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What's Under Foot?

Multi-use Trail Surfacing Options

by George Hudson, Principal, Alta Planning + Design

When approaching a trail project, trail designers and local agency representatives often assume their trail will be surfaced with asphalt or perhaps concrete if budget allows. These are some of the most common and acceptable materials used on trails. But this may not be what local residents had in mind when the trail idea was initially conceived. Or, local residents may not have considered the trail surface until a specific surface was proposed, and then suddenly everyone has an opinion. Trails typically serve a transportation function but most trail users do not want a trail to appear as a mini-roadway. This often leads designers into an exploration of possible trail surfacing options.

These conflicts often lead designers into exploring possible trail surfacing options (of which there are more every year), including:

- traditional asphalt and concrete
- permeable asphalt and concrete
- commercial soil stabilizers
- geotextile confinement systems
- chip seal
- crusher fines
- limestone treated surfaces
- rubberized surfaces, such as "Nike Grind"
- organic surfaces, such as bark mulch and wood planer shavings
- agricultural by-products, such as filbert shells
- wood, in the form of boardwalks

In arriving at a recommended trail surface, several key criteria should be considered including:

- **Initial Capital Cost** – Trail surface costs vary dramatically and dollars to build trails are scarce. Construction costs include excavation, subbase preparation, aggregate base placement, and application of the selected trail surface. Costs can vary from a low of around $2.00/SF for a bark mulch trail, up to $12-$13/SF for a rubberized surface.

- **Maintenance and Long Term Durability** – The anticipated life of a trail surface can vary from a single year (bark surface in a moist climate) to 25+ years (concrete). In addition, each trail surface has varying maintenance needs that will require regular to sporadic inspections and follow up depending on the material selected. Some surface repairs can be made with volunteer effort such as on a bark surface trail, while other such as a concrete surface will require skilled craftsmen to perform the repair.

- **Existing Soil and Environmental Conditions** – Soil conditions are a given and play a critical role in surfacing selection. Rail-to-trail projects are often gifted with an excellent base to build a trail on. But a surface such as chip seal has a greater chance of developing a wash boarding effect over time due to "railroad tie memory." In addition, when considering the use of a permeable concrete or asphalt surface, the success rate of these surfaces is directly correlated to the permeability of the soil and climatic conditions. The lower the permeability and moisture, the greater risk of failure.

- **Availability of Materials** – A great trail surface in one area of the country may prove cost-prohibitive in another area due to availability of materials. Limestone-treated trail surfaces are common in the eastern US, but unheard of in the west due to a lack of limestone. There are also some environmentally sound ideas such as the use of recycled glass in asphalt (called "Glassphalt"), but because this is not done on a large scale basis, finding a source for the glass aggregate may prove difficult.

- **Anticipate Use/Functionality** – Who are the anticipated users of the trail? Will the trail surface need to accommodate equestrians, wheelchairs, maintenance vehicles, bicycles, etc.? Multiple use trails attempt to meet the needs of all anticipated trail users. But this may not be feasible with a single trail surface. Consider the shoulder area as a usable surface, making it wide enough for use by those preferring a softer material. Each surface also has varying degrees of roughness and therefore accommodates varying users. In-line skates, for example, cannot be used on a chip seal surface or most permeable concrete surfaces due to the coarseness of the finished surface.

- **Funding Source** – The funding source for the trail may dictate the trail surface characteristics. If the trail has federal funds and is being administered through a state DOT, the state DOT will need to review and approve the selected trail surface.

- **Susceptibility to Vandalism** – Trail surfaces are not usually thought of as being susceptible to vandalism, but the characteristics of the varying surfaces do lend themselves to a variety of vandalism including movement of materials such as gravel or bark, graffiti on hard surfaces, arson (wood and rubber surfaces), and deformation.

- **Aesthetics** – Each trail surface has varying aesthetic characteristics that should fit with the overall design concept desired for the project.

On a recent trail master plan project, the Trolley Trail in the southeast Portland, Oregon metropolitan area, Alta researched several trail surfacing options suitable for use on a multi-use trail in the Pacific Northwest. The project trail follows an abandoned rail corridor, with most of the base lost over time. Native soils present at the site were poorly draining.

The following images show trail surfacing options reviewed for this project. A table follows, which summarizes the surfacing research findings.

