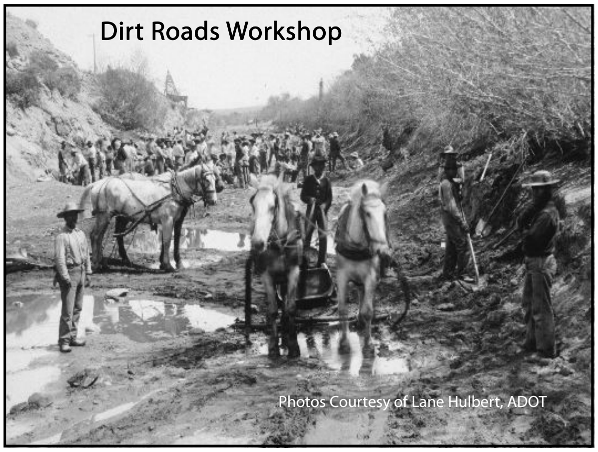


1

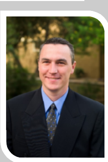
Agenda

- Opening (10 minutes)
- Introduction to Dirt Roads (10 mins)
- Geotech 101 (45 minutes)

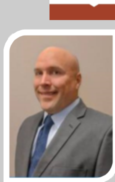
  Break (10 minutes)
- Drainage 101 (35 minutes)
- Improving Dirt Roads (10 minutes)
- Soil Stabilization (25 minutes)
- Open Discussion / Lessons Learned (15 minutes)

2

Presenters



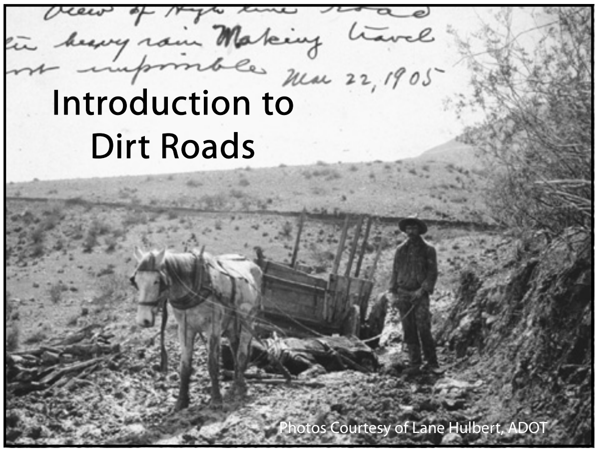
Paul Balch, PE
Sr. Project Manager
Dibble



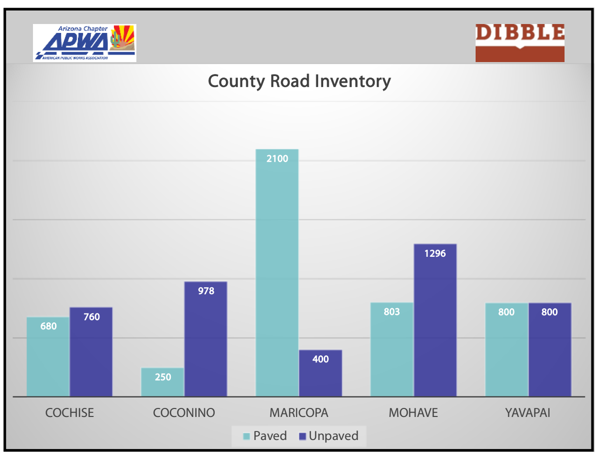
Jeff Rodgers, PE, PG
Principal Engineer
Ninyo & Moore

Ian Mowry, PE
Project Manager
Dibble

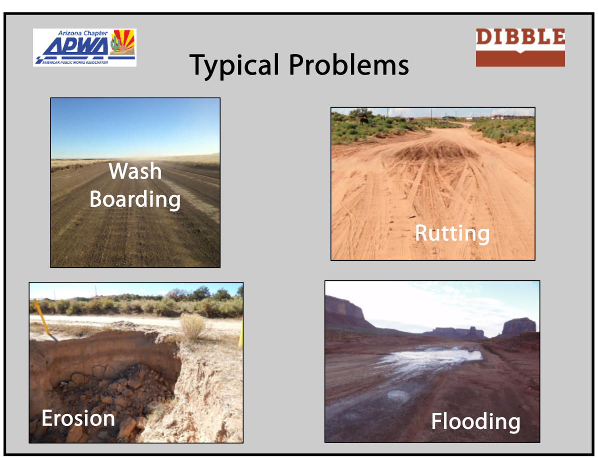
3


Introduction to
Dirt Roads
Photos Courtesy of Lane Hulbert, ADOT

4

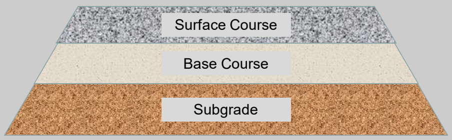

Arizona Chapter APWA
DIBBLE
County Road Inventory
680
760
250
978
2100
400
803
1296
800
800
COCHISE
COCONINO
MARICOPA
MOHAVE
YAVAPAI
Paved
Unpaved

5


Arizona Chapter APWA
DIBBLE
Typical Problems
Wash Boarding
Rutting
Erosion
Flooding

