased (or decreased) use of the NCDFR's bridgemats, with the possible exception of April.



Appendix D: NCDFR Bridgemat Tracking Form

Complete every time bridgemats are loaned out



N.C. Division of Forest Resources' Bridgemat (BM) Tracking Form



District _____ County of Use: _____ FAS # _____ Today's Date _____
 DFR Report by: _____ BM type wood steel Month _____
 Condition of BM set: Good Suitable Needs Replacement
 Comments: _____
 Status of BM set: Available, idle Assigned Out of Service: Why? _____
 Location of BM set: DFR (Location:) _____ Mill Site Customer
 Name of Mill / Customer (Person & Comp. Names) _____
 Phone # _____ Physical Address _____
 Directions to bridgemat use location _____

Date assigned to Customer: _____ Required Return Date: _____

By participating in the North Carolina Division of Forest Resources' Bridge Mat Loan Program, I acknowledge my obligation to return the loaned bridge mats on or before the date specified herein. Furthermore, I acknowledge I will be held financially accountable for the repair and/or replacement of these loaned bridge mats if lost/stolen, failure to return upon request, or damage occurs due to misuse/abuse of this State property excluding normal and accepted wear associated with routine forestry operations. The State of North Carolina and the Division of Forest Resources makes no assurances or guarantees as to the integrity or the soundness of the mats and is not liable for any damage, injury, and/or death resulting from the use of the mats. The use of these mats is at my own risk.

CUSTOMER'S SIGNATURE & DATE: _____ seal ACTUAL DATE RETURNED _____
 DIV. FOREST RESOURCES' SIGN & DATE: _____ seal DFR Initial _____ NEEDS-REPLACEMENT

Number of Acres To Be Accessed USING DFR Mats: _____ estimated acres
 TOTAL Tract Acres Being Worked: _____ estimated acres
 Expected TOTAL Number of BM crossings on this tract: _____ (using DFR bridgemats)

FOR USE DURING INSPECTION OF BRIDGEMATS ON TRACT

Actual # of crossings where DFR BM used on tract so far: _____ Inspection Date _____
 (Please provide details in Comments section for any "NO" answers)

	YES	NO
(1) Does the BM crossing appear to be installed properly?	<input type="checkbox"/>	<input type="checkbox"/>
(2) Did DFR inspect or monitor any installation of BM's on this tract?	<input type="checkbox"/>	<input type="checkbox"/>
(3) Did the customer pick up and transport the BM's without DFR help?	<input type="checkbox"/>	<input type="checkbox"/>
(4) Is protection of water&stream quality enhanced by using BM crossing?	<input type="checkbox"/>	<input type="checkbox"/>
(5) Are water & stream/channel conditions left un-damaged after BM removal?	<input type="checkbox"/>	<input type="checkbox"/>
(6) Are BM's to be used for ALL crossings on this tract?	<input type="checkbox"/>	<input type="checkbox"/>
(7) In your opinion, is a BM crossing the best method to use on this tract?	<input type="checkbox"/>	<input type="checkbox"/>

Comments: _____



Appendix E: List of Known Bridgemat Suppliers

Suppliers of Bridgemats, Skidder Bridges, Dragline Mats and Logging Mats

This is not intended to be a complete list of suppliers. This information has been prepared to assist those who may require this equipment for forestry operations. Potential buyers should compare costs and specifications before ordering to ensure that the "equipment fits the job." Inclusion on this list does not imply recommendation nor any guarantee by the State of North Carolina related to the purchase or use of these products.

Steel Bridgemats

DAMCO, Inc. (252) 633-1404 damcoinc@earthlink.com P.O. Box 1656 New Bern, NC 28563	KM Machine Co. Inc. 1/877-428-2368 www.kmmachineco.com 201 McCaskill Street Biscoe, NC 27209	Hitch Crafters (336) 859-3257 www.hitchcrafter.com 853 Cid Road Lexington, NC 27292	T&W Machine and Welding (919) 934-6077 1896 Mallard Road Smithfield, NC 27577	Wharam Welding and Repair Service (434) 983-3933 273 Allens Lake Rd Dillwyn, VA 23936
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Wood & Timber Mats