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Surfacing Options

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Concrete

Permeable Asphalt

Asphalt

Asphalt

Glassphalt

Polly Pave

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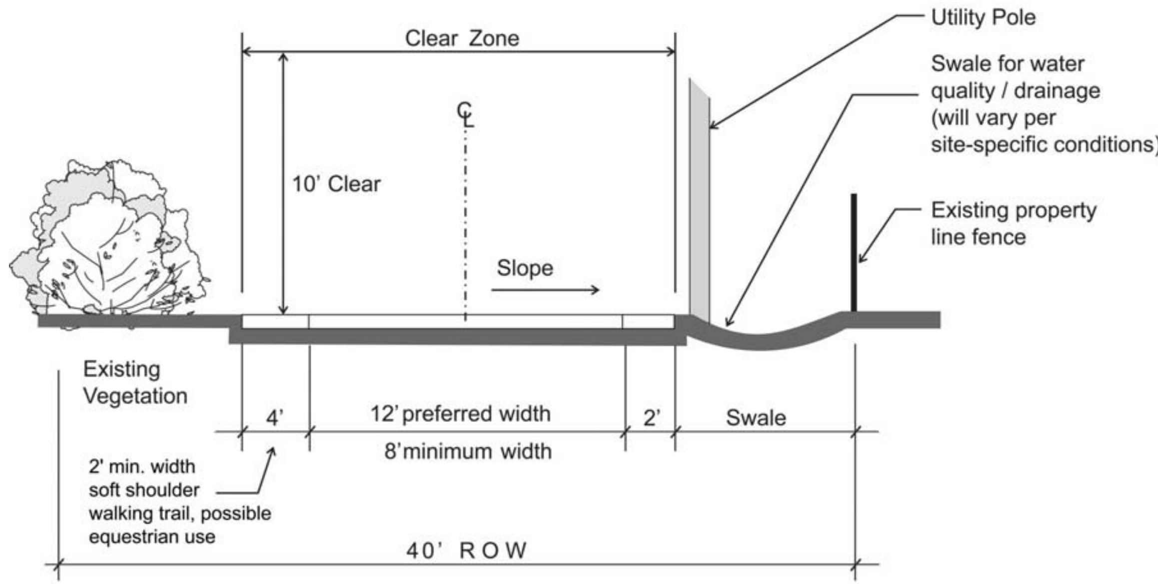
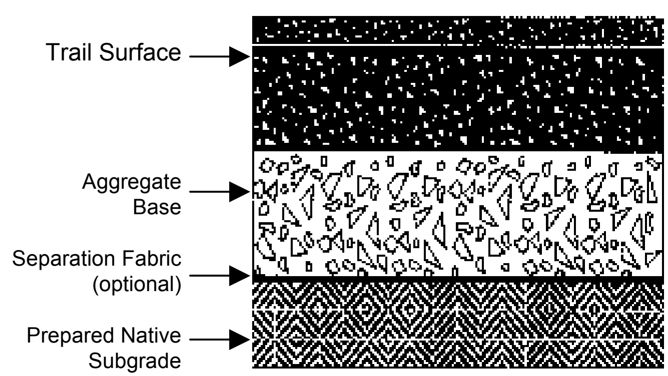
Trolley Trail Master Plan
Trail Section





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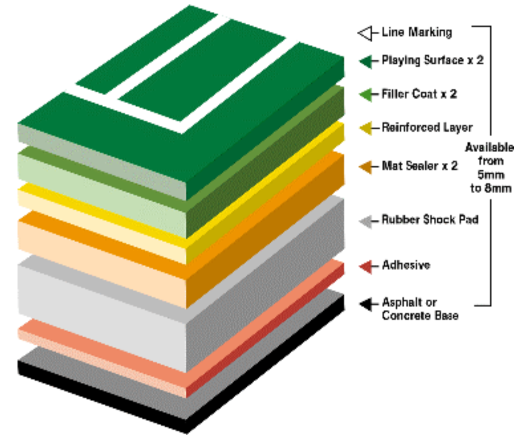
Surfacing Options