6

Elements of Roadway



7

Resources

8

Geotech 101

9

Unpaved Roads

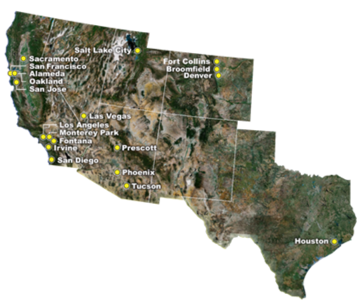
Jeff Rodgers, PE, PG

Phoenix | Tucson | Prescott | San Diego | Irvine | Fontana | Los Angeles | Monterey Park | Oakland | Alameda
San Jose | Sacramento | San Francisco | Las Vegas | Salt Lake City | Denver | Broomfield | Houston

Ninyo & Moore
Experience · Quality · Commitment

10

Ninyo & Moore Offices



Ninyo & Moore
Experience · Quality · Commitment

11

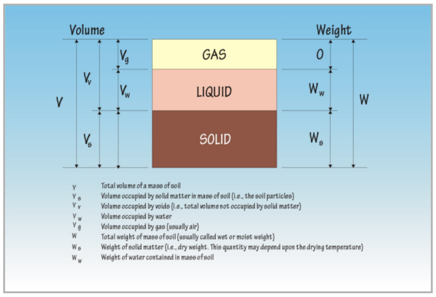
Ninyo & Moore

- Established in 1986 in San Diego
- More than 550 employees in 17 Offices throughout California, Nevada, Arizona, Colorado, and Texas
- An ENR Top 500 Design Firm
- Professional staff includes certified Engineers, Geologists, Hydrogeologists, Environmental Assessors, Industrial Hygienists, Inspectors, and Field and Laboratory Personnel
- Full-Service, Accredited Soils and Materials Testing Laboratory Capabilities
- Established QA/QC Program

Ninyo & Moore
Experience · Quality · Commitment

12

Geotechnical Engineering 101
What is Soil?



13

Geotechnical Engineering 101
What is Soil?

- Important Soil Characteristics
  - Grain size (coarse or fine-grained)
  - Coarse particle shape (angular, rounded, etc.)
  - Plasticity and cohesion
  - Voids and whether they are connected
  - Moisture conditions
  - Arrangement of particles (dispersed or flocculent)
  - Fill soils (documented and undocumented)
  - Compaction of fill soils
  - Cementation

14

Geotechnical Engineering 101
What is Soil?

- Soil Behaviors
  - Expansion and contraction (i.e. swell/shrink)
  - Collapse
  - Primary consolidation
  - Creep Settlement
  - Soil dissolution
  - Particle Migration

15

Geotechnical Engineering 101
What is Soil?

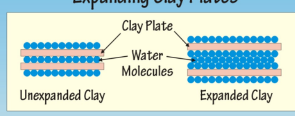
- Soil Behaviors
  - Expansion and contraction (i.e. swell/shrink)
  - Collapse
  - Primary consolidation
  - Creep Settlement
  - Soil dissolution
  - Particle Migration

Ninyo & Moore
Experience · Quality · Commitment

16

Expansive Soils

Expanding Clay Plates



Classification of Expansive Soil (UBC 29-2)

EXPANSION INDEX	POTENTIAL EXPANSION
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
Above 130	Very High

$$\text{EXPANSION INDEX} = \frac{(\text{FINAL THICKNESS} - \text{INITIAL THICKNESS})}{\text{INITIAL THICKNESS}} \times 100$$

Ninyo & Moore
Experience · Quality · Commitment

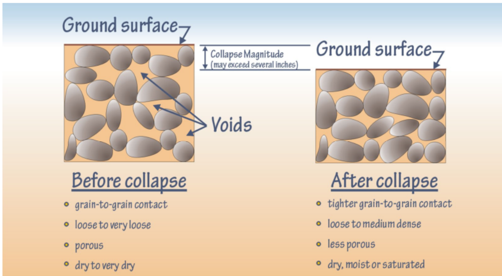
17

Expansive Soils

Ninyo & Moore
Experience · Quality · Commitment

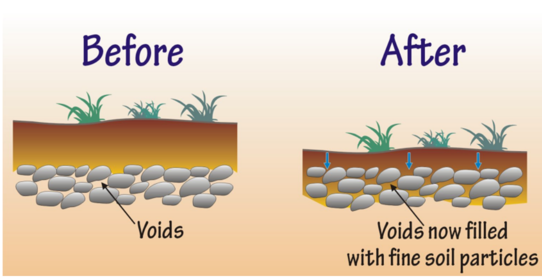
18

Collapsible Soils



19

Particle Migration



20

Field Exploration

21

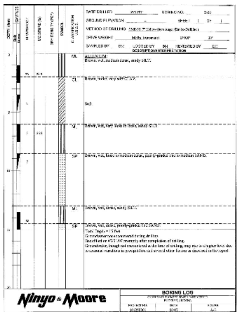
Soil Sampling

Modified California Ring Sampler

Standard Penetration Test (SPT)

