

Center for Environmental Excellence AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS





U.S. Department of Transportation Federal Highway Administration

# Efficient, Effective and Innovative Water Quality BMPs

CEE by AASHTO Stormwater Community of Practice May 2, 2018

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  - Practitioner's Handbooks
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# **AASHTO and FHWA**



### Melissa Savage

AASHTO Center for Environmental Excellence



### Eric Kopinski, PE

AASHTO Center for Environmental Excellence



#### Susan Jones, PE

Federal Highway Administration

# **Community of Practice Presenters**



#### Bhaskar Joshi

*California Department of Transportation* 



#### Jana Ratcliff

Washington State Department of Transportation



Nick Tiedeken

Minnesota Department of Transportation



Scott McGowen (Moderator) Michael Baker International

# **Community of Practice Forum Overview**

# Open Graded Friction Courses (OGFC)

- Bhaskar Joshi, CALTRANS
- Innovative Roadside BMPs
  - Jana Ratcliff, Washington State DOT

### Winter Storm Management

- Nick Tiedeken, Minnesota DOT
- Community of Practice Forum
  - Scott McGowen, Michael Baker International
- Closing

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# **Open Graded Friction Courses (OGFC)**



Chief, Office of Stormwater Program Development

California Department of Transportation

# **Open Graded Friction Courses (OGFC)**





#### OPEN GRADED FRICTION COURSE USAGE GUIDE



California Department of Transportation Division of Engineering Services Materials Engineering and Testing Services-MS #5 Office of Flexible Pavement Materials 5900 Folsom Boulevard Sacramento, CA 95819-4612

February 8, 2006

# **OPEN GRADED FRICTION COURSE**

- Sacrificial wearing course
- Aggregate with relatively uniform grading
- Little or no fine aggregate and mineral filler
- High void space in the compacted mix

# BENEFITS

- Roadway Safety
- Stopping distance
- Visibility 1
- Contrast in pavement markings
- 🕨 Drainage 1
- Surface friction 1
- Environmental
  - Noise reduction
  - Stormwater Treatment ??



New construction

Major Rehab

Maintenance overlays

• High Traffic volumes

# **OGFC USAGE**

Wet and nighttime accidents

Skid resistance

Lane widening next to existing OGFC

Cross slope < 2%

**Bleeding pavements** 

Delay aging of DGAC in desert areas

Over unsound pavement

Fuel or Oil Spill Areas

Paving Air Temperature < 45°F

Routine surface seal

Snowy/icy areas ??

Severe Turn Areas ??



JULY 2017 | CTSW-RT-17-314.24.1



- Project Planning and Design Guide (PPDG)
- Construction Site Best Management Practice (BMPs) Manual
- Stormwater Pollution Prevention Plan (SWPPP) and Water Pollution Control Program (WPCP) Preparation Manual

# **OGFC for Stormwater Treatment**

- OGFC considered a flow-through treatment device
- Calculate and claim Credit for stormwater treatment
- Recommended Usage
  - No offsite sediment laden stormwater flows
  - Contributing Impervious Drainage areas
  - Consistent with Pavements Usage Guidance
- Pollutant Removal Mechanism
  - Straining
  - Reduction in splash and spray

# **OGFC Pilot Study – Water Quality**















# **Specifications**

- Existing Caltrans practice
- Caltrans Standard Specifications
  - 39-2.04 Open Graded Friction Courses
- Service Life:
  - Shown to last: 2 to 10 years
  - More common: 4 to 6 years
  - Function of several factors



# **Maintenance and Rehabilitation**

- Existing Caltrans practice
- No additional maintenance requirements:
  - Caltrans Maintenance Manual Volume I
    - Chapter A, Flexible Pavement
    - Chapter D1.04, Debris and Sediment Removal
  - Caltrans Maintenance Technical Advisory Guide
    - Chapter 8 Thin Maintenance Overlays

# **Study Conclusions**

### General

- TSS, Total Phosphorus
- Total Copper, Total Lead, Total Zinc
- OGFC vs Austin Sand Filter Effluent
  - Nutrients, Metals (total and dissolved)
  - Total N concentrations are not significantly different