Nike Grind – Atlas Track

Nike Grind – Field Turf



Nike Grind – Rebound Ace

Pavers with Fines

Permeable Concrete

Permeable Concrete

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Surfacing Options

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Chip Seal

Wood Planer Shaving/Bark

Crusher Fines

Filbert Shells

Trolley Trail
Trail Surfacing Matrix, Multi-Use Hard Surface Trail

Product	Description/Installation Method	Durability	Maintenance Description	Permeable	Functionality	ADA	MTIP Fundable	Availability	Vandalism Susceptible	Cost Per SF	2'-12'-2' section cost
					B=Bicycle P=Pedestrian S=Roller blade W=Wheelchair			**H=High M=Moderate L=Low**	**G=Graffiti C=Cutting A=Arson M=Moved D = Deformation**		
Nike Grind – Atlas Tracks (Familian Product)	Prepare subbase, place geotextile, 6" aggregate base, apply Nike grind atlas track rubberized surface over base.	8-10 years	Reapply binding agent every 5-6 years. Keep surface clean, dirt and sand wear surface down, Full replacement needed after 10 years	Yes	Pedestrian only. Avoid heavy loads including equestrians, bicyclists, and vehicles	Yes	No	L – locally based but few installers	C, A, G	$12.50	$3,198,000
Nike Grind – Field Turf	Prepare subbase, place geotextile, 6" aggregate base, apply field turf surface over base, similar to laying a carpet.	8-10 years	Sweep regularly; keep free of organic materials as they will rot the surface. Replace surface after 10 years	Yes	Pedestrians only, too soft for bikes and wheels	No	No	L	C, A, G	$11.75	$3,006,120
Nike Grind – Rebound Ace	Prepare subbase, place geotextile, 6" aggregate base, pour concrete or asphalt base, apply rebound Ace surface directly over hard surface.	8-12 years	Replace topcoat after 10 years	No	B, P, W, S, but not tested, intended application is sport surfaces	Yes	Yes	L	C, A, G	$10.50	$2,686,320
Permeable Concrete	Prepared subbase, place geotextile, 12" depth aggregate base, Portland cement, coarse aggregate, water, 5" depth section	15 years	Vacuum sweep and pressure wash 4 times a year	Yes	B, P, W	Yes	Yes	M	G	$6.00	$1,535,040

Product	**Description/Installation Method**	**Durability**	**Maintenance Description**	**Permeable**	**Functionality**	**ADA**	**MTIP Fundable**	**Availability**	**Vandalism Susceptible**	**Cost Per SF**	**2'-12'-2' section cost**
					B=Bicycle P=Pedestrian S=Roller blade W=Wheelchair			**H=High M=Moderate L=Low**	**G=Graffiti C=Cutting A=Arson M=Moved D = Deformation**		
Concrete	Prepared subbase, place geotextile, 6" agg. base, Portland cement, aggregate, sand, water 4" depth section	25 years	Periodic inspection for uplift and settlement, repair as needed	No	B, P, S, W	Yes	Yes	H	G	$4.75	$1,215,240
Permeable Asphalt	Prepared subbase, place geotextile, 12" depth aggregate base, emulsion and coarse aggregate 2" depth section	8 years	Vacuum sweep and pressure wash 4 times a year, patch any pot holes as needed	Yes	B, P, S, W	Yes	Yes	M	G	$3.50	$895,440
Glassphalt	Prepared subbase, place geotextile, 6" agg. base, asphalt with aggregate/glass, 2" depth section	7-10 years	Pothole patching	No	B, P, S, W	Yes	Yes	M	G	$2.75	$703,560
Reground Asphalt	Prepared subbase, place geotextile 6" aggregate base, emulsion recycled asphalt chips 2" depth section	7-10 years	Pothole patching	No	B, P, S, W	Yes	Yes	M	G	$2.75	$703,560
Asphalt*	Prepared subbase, place geotextile, 6" aggregate base, emulsion, aggregate	10 years	Pothole patching	No	B, P, S, W	Yes	Yes	H	G	$2.75	**$703,560***
Poly Pave	Prepared subbase, place geotextile, 6" aggregate base, grade and shape, mix poly pave in top 2" of base, spray on two top coats of poly pave 2" depth section	5-10 years	Reapply Poly pave solidifier every 1-2 years depending on level of use. Make spot repairs as needed.	No	B, P, W, S	Yes	Unknown	L	G	$2.50	$639,600
Chip Seal	Prepared subbase, place geotextile, 6" aggregate base, emulsion, ½" – ¼" aggregate, two coat process	7-10 years	Pothole patching	No	B, P, W	Yes	Yes	M	G	$2.00	$511,680