22

Boring Log



23

Laboratory Testing

- Tests commonly used for roadway design
  - Moisture Content and Dry Unit Weight
  - Gradation
  - Atterberg Limits
  - Resistance Value (R-Value)
  - California Bearing Ratio (CBR)

24

Gradation Testing

- Sieve Equipment

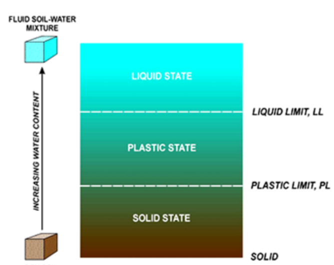
25

Atterberg Limits

26

Atterberg Limits

- Plastic Limit (PL)
  Soil has enough water that it starts behaving like a plastic (modeling clay)
- Liquid Limit (LL)
  Soil has enough water that it starts behaving like liquid
- Plasticity Index (PI)
  PI = LL – PL
  Higher the plasticity index the more water a soil is able to retain & therefore has the potential to increase in volume the most



27

Soil Classification

- Three Common Classification Systems
  - Unified Soil Classification System (USCS)
  - American Association of State Highway and Transportation Officials (AASHTO)
  - United States Department of Agriculture (USDA)

Ninyo & Moore
Experience · Quality · Commitment

28

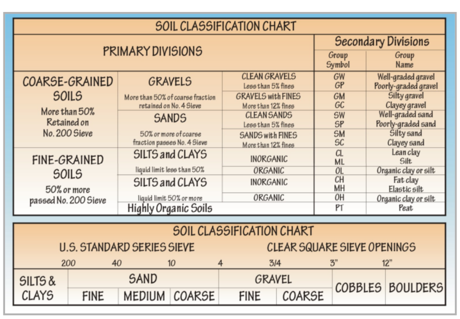
Soil Classification

- Three Common Classification Systems
  - Unified Soil Classification System (USCS)
  - American Association of State Highway and Transportation Officials (AASHTO)
  - United States Department of Agriculture (USDA)

Ninyo & Moore
Experience · Quality · Commitment

29

USCS



SOIL CLASSIFICATION CHART

PRIMARY DIVISIONS			Secondary Divisions: Group Symbol	Secondary Divisions: Group Name
COARSE-GRAINED SOILS More than 50% Retained on No. 200 Sieve	GRAVELS More than 50% of coarse fraction retained on No. 4 Sieve	CLEAN GRAVELS Less than 5% fines	GW GP	Well-graded gravel Poorly-graded gravel
		GRAVELS with FINES More than 12% fines	GM GC	Silty gravel Clayey gravel
	SANDS 50% or more of coarse fraction passes No. 4 Sieve	CLEAN SANDS Less than 5% fines	SW SP	Well-graded sand Poorly-graded sand
		SANDS with FINES More than 12% fines	SM SC	Silty sand Clayey sand
FINE-GRAINED SOILS 50% or more passed No. 200 Sieve	SILTS and CLAYS liquid limit less than 50%	INORGANIC	CL ML	Lean clay Silt
		ORGANIC	OL	Organic clay or silt
	SILTS and CLAYS liquid limit 50% or more	INORGANIC	CH MH	Fat clay Elastic silt
		ORGANIC	OH	Organic clay or silt
	Highly Organic Soils		PT	Peat

SOIL CLASSIFICATION CHART

U.S. STANDARD SERIES SIEVE — CLEAR SQUARE SIEVE OPENINGS

	200	40	10	4	3/4	3"	12"	
SILTS & CLAYS	SAND: FINE	SAND: MEDIUM	SAND: COARSE	GRAVEL: FINE	GRAVEL: COARSE	COBBLES	BOULDERS	

Ninyo & Moore
Experience · Quality · Commitment

30

AASHTO

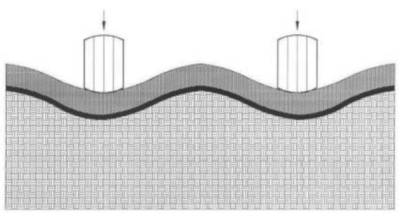
Table 5.1. AASHTO Classification System

General Classification	Granular materials (35% or less passing No. 200 Sieve (0.075 mm)							Silt-clay Materials More than 35% passing No. 200 Sieve (0.075 mm)			
Group Classification	A—1		A—3	A—2				A—4	A—5	A—6	A—7
	A—1—a	A—1—b		A—2—4	A—2—5	A—2—6	A—2—7				A—7—5 A—7—6
(a) Sieve Analysis: Percent Passing											
(i) 2.00 mm (No. 10)	50 max										
(ii) 0.425 mm (No. 40)	30 max	50 max	51 min								
(iii) 0.075 mm (No. 200)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
(b) Characteristics of fraction passing 0.425 mm (No. 40)											
(i) Liquid limit				40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
(ii) Plasticity index	6 max		N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min*
(c) Usual types of significant Constituent materials	Stone Fragments Gravel and sand		Fine Sand	Silty or Clayey Gravel Sand				Silty Soils		Clayey Soils	
(d) General rating as subgrade.	Excellent to Good							Fair to Poor			