# **BMP SELECTION CHECKLIST**

Tier	Infiltration	Infiltration	Infiltration
	< 20% <sup>2,3</sup>	20%–50%	> 50%
1	Austin Media Filter with AA	Austin Media Filter with AA	Austin Media Filter with AA
	Austin Sand Filter <sup>4</sup> : Both	Austin Sand Filter <sup>4</sup> : Both	Austin Sand Filter <sup>4</sup> : Both
	Bioretention	Bioretention	Bioretention
	Delaware Filter	Delaware Filter	Delaware Filter
	Detention Basin	Detention Basin	Detention Basin
	MCTT	MCTT	MCTT
	OGFC	OGFC	OGFC
	Strip <sup>5</sup> : As/Ad > 0.2	Strip <sup>6</sup> : All	Strip <sup>6</sup> : All
	Strip <sup>5</sup> : As/Ad < 0.1	Swales	Swales
	Wet Basin	Wet basin	Wet basin
2			
3	Detention Basin: Lined	Detention Basin: Lined	Detention Basin: Lined

# **Implementation Challenges**

- Demonstration of treatment efficiency
- Treatment BMP Ranking
- Tracking of treatment credits
- Maintenance operations and equipment

# **Innovative Roadside BMPs**



#### Jana Ratcliff

Stormwater and Watersheds Program Manager

Washington State Department of Transportation

## **Need for Innovative Roadside BMPs**

- Long linear BMPs that fit well in transportation corridors
- Can treat a large amount of pavement with a relatively small footprint
- Construction ease of access from the roadway
- Low-cost, well performing, low maintenance BMPs

# Vegetated Filter Strip (VFS)



 See Table 3-1 and Section 2-6.4 for additional guidance.

# **VFS Limitations**



Compost Amended Vegetated **Filter Strips** (CAVFS)



quidance.

# **CAVFS Limitations**



# **Modified VFS**



# Media Filter Drain (MFD)



Media Filter Drain Along SR 167 in King County

**Description:** Linear flow-through stormwater runoff treatment device along highway side slopes and medians. Also has end-of-pipe configurations.

#### **Geometry Limitations**

Contributing Flow Path	≤ 150'
Embankment Slope	2%-25%

		oani		
	BMP Function ☑ LID □ Flow Control ☑ Burgeff Treatment		Effective Life (Years) 25	
	<ul> <li>□ Oil Control</li> <li>☑ Phosphorus*</li> <li>☑ TSS - Basic</li> <li>☑ Dissolved Metals - Enhanced</li> </ul>	Capital	Cost         M & O Cost           .ow         D Low to Moderate	
Г	Additional Co		equirements	
	<ul> <li>4-5 Infiltration Design Criteria</li> <li>Setback</li> <li>Landscaping/Planting</li> <li>Wetland Planting and Plant Establishme</li> <li>Inlet and Outlet Spacing</li> <li>Overflow</li> <li>Multidisciplinary Team</li> <li>WSDOT Pavement Engineer Approval</li> </ul>	nt	<ul> <li>Soil Amendments/Compost</li> <li>Energy Dissipater/Level Spreader</li> <li>5-4.3.3 Facility Liners</li> <li>5-4.3.7 Signing</li> <li>Fencing</li> <li>Presettling/Pretreatment</li> <li>Underdrain (Where Permitted)</li> <li>Soil Preparation</li> </ul>	
	Id       Preferred         □       Fecal Coliform         ☑       Phosphorus*         □       Nitrogen         □       Temperature         ☑       Dissolved Metals         ☑       Total Suspended Solid         □       Dissolved Oxygen         □       pH         □       Oil/Grease         □       PAHs	ds/Turbidity	Maintenance Requirements Access Roads or Pullouts Vactor Truck Access Mowing Valve Access Specialized Equipment Specialized Training Further Requirements: See Section 5-3.7.1 and 5.5. Also, see Table 5-2 <sup>-1</sup> *if a compost blanket is used on the media filter drain mix then this	
<ul> <li>Pesticides</li> <li>See Table 3-1 and Section 2-4.2 for additional guidance.</li> </ul>		BMP is not approved for phosphorous control.		