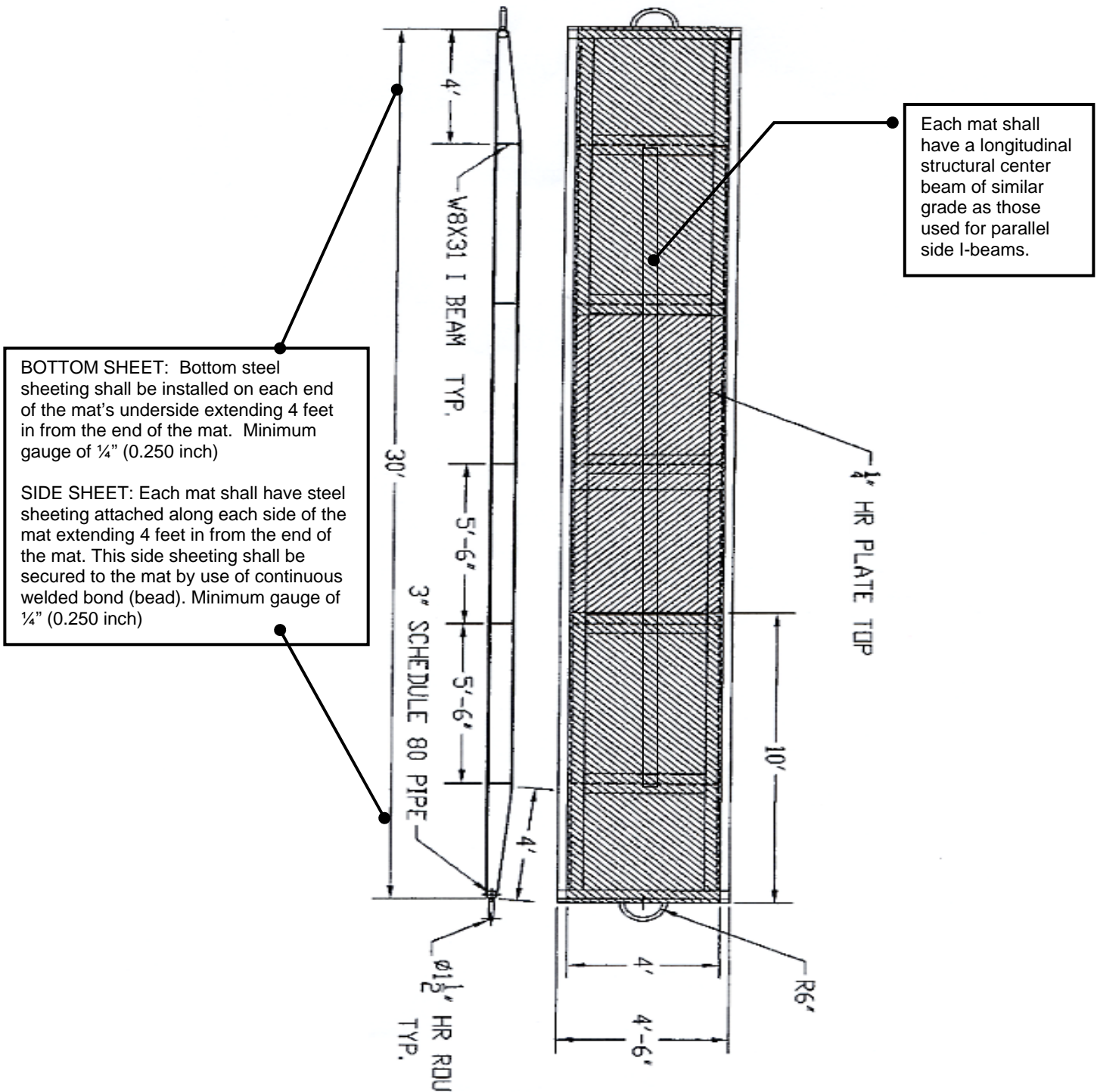
Advantage Lumber Company 1/877-612-3656 advantagelumber@yahoo.com 926 Anthony Avenue Opelousas, LA 70570	Custom Cut Timber Products (478) 994-0167 701 W. Main Street Forsyth, GA 31029	Long Lumber Company (334) 886-3326 771 West Bateman Ave Slocomb, AL 36375	Sterling Lumber Company (708) 388-2223 www.sterlinglumber.com 3415 West 127th Street Blue Island, IL 60406
Albert Forest Products (828) 862-8188 www.albertforestproducts.com PO Box 721 Cedar Mountain, NC 28718	Dixie Mat and Hardwood 1/800-927-2059 www.dixiemat.com 236 Herring Road Sandy Hook, MS 39478	North Pacific Group 1/800-276-3427 www.cranemats.com P.O. Box 3915 Portland, OR 97208	Tarheel Mats, Inc (252) 331-5400 654 Highway 343-North Camden, NC 27921
Arcola Lumber Company (252) 257-4923 2316 Highway 43 Warrenton, NC 27589	Garnett Wood Products (314) 495-1284 www.garnettwood.com 255 Cornerstone Drive Brandon, MS 39042	Richard West Co., Inc. (252) 793-4440 174 Highway 64-West Plymouth, NC 27962	T. E. Johnson Lumber Co. (919) 963-2233 3872 Old School Road Four Oaks, NC 27524
Blue Ridge Pipe and Supply 1/800-738-8327 4267 Goose Creek Road Glenwood, NC 28737	Gnu-Co Incorporated 1/888-437-6390 www.gnu-co.com 2032 Independence Commerce Dr. Matthews, NC 28105	Sound Industries (208) 777-9025 www.oakmats.com 1810 Schneidmiller Ave Post Falls, ID 83854	Twin Mills Timber & Tie (618) 932-3662 www.twinmills.org 3268 State Route 37 West Frankfort, IL 62896
Carolina Mat Inc. (252) 793-4045 www.carolinamat.com 193 Highway 149-North Plymouth, NC 27962	Hopewell Hardwood Sales (804) 458-5178 hopewellhardwoods@earthlink.net 5333 Hall Farm Road Prince George, VA 23875	South Eastern Timber Corp. 1/800-752-3804 www.crane-mats.com PO Box 9289 Coral Springs, FL 33075	