* If plasticity index is equal to or less than (liquid Limit—30), the soil is A—7—5 (i.e. PL > 30%)
If plasticity index is greater than (Liquid Limit—30), the soil is A—7—6 (i.e. PL < 30%)

31

Unpaved Roadway Design



32

Unpaved Roadway Design

- Examples of Unpaved Roads
  - Soil cement surface
  - Aggregate-filled geocells
  - Aggregate surface
  - Copolymer/soil mixture surface

33

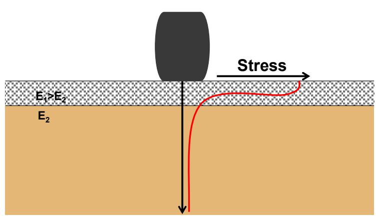
Unpaved Roadway Design

- Design Considerations
  - Traffic Volume (Average Daily Traffic, ADT)
  - Vehicle Types
    - Passenger cars/pick up trucks
    - Two-axle trucks
    - Three to five-axle trucks
  - Design life
  - Freeze/Thaw Conditions
  - Drainage
  - Rut depth

Ninyo & Moore Experience · Quality · Commitment

34

Design Theory – Giroud Han (2004)



Ninyo & Moore Experience · Quality · Commitment

35

Design Theory – Giroud Han (2004)

$$h = \frac{0.868 + (0.661 - 1.006 J^2)\left(\frac{r}{h}\right)^{1.5} \log N}{\left[1 + 0.204(R_E - 1)\right]} \left(\sqrt{\frac{\frac{P}{\pi r^2}}{\frac{s}{f_s}\left[1 - 0.9 e^{-\left\{\frac{r}{h}\right\}^2}\right] N_c f_c CBR_{sg}}} - 1 \right) r$$

Where:

h = Aggregate base thickness
r = Radius of tire contact area
R_E = modulus ratio = 3.28*$CBR_{bc}^{0.3}$/CBR_{sg} ≤5
N = Number of axle passes
CBR_{bc} = Aggregate base CBR
CBR_{sg} = Subgrade CBR
P = Wheel load
s = rut depth

f_s = rut depth factor
N_c = bearing capacity factor
= 3.14 (unreinforced roads)
= 5.14 (geotextile reinforced roads)
= 5.71 (geogrid reinforced roads)
f_c = factor relating to subgrade CBR to undrained cohesion

Ninyo & Moore Experience · Quality · Commitment

36

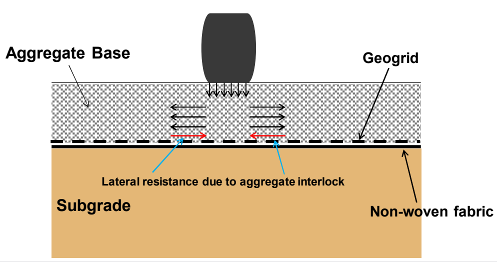
Roadway Reinforcement

- Geotextile fabrics
  - Separates road fill soils from subgrade – prevents soil migration
  - Non-Woven – Higher strength, does not let water pass quickly
  - Woven – Lesser strength but lets water pass.
- Geogrid
  - Reinforces aggregate by adding lateral confining pressures resulting in a stiffer roadway.

Ninyo & Moore

37

Roadway Reinforcement



Ninyo & Moore

38

Design Example

- Compare Unreinforced Unpaved Road to Reinforced Unpaved Road
  - Axle Passes - 1,200
  - Maximum rut depth - 1.5 inches
  - Aggregate base CBR - 20
  - Subgrade CBR – 3
- Results:
  - Unreinforced Road – 19 inches thick
  - Reinforced Road – 7 inches thick

Ninyo & Moore

39

Construction

Source: http://co.laplata.co.us/cms/one.aspx?pageId=1633739

40

Materials Testing

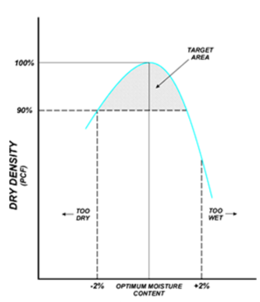
- Proofrolling Observations
  - Pumping
  - Rutting
- Material Specifications (County DOT, ADOT, etc.)
  - Gradation
  - Plasticity
- Compaction Requirements
  - ASTM D 698
  - ASTM D 1557
  - AASHTO T180
- Inspection

41

Compaction Theory

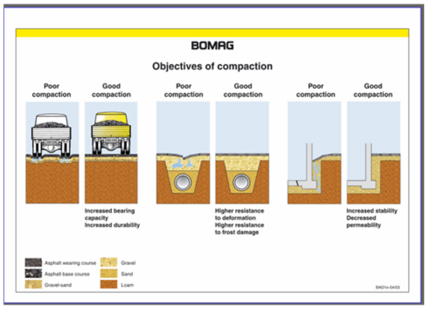
There is a correlation between dry unit weight and moisture content. Moisture acts as a lubricant in the soil material thus permitting maximum densification.

There is a level at which the moisture content within a material will be at an optimum level and permit the maximum densification for the given compactive effort.