# **Type 1 MFD**




#### **Type 4 MFD**





## **MFD Limitations**



# Getting credit for what's already in the roadway prism - embankments

- Runoff treatment and flow control
- Natural dispersion BMP
- Research supporting embankments as BMPs
- Research to develop better method of estimating infiltration rates (Ksat)

#### **Winter Storm Management**



#### **Nick Tiedeken**

Hydrologist

Minnesota Department of Transportation





Winter Storm Management AASHTO Community of Practice

Nick Tiedeken – Minnesota DOT

### **Conventional Snow and Ice Fighting**





- Safety
- Cost Effective
- Environment







Chloride Reduction: strive for the most efficient and effective methods of snow and ice control to prevent road salt from entering lakes and rivers.

- Right Material
- Right Amount
- Right Time
- Right Place



Minnesota Department of Transportation

#### SUSTAINABILITY REPORT

Establishing a Baseline (2016)

DEPARTMENT OF

FEBRUARY 2017



## **2 Year Comparison**

#### Snapshot of winter: 2-year comparison

Category	Measure	2015-16	2016-17
Infrastructure	Lane Miles	30,632	30,517
Weather	Snowfall, near MSP Airport	36.7*	43.5"
	Snowfall, statewide across districts	52.6"	54.0"
	Number of winter events, statewide average	27	22
Materials	Saltused	157,812 tons	197,417 tons
	Average weighted cost of salt per ton	\$75.79	\$73.99
	Salt brine used	2.2 million gallons	5.0 million gallons
Costs and Performance	Total plowing, salting and sanding costs	\$94.2 million*	\$97 million*
	Total plowing, salting and sanding costs per lane mile, statewide average	\$3,074	\$3,180
	Frequency of achieving bare lane after winter event (70% target)	89%	87%
Labor and Services	Regular labor hours	510,147	465,798
	Overtime winter labor hours	78,111	54,933

\*Based on fiscal year

### **Winter Severity Index Factors**



#### Frequency of meeting bare lane targets (cost in millions)



#### Winter Severity Index by district for past 3 years

District	2014-15	2015-16	2016-17
1	93	135	148
2	85	103	127
8	69	92	107
4	92	106	123
Metro	66	71	89
6	88	89	109
7	97	107	97
8	92	97	96
Statewide	87	106	119

#### Salt and Sand (in thousands of tons)



#### **Best Management Practices**

- Training
- Storage and Loading
- Equipment Calibration and Upgrades
- Liquids-Anti-icing, Prewetting
- Alternative Deicers
- Blowing Snow Control
- Road Weather Technology
- Innovation
- Research
- Traveler Information

# Training



#### Snow & Ice Event/Bare Lane Training 2014-2015

#### Minnesota Snow and Ice Control

Field Handbook for Snowplow Operators Second Revision

MINNESOTA LTAP center for transportation studies

UNIVERSITY OF MINNESOTA



Minnesota Department of Transportation Minnesota Local Road Research Board August 19, 2005