**The cost for all hard surface options includes using 2' wide shoulders of ¾" minus gravel for a 6 mile trail..

Trolley Trail
Trail Surfacing Matrix, Soft Surface/Shoulder

Product	Description/Installation Method	Durability	Maintenance Description	Permeable	Functionality	ADA	MTIP Fundable	Availability	Vandalism Susceptible	Cost Per SF	6' wide section cost*
					B=Bicycle P=Pedestrian S=Roller blade W=Wheelchair E=Equestrians			**H=High M=Moderate L=Low**	**G=Graffiti C=Cutting A=Arson M=Moved D = Deformation**		
Nike Grind – Atlas Tracks (Familian Product)	Prepare subbase, place geotextile, 6" aggregate base, apply Nike grind atlas track rubberized surface over base.	8-10 years	Reapply binding agent every 5-6 years. Keep surface clean, dirt and sand wear surface down. Full replacement needed after 10 years	Yes	Pedestrian only. Avoid heavy loads including equestrians, bicyclists, and vehicles	Yes	Not as primary trail, ok as shoulder	L – locally based but few installers	C, A, G	$12.50	$1,200,600
Nike Grind – Field Turf	Prepare subbase, place geotextile, 6" aggregate base, apply field turf surface over base, similar to laying a carpet.	8-10 years	Sweep regularly; keep free of organic materials as they will rot the surface. Replace surface after 10 years	Yes	Pedestrians only, too soft for bikes and wheels	No	Not as primary trail, ok as shoulder	L	C, A, G	$11.75	$1,128,564
Nike Grind – Rebound Ace	Prepare subbase, place geotextile, 6" aggregate base, pour concrete or asphalt base, apply rebound Ace surface directly over hard surface.	8-12 years	Replace topcoat after 10 years	No	B, P, W, S, but not tested, intended application is sport surfaces	Yes	Yes	L	C, A, G	$10.50	$1,008,504
Pavers with Fines	Prepare subbase, place geotextile, 6" aggregate base, place plastic pavers over base, fill cells with 3/16" minus crushed rock.	15 years	Keep weeded, refill cells with gravel as needed	Yes	B, P, W, S, E	Yes	Yes	M	M	$4.50	$432,216

Product	Description/Installation Method	Durability	Maintenance Description	Permeable	Functionality	ADA	MTIP Fundable	Availability	Vandalism Susceptible	Cost Per SF	6' wide section cost
					B=Bicycle P=Pedestrian S=Roller blade W=Wheelchair E=Equestrians			**H=High M=Moderate L=Low**	**G=Graffiti C=Cutting A=Arson M=Moved D = Deformation**		
Wood Planer Shavings	Prepare subbase, place geotextile, 4" aggregate base, place 3" layer of wood planers shavings, add additional 3" layer after initial compaction	2-3 years	Add 2"-3" of new material annually	Yes	P, E	No	Not as primary trail, ok as shoulder	H	M, D, A	$2.60	$249,725
Crusher Fines/Gravel	Prepare subbase, place geotextile, 6" aggregate base, place 2" depth ½" minus over base, roll and compact	2-5 years, depending on maintenance	Sweep to fill voids from dislodged fines	Yes	P, B	No	Not as primary trail, ok as shoulder	H	M, D	$2.50	$240,120
Filbert Shells	Prepare subbase, place geotextile fabric, 4" aggregate base, then 3" layer of filbert shells	7-10 years	Keep shells in place by regular raking. Re-top every 5 years	Yes	P, E	No	Not as primary trail, ok as shoulder	M	M	$2.25	$216,108
Wood Mulch	Prepare subbase, place geotextile, 4" aggregate base, place 3" layer of wood mulch, rake and shape, apply second 3" layer after initial compaction and settlement	1-3 years	Top dress annually	Yes	P, E	No	Not as primary trail, ok as shoulder	H	M, D, A	$2.10	$201,700

* 6' width is used as an example and cost estimating purposes only. Other widths can be considered.

Summary of Qualifications

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Alta Planning + Design is one of North America's leading firms specializing in progressive transportation planning, design, and implementation. We focus on multi-modal solutions, particularly bicycle, pedestrian and trail corridors and systems.