42

Compaction Theory



Ninyo & Moore
Experience · Quality · Commitment

43

Compaction Testing

Relative Compaction Testing – Sand Cone (ASTM D1556)

Ninyo & Moore
Experience · Quality · Commitment

44

Compaction Testing

Relative Compaction Testing – Nuclear Gauge (ASTM D 6938)

Ninyo & Moore
Experience · Quality · Commitment

45

Maintenance

- Grading
- Pothole repair
- Leveling/Blading
- Maintain positive drainage

46

Dust Control

- Reduce speed
- Reduce traffic
- Water
- Gravel Surfacing
- Soil Cement Surfaces
- Acrylic Copolymers

47

Dust Control

Watering and Gravel Surfacing

48

Dust Control
Soil Cement Surfacing

Ninyo & Moore
Experience · Quality · Commitment

49

Dust Control
Soil Cement Surfacing

Ninyo & Moore
Experience · Quality · Commitment

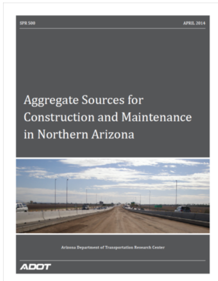
50

Dust Control
Acrylic Copolymers

Ninyo & Moore
Experience · Quality · Commitment

51

Materials Sources



https://apps.azdot.gov/ADOTLibrary/publications/project_reports/PDF/AZ500.pdf

Ninyo & Moore
Experience · Quality · Commitment

52

Questions?

Ninyo & Moore
Experience · Quality · Commitment

53

Arizona Chapter APWA

DIBBLE

10 MINUTE BREAK

54

Drainage 101

55

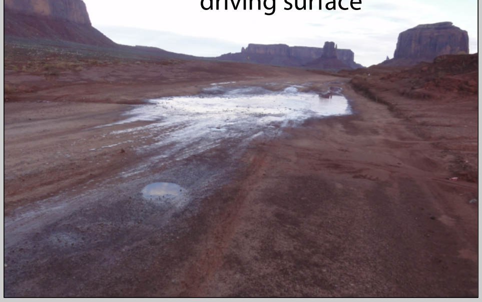
56

57

Poor Drainage

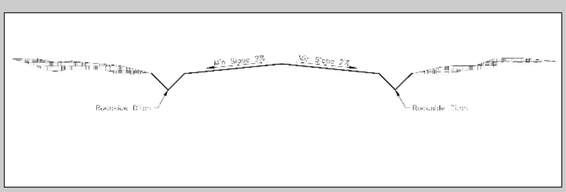
58

Keep the water off the driving surface

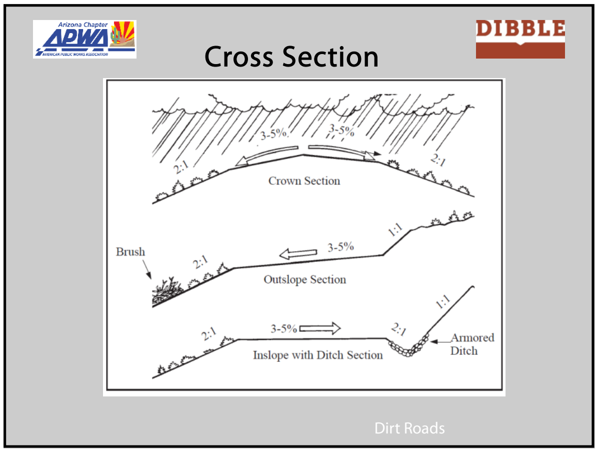


59

Cross Section



60


Arizona Chapter APWA
DIBBLE
Cross Section
3-5%
3-5%
2:1
2:1
Crown Section
Brush
2:1
3-5%
1:1
Outslope Section
1:1
2:1
3-5%
2:1
Armored Ditch
Inslope with Ditch Section
Dirt Roads

61


Crown
(w/ minimum 2% Cross Slope)
06/20/2012 14:29

62


Superelevation
Photos Courtesy of Lane Hulbert, ADOT

63

64

65

V-Ditches

66

Waterbars/ Check Dams

67

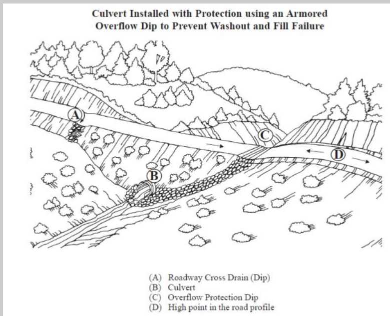
Turnouts

68

Spillways

69

Spillways

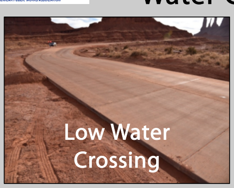


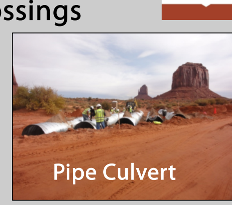
70

Water Crossings

71

Water Crossings





72

Approximate Drainage Flows

Culvert / Bridge	Approx. Capacity
24" culvert	15 cfs
48" culvert	75 cfs
60" culvert	240 cfs
10'x6' box culvert	540 cfs
50' bridge span	820 cfs