MAINTENANCE MANUAL

Clear Roads

#### Table 2-8.01.01A Application Rate Guidelines (lbs/2-lane mile)

			lbs/ 2-lane mile***			
Pavement Temp. (°F) and Trend (↑↓)	Weather Condition	Maintenance Actions	Salt Prewetted/ Pretreated With Salt Brine	Salt Prewetted/ Pretreated With Other Blends	Dry Salt*	Winter Sand (abrasives)
>30° ↑	Snow	Plow, treat intersections only	80	70	100*	Not recommended
	Frz. Rain	Apply chemical	80 – 160	70 - 140	100 - 200*	Not recommended
30°↓	Snow	Plow & apply chemical	80 – 160	70 - 140	100 - 200*	Not recommended
	Frz. Rain	Apply chemical	150 -200	130 - 180	180 - 240*	Not recommended
25 - 30° ↑	Snow	Plow & apply chemical	120 – 160	100 - 140	150 - 200*	Not recommended
	Frz. Rain	Apply chemical	150 - 200	130 - 180	180 - 240*	Not recommended
25 - 30° ↓	Snow	Plow & apply chemical	120 – 160	100 - 140	150 - 200*	Not recommended
	Frz. Rain	Apply chemical	160 - 240	140 - 210	200 - 300*	400
20 - 25° ↑	Snow or Frz. Rain	Plow & apply chemical	160 – 240	140 - 210	200 - 300*	400
20 - 25° ↓	Snow	Plow & apply chemical	200 – 280	175 - 250	250 - 350*	Not recommended
	Frz. Rain	Apply chemical	240 - 320	210 - 280	300 - 400*	400
15° to 20° ↑	Snow	Plow & apply chemical	200 - 280	175 - 250	250 - 350*	Not recommended
	Frz. Rain	Apply chemical	240 - 320	210 - 280	300 - 400*	400
15° to 20° ↓	Snow or Frz. Rain	Plow & apply chemical	240 - 320	210 - 280	300 - 400*	500 for fiz. rain
0 to 15° †↓	Snow	Plow, treat with blends, sand hazardous areas	Not recommended	300 - 400	Not recommended	500 - 750 spot treat as needed
< 0°	Snow	Plow, treat with blends, sand hazardous areas	Not recommended	400 -600**	Not recommended	500 - 750 spot treat as needed

Notes: \*Dry salt is not recommended. It may blow off the road before the melting process can begin. \*\*Applied at the centerline of the roadway.

A blend of 6 - 8 gal/ton MgCl2 or CaCl2 added to NaCl can melt ice as low as -10°.

Salt brine should be mixed to a 23.3% concentration which is a salimeter reading of 85% and hydrometer reading of 1.176.

How to use Table 2-8.01.01A:

- Select the row with the appropriate pavement temperature, temperature trend and weather conditions.
- 2. Select the column that is appropriate for the type of material being used.
- Find the box where the row and columns intersect to find the application rate.
- 4. Compare values to the calibration chart for the appropriate truck.
- Dial the correct setting for the rate indicated on the application rate guidelines.

# **Covered Storage**



December 21, 2007



#### Mn/DOT Snowplow Salt and Sander Controller Calibration Guide





# **Plows and Blades**



## **Brine Tank and Spinner**





# **Anti-icing**



#### **Winter Chemicals**

#### 2017-2018 Mn/DOT Winter Chemicals – Approved Product List

Product Name	Manufacturer	Date Approved
ArtiClear Gold	Compass Minerals	10/09/2013
LCS Concentrate	Envirotech Services	4/30/2015
Geomelt 55	SNI Solutions	9/30/2011
Headwaters 10F <sup>(1)</sup>	Rivertop, Inc.	Provisional Approval
		10/08/2013
Headwaters <sup>(1)</sup>	Rivertop, Inc.	Provisional Approval
		10/08/2013
Beet55 <sup>(1)</sup>	Smith Fertilizer	Provisional Approval
		8/21/2014
AMP	Envirotech Services	Provisional Approval
		12/31/2015

#### **Corrosion Inhibitors / Salt Brine Additives**

#### **Non Chloride Chemicals**

Acetates (liquid or solids)				
Product Name	Manufacturer	Date Approved		
CF7 (liquid) potassium acetate	Cryotech Deicing	9/06/2013		
NAAC (pellets) sodium acetate	Cryotech Deicing	9/06/2013		
Alpine Ice Melt (liquid) <sup>(1)</sup>	Compass Minerals	Provisional Approval		
		10/05/2010		
Geomelt GEN3 (liquid)	SNI Solutions	9/30/2011		

# **Blowing Snow Control**



### **Snow Fence**



#### **Earthwork for Drift Control**



NW Quadrant TH 10 and TH 32 in March 2013







### **Road Weather Information System**



- Air (Temp, RH, Dew)
- Wind (Speed, Gust, Dir)
- Precip (Type, Int, Rate)
- Precip period
- Accumulation
- Surface Data
  - Status
  - Pavement Surface Temperature
  - Pavement Temperature
  - Subsurface Temperature

### **Weather Stations**





## **MDSS/AVL**

Maintenance Decision Support System and Automated Vehicle Location



# **Sustainability Target (5 year)**

#### <10% Salt Use Above MDSS Recommendation</p>



## **Innovation – Slurry Truck**



#### **Innovation - Plow**



MAINTENANCE OPERATIONS

#### MNDOT PLOW DRIVERS INVENT NEW, HYBRID PLOW DESIGN

◎ FEBRUARY 25, 2015 SHANNON FIECKE FLEAVE A COMMENT

If the plow pictured above looks like two different plows welded together, it's because they are.