Services

Alta provides a full range of services including:

- master plans
- project design
- sign plans
- public involvement
- environmental review and documentation
- bicycle/pedestrian integration with transit
- corridor plans
- bicycle parking design
- plan updates
- school safety studies
- technical assistance and trainings
- construction documents and observation

We offer complete landscape architecture and engineering services.

Staff

We are at the forefront of the progressive transportation movement. Alta staff are active in the Association of Pedestrian and Bicycle Professionals, Institute of Transportation Engineers, Transportation Research Board, and are conducting national studies for the U.S. Department of Transportation. We conduct pedestrian and bicycle trainings nationwide, and have been involved in award-winning plans and projects.

Experience

We have experience working in all size communities, from a few thousand to millions, from rural to mountain and desert to suburban and urbanized areas. We strive to tailor each project to the community's unique setting, history and culture through an active public participation process.

Alta staff are proud to have designed and implemented over 1,500 miles of bikeways.

Firm Profile

Alta Planning + Design

Year Established:	1996
Office Locations:	San Rafael, California (main); Plymouth, Massachusetts; Berkeley, California; Portland, Oregon; San Diego, California; Los Angeles, California
Staff:	15 professional staff, including five Principals
Professional Skills:	Planning (Transportation, Environmental, Community); Landscape Architecture; Engineering; CAD Design; GIS Mapping; Drawing, Rendering and Image Manipulation

Principals

Michael G. Jones, MCP, has managed more than 200 studies since 1985, ranging from major national, state, and regional plans to corridor studies to plans for small towns. Mr. Jones is a nationally-recognized expert in bicycle, pedestrian, and trail planning and design, as well as in financial analysis, and transportation and parking management. He has developed innovative methodologies and models for topics such as bicycle demand, GIS-linked roadway suitability, and shared-use parking. He has presented to and been published by the Institute of Transportation Engineers, the American Planning Association, the American Society of Landscape Architects, and the Rails-to-Trails Conservancy.

Mia Birk manages the Pacific Northwest office of Alta. She is responsible for all aspects of program management, including project development, budget management, public communication, project design, cost estimation and analysis, report writing, and management of advisory committees, technical assistance and support staff. She has developed numerous bicycle, pedestrian, trail, and corridor plans, and has managed the public process, design and implementation of over 200 miles of new bikeways, thousands of bicycle parking spaces, and a bikeway maintenance program. While at the City of Portland, she developed Portland's Bicycle Master Plan, commuter map, web site, and numerous public outreach materials.

George Hudson, RLA, ASLA, is one of the leading trail and bikeway designers in the Western United States. He has worked exclusively on alternative transportation projects for the past 12 years. He has acquired rights-of-way, master planned over 200 miles of alternative transportation routes, secured in excess of $10 million dollars for development projects, facilitated public processes on over 25 projects, addressed endangered species issues in conjunction with development projects, successfully negotiated trail rights with railroads, and overseen $35 million dollars of construction. Mr. Hudson has a proven record of accomplishment on complex projects requiring a multi-disciplinary team approach. His experience has ranged from major urban waterfront esplanades to earthen hiking and ski trails in the national forest.

Paul Smith manages the Eastern Division of Alta Planning + Design, which conducts transportation planning and design projects for clients in New England and beyond. Mr. Smith served as the Project Manager for the first bicycle transportation plans of Massachusetts and the City of Boston. He managed feasibility studies for Maine's 140-mile Downeast Trail and Virginia's 50-mile Capital-to-Capital Bikeway. He has also conducted bicycle and pedestrian projects for Nantucket (Massachusetts), the Massachusetts Institute of Technology, Harvard University, and the State of Oregon. He currently manages an on-call bicycle/pedestrian contract with the New Hampshire Department of Transportation.

Brad Lewis, ASLA manages our Southern California operations, bringing over 23 years of experience in the fields of Landscape Architecture, Planning and Urban Design. Mr. Lewis is an expert in pedestrian circulation and non-motorized transportation, having brought numerous projects to successful completion throughout the United States, as well as in Hong Kong and Australia. His experience includes developing urban design standards and guidelines as well as final design and construction. Mr. Lewis was previously a Principal with Wilbur Smith Associates and Director of Urban Design Services with Boyle Engineering.