73

Approximate Comparative Costs

Low water crossing	$250k
Box culvert	$450k
Bridge	$1,500k

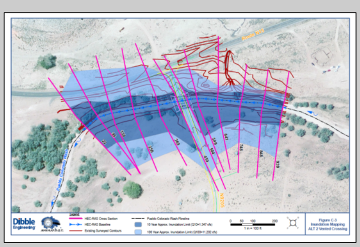
74

Drainage Analysis

Hydrology

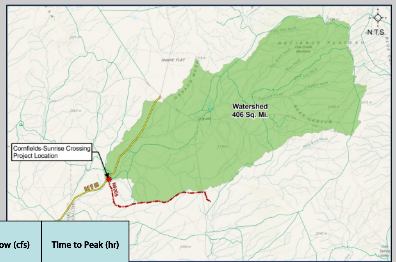
Hydraulics

Final Design



75

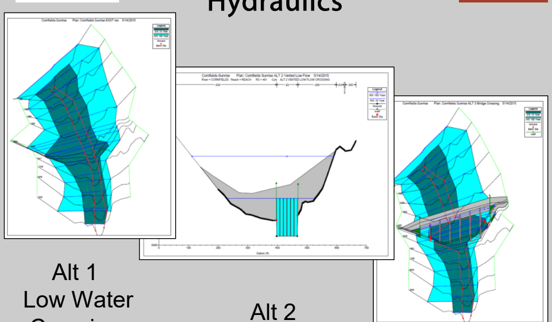
Hydrology



HEC-1 Return Period (24-Hr Duration)	Peak Flow (cfs)	Time to Peak (hr)
10 Year	1,347	26.67
25 Year	3,993	22.00
50 Year	6,918	20.17
100 Year	11,202	18.17

76

Hydraulics



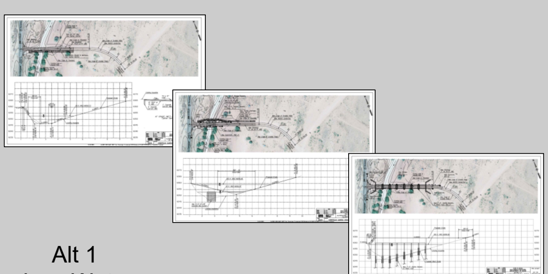
Alt 1
Low Water
Crossing

Alt 2
Box Culvert

Alt 3
Bridge

77

Final Design



Alt 1
Low Water
Crossing

Alt 2
Box Culvert

Alt 3
Bridge

78

Improving Dirt Roads

79

Decision Matrix
(based on traffic)

ADT	Potential Strategy
<100	Blade
100 to 249	Stabilize dirt road
250 to 499	Gravel
500 to 999	Gravel and double chip seal
>1,000	Pave with asphalt concrete

80

Improvement Prioritization

Criteria for Consideration
- Traffic Volumes (ADT)
- Lack of Alternative Routes
- School Bus Routes
- Emergency Access
- Commercial Vehicle Usage

81

School Bus Routes

Photo Source; Arizona Republic and Deseret News

82

Emergency Access

Photo Source; Indian Country Today, Flickriver and Dine Resource and Info Center

83

Commercial Vehicles

Photo Courtesy of Lane Hulbert

84

Improvement Options

- Blade existing roadway
- Stabilize the existing natural material
- Haul in gravel
- Gravel plus chip seal
- Pave the roadway

85

Comparative Costs

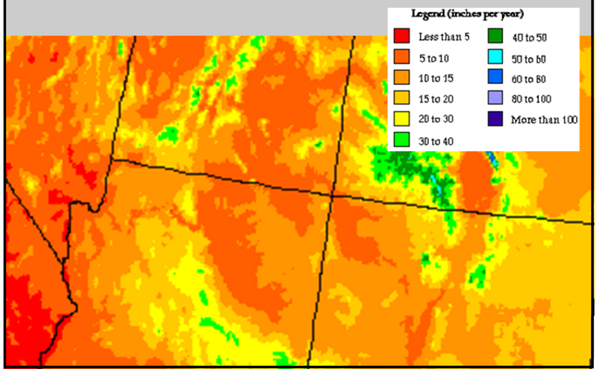
Roadway Treatment	Approximate Cost
Blading roadway	$2,000 per mile
Stabilize existing natural material	$50,000 per mile
4" gravel	$100,000 per mile
6" gravel plus a chip seal	$400,000 per mile
Pave the roadway	$1,500,000 per mile

86

Soil Stabilization

87

Environment



88

Goal of Stabilization

1. Dust Mitigation
2. Improved wet conditions
3. Reduce maintenance cost

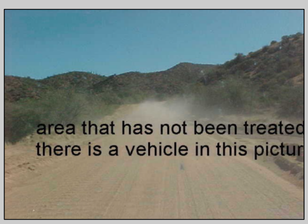


Photo Courtesy of Lane Hulbert, ADOT

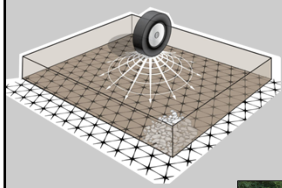
89

Mechanical

- Mixing soil types
- Adding fibrous material
- Geogrids
- Fabrics

90

Geogrids with Gravel



Stabilize weak subgrades

Photos Courtesy of Tensar International

91

Chemical

- Traditional
- Non-traditional

92

Traditional Chemicals

- Cement
- Lime
- Fly-ash
- Bitumen

Not typically used as a surface course (applies to Cement, Lime, Fly-ash)