### **Research Examples**

- Clear Roads Best Practices Manual, Deicer Toxicity
- MnDOT Optimizing Deicing and Anti-Icing Performance, KAc Field Study
- LRRB Salt Accumulation and Movement, Field Usage of Alternative Deicers
- NCHRP Toxicological Effects, Cl Mitigation



#### **Weather Stations**

High Winds': This weather station is reporting 'high winds' in the area.



~ Ø 00

#### 26° F Precipitation Light Snow Visibility 0.55 miles Wind Direction (avg) SE ↓ Wind Speed (avg) 17.4 mph

share -

#### More Data

near Jeffers

Last updated: Today at 1:40 pm Disclaimer

US 71: Jeffers

#### US 71: Roadway is completely covered with snow.

Between 100th Street; Iowa State Line (5 miles south of the Jackson area) and US 14 (Sanborn). The roadway is completely covered with snow.

Last updated: Today at 10:15 am






## **Plow Cams**

## **Chloride Impaired Waters**



Figure 1. 2014 Chloride Assessment Results in the TCMA

### **Chloride TMDLs -TCMA**

- 23 lakes, ponds and wetlands
- 15 streams

Twin Cities Metropolitan Area Chloride Total Maximum Daily Load Study





February 2016



wq-iw11-06e

## **Performance Based Approach**

- Priority on improving winter maintenance practices
- Minimizing Use of Salt
- Performance based
- WMAt
- MPCA continue to monitor WQ
- Future
- Statewide Chloride Plan

### **Assessing Operations**

### Green/Yellow/Red for 180 BMPs

### **MS4** Permit

#### MINNESOTA POLLUTION CONTROL AGENCY

#### Winter Maintenance Assessment Tool (WMAt)

#### You are not currently logged in as a WMAt user.

If you have previously created an account, please click the button below to log in to your account:

#### User Account Login

If you are a new user, please click the button below to create a WMAt user account:

#### Create WMAt User Account

To learn more about road salt and water quality in Minnesota, visit <u>MPCA's Road Salt and</u> <u>Water Quality Website</u>.

# AASHTO/ASDWA Road Salt Webinar March 8, 2018

https://www.asdwa.org/event/aashto-asdwa-webinarstate-highway-drinking-water-programs-can-worktogether-mutual-benefits-reduce-impacts-road-salt/











#### Mn/DOT Snowplow Salt and Sander Controller Calibration Guide















### **MnDOT Salt Sustainability Program**

- Literature Search Salt Reduction Strategies
- Compilation of BMPs
- Training Materials and Guides
- Annual Salt Reduction Measurement Tool
- Final Report

# Thank You Nick.Tiedeken@state.mn.us



# Stormwater Community of Practice Forum Collaboration

- Submit your questions
  Type in the Q&A box on the panel on your screen.
  - Select 'Host & Presenter' in the drop down.
  - Click 'Send'



# **CoP Questions/Discussions**



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# **CLOSING**

A recording of this webinar will be available on the Center for Environmental Excellence by AASHTO Website.



Individual Community of Practice discussions are facilitated and moderated by Center technical experts. Typically, the communities participate in regular conference calls, Transportation Systems Technical

Assistance Program

http://environment.transportation.org Products & Programs > Communities of Practice > Stormwater Management



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U.S. Department of Transportation Federal Highway Administration

# **Efficient, Effective** and Innovative **Water Quality BMPs THANK YOU FOR ATTENDING CEE by AASHTO Stormwater Community of Practice** May 2, 2018