This list is periodically updated and is available to download from the 'Water Quality' section of the Division's Web site: www.dfr.nc.gov

List updated March 2009



Appendix F: Sample Sketch Illustration of a 30-foot Steel Bridgemat



General design sketch of portable steel bridgemats used for specifying the 2008 purchase by the N.C. Division of Forest Resources. Plans modified June 2007 from original source.

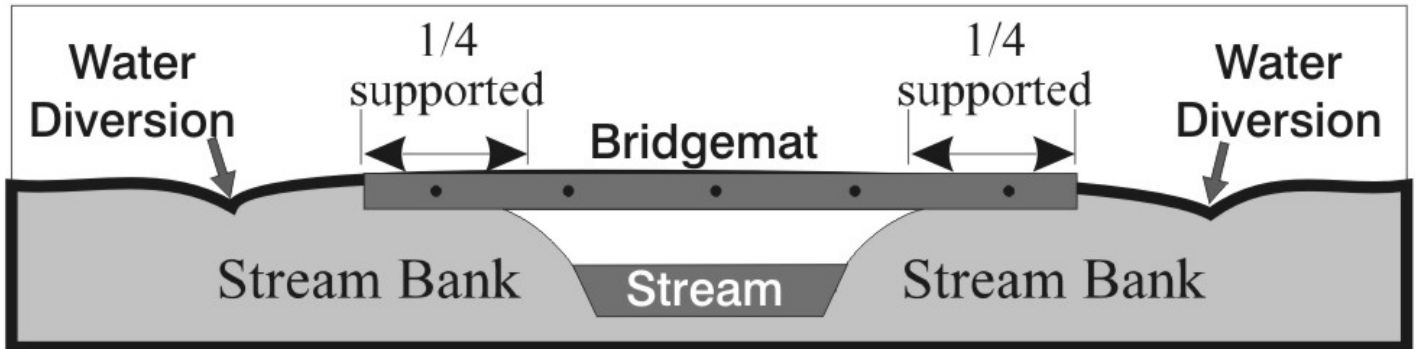
These drawings **ARE NOT** developed, certified, or approved by a Professional Engineer.

This drawing is for reference and information purposes only.



Appendix F: Illustration of a Bridgemat Stream Crossing

Original artwork by N.C. Division of Forest Resources (C.Carlson)



Bridgemat for Stream Crossing

Appendix G: Additional Sources of Information on Bridgemats

- N.C. Division of Forest Resources Web site:
http://www.dfr.state.nc.us/water_quality/bridgemats.htm
- *The Kentucky Logjam*. Fall 2001. University of Kentucky Cooperative Extension Service. Volume 6, Number 4. <http://www.masterlogger.org/logjam/issues/Lj64a.pdf>
- *Portable Bridges for Forest Road Stream Crossings*. Brinker, R.W. and Taylor, S.E. Alabama Cooperative Extension System. Publication ANR-1074.
<http://www.aces.edu/pubs/docs/A/ANR-1074/>
- *Portable Timber Bridges as a Best Management Practice in Forest Management*. March 2004. USDA-Forest Service, Wood in Transportation Information Center. Publication NA-TP-04-04.
<http://www.nrs.fs.fed.us/pubs/9445>
- *Skidder Bridge Fact Sheet*. January 1997. University of Massachusetts Extension.
http://www.umass.edu/nrec/pdf_files/skidder_bridge.pdf
- This 2002 to 2008 program status report is one of several periodic status reports that have been compiled by the NCDFR. Previous bridgemat program delivery and accomplishments are summarized in these reports available from NCDFR:
Final Report for Nonpoint Source Program Section 319-Grant Contract EW05074.
Compiled by Tom Gerow, Jr. December 2005.

Report on the Bridgemat Loan and Education Program for the Period 1999-2001.
Compiled by Tom Gerow, Jr. June 2003.

1996-98 Dragline Mat Loan Program. Compiled by Bill Swartley. May 2000.





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