93

Non-traditional Chemical Stabilization

1. Chlorides
2. Clay additives
3. Electrolyte emulsions
4. Enzymatic emulsions
5. Lignosulfonates
6. Synthetic polymer emulsions
7. Tree resin emulsions

94

95

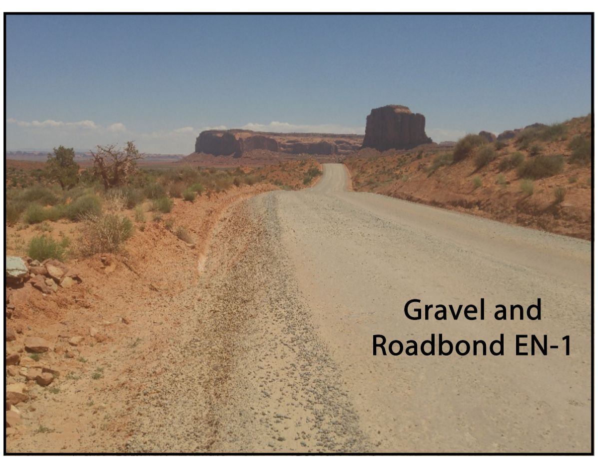
96


Pulverized Ionic Solution
06/19/2012 10:38
Photos Courtesy of Pinal County

97


Synthetic Polymer
Photo Courtesy of Pinal County

98


Gravel and
Roadbond EN-1

99

100

Methods of Placement

Photos Courtesy of Lane Hulbert

Photo Courtesy of Pinal County

101

Chemical Types

Stabilizer Type	Method of Stabilization
Bitumen (Asphalt)	Coat particles with a thin layer of asphalt increasing particle mass and decreasing the chance of becoming airborne.
Chlorides	Salts that work by using moisture from the air to bind the surface fines together.
Electrolyte Emulsions	Electro-chemical bonding within the soil replacing water molecules, and results in the soil rejecting water and allowing the soil particles to bond, increasing soil strength.
Enzymatic Emulsions	Protein molecules (enzymes) reacting with the soil to bind the soil particles together and reduces soils affinity for water.
Lignosulfates	Plant resins that draw moisture from the air to keep the road surface moist without application of water.
Synthetic Polymer Emulsions	Acrylic or acetate polymers that form chemical bond between soil particles to create water resistant semi-rigid surface.
Tree Resin Emulsion	Tree resin combined with additives to form emulsion that bonds with soil particles asphalt increasing particle mass and decreasing the chance of becoming airborne.

102

Products

Chlorides	Electrolyte Emulsion	Enzymatic Emulsion	Lignosulfate	Synthetic Polymers	Tree Resin Emulsion
MgCl (Desert Mountain)	RoadBond EN-1 (RoadBond Soil)	EMC Squared (Soil Stabilization Products)	Dustac (Quattro Solutions)	Soil Sement (Midwest Industrial)	Naturalpave (Soil Stabil. Products)
	Bionic Soil (Bionic Soil)	Perma-zyme (International Enzymes)		Gorilla Snot (Soil Works)	Eco-Pave (Midwest Industrials)
	Gravelock (Con-aid/CBR plus)	Terazyme (Nature Plus)		Soiltac (Soil Works)	
	Condor SS (Stabil Earth)			Durasoil (Soil Works)	
	5A-44 System (Geo Surface Solutions)			RhinoSnot (Envirotac)	
				FSB1000 (Soil-Tech)	
				Top Seal W&B (Terra Pave)	
				Liquid Dust Control (Environseal)	
				Poly Pavement (Poly Pavement)	
				PX -300 (GM Boston Company)	

103

Products

Chlorides	Electrolyte Emulsion	Enzymatic Emulsion	Lignosulfates	Synthetic Polymers	Tree Resin Emulsion
MgCl (Desert Mountain)	RoadBond EN-1 (RoadBond Soil)	EMC Squared (Soil Stabilization Products)	Dustac (Quattro Solutions)	Soil Sement (Midwest Industrial)	Naturalpave (Soil Stabil. Products)
	Bionic Soil (Bionic Soil)	Perma-zyme (International Enzymes)		Gorilla Snot (Soil Works)	Eco-Pave (Midwest Industrials)
	Gravelock (Con-aid/CBR plus)	Terazyme (Nature Plus)		Soiltac (Soil Works)	
	Condor SS (Stabil Earth)			Durasoil (Soil Works)	
	5A-44 System (Geo Surface Solutions)			RhinoSnot (Envirotac)	
				FSB1000 (Soil-Tech)	
				Top Seal W&B (Terra Pave)	
				Liquid Dust Control (Environseal)	
				Poly Pavement (Poly Pavement)	
				PX -300 (GM Boston Company)	

Best for Well Graded Gravels

104

Products

Chlorides	Electrolyte Emulsion	Enzymatic Emulsion	Lignosulfates	Synthetic Polymers	Tree Resin Emulsion
MgCl (Desert Mountain)	RoadBond EN-1 (RoadBond Soil)	EMC Squared (Soil Stabilization Products)	Dustac (Quattro Solutions)	Soil Sement (Midwest Industrial)	Naturalpave (Soil Stabil. Products)
	Bionic Soil (Bionic Soil)	Perma-zyme (International Enzymes)		Gorilla Snot (Soil Works)	Eco-Pave (Midwest Industrials)
	Gravelock (Con-aid/CBR plus)	Terazyme (Nature Plus)		Soiltac (Soil Works)	
	Condor SS (Stabil Earth)			Durasoil (Soil Works)	
	5A-44 System (Geo Surface Solutions)			RhinoSnot (Envirotac)	
				FSB1000 (Soil-Tech)	
				Top Seal W&B (Terra Pave)	
				Liquid Dust Control (Environseal)	
				Poly Pavement (Poly Pavement)	
				PX -300 (GM Boston Company)	

High Clay, High Plastic Index

105

Products

Chlorides	Electrolyte Emulsion	Enzymatic Emulsion	Lignosulfates	Synthetic Polymers	Tree Resin Emulsion
MgCl (Desert Mountain)	RoadBond EN-1 (RoadBond Soil)	EMC Squared (Soil Stabilization Products)	Dustac (Quattro Solutions)	Soil Sement (Midwest Industrial)	Naturalpave (Soil Stabil. Products)
	Bionic Soil (Bionic Soil)	Perma-zyme (International Enzymes)		Gorilla Snot (Soil Works)	Eco-Pave (Midwest Industrials)
	Gravelock (Con-aid/CBR plus)	Terazyme (Nature Plus)		Soiltac (Soil Works)	
	Condor SS (Stabil Earth)			Durasoil (Soil Works)	
	5A-44 System (Geo Surface Solutions)			RhinoSnot (Envirotac)	
				FSB1000 (Soil-Tech)	
				Top Seal W&B (Terra Pave)	
				Liquid Dust Control (Environseal)	
				Poly Pavement (Poly Pavement)	
				PX -300 (GM Boston Company)	

Non-sandy, Low to no Clay

106

Products

Chlorides	Electrolyte Emulsion	Enzymatic Emulsion	Lignosulfates	Synthetic Polymers	Tree Resin Emulsion
MgCl (Desert Mountain)	RoadBond EN-1 (RoadBond Soil)	EMC Squared (Soil Stabilization Products)	Dustac (Quattro Solutions)	Soil Sement (Midwest Industrial)	Naturalpave (Soil Stabil. Products)
	Bionic Soil (Bionic Soil)	Perma-zyme (International Enzymes)		Gorilla Snot (Soil Works)	Eco-Pave (Midwest Industrials)
	Gravelock (Con-aid/CBR plus)	Terazyme (Nature Plus)		Soiltac (Soil Works)	
	Condor SS (Stabil Earth)			Durasoil (Soil Works)	
	5A-44 System (Geo Surface Solutions)			RhinoSnot (Envirotac)	
				FSB1000 (Soil-Tech)	
				Top Seal W&B (Terra Pave)	
				Liquid Dust Control (Environseal)	
				Poly Pavement (Poly Pavement)	
				PX -300 (GM Boston Company)	

Silty Sand, Low Plastic Index

107

Recommended Practices

1. Address drainage
2. Determine traffic volume
3. Determine preferable solution
4. If the preferable solution is to stabilize the existing material then determine climate zone
5. Determine the goal of stabilization
6. Test the current soil condition (gradation, clay content, plasticity, optimum moisture content)

108

Recommended Practices (cont.)

7. Utilize the Soil Stabilization Selection Flowchart to determine recommended types of soil stabilization
8. Identify acceptable products
9. Identify top 3 to 5 products based on experience and answers from manufacturer's survey.
10. Contact manufacturers and provide specific information. Determine the application rate, method and estimated cost.

109

Recommended Practices (cont.)

11. Review material from manufacturers and identify the acceptable product or products. Advertise project and allow contractor to select a product from the list.
12. Utilize manufacturer support staff to get the best product possible.
13. After construction is completed, schedule maintenance
14. Compile all data from the project for future comparison and analysis

110

Maintaining Stabilized Roads

111

Reactivate

- Some products set up and cannot be reactivated with normal ripping and reshaping with routine maintenance equipment.
- If reactivation is desired, an agent such as calcium chloride or magnesium chloride is recommended.
- Need to add water and reactivate. Can be problematic if it gets too dry.

112

Cannot be Reactivated

- Examples include cement, lime, and enzymatic emulsions.
- If a permanent solid-wear surface is desired, an enzymatic emulsion should be evaluated and considered.
- Examples include Bionic Soil, EMC^2 and Roadbond EN1

113

Sequence

1. Clean out v-ditches
2. Reestablish ditch line
3. Pull in the road edges
4. Loosen the road surface
5. Add moisture
6. Rebuild the shape
7. Groom and finish the road
8. Compact

114

Open Discussion / Lessons Learned

115