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Bike Safe Wisconsin

Methodology & Technical Approach

How the map scores bicycle stress, screens road geometry, and finds the calmest route

Method v1.2 - July 2026

Bike Safe Wisconsin is a free, public tool that shows how stressful every street in Wisconsin is to ride, and finds the calmest bicycle route between two points. If you've wondered why a street is colored red, why the suggested route goes the long way around, or whether you can trust any of it, this document is the answer. It explains, in plain language with the technical detail kept in view, what data the map is built from, how every road and crossing is scored, how those scores choose your route, and - just as important - what the model cannot see. Every scoring standard used here is one the Wisconsin DOT and the Federal Highway Administration already use. Results are planning-level estimates, not a guarantee of safety. Prepared by a licensed Professional Engineer.

At a glance

Streets: OpenStreetMap, one network per county | Stress scores: Level of Traffic Stress, the national standard (Mineta / Furth / Montgomery County) | Speeds: measured driving speeds on major roads, posted limits elsewhere | Terrain: USGS 1-meter LiDAR | Routing: safest / balanced / most-direct options.

PART 1

What the map is built from

Every score starts from public data, assembled into one routable street network per county. All 72 Wisconsin counties are covered; each county is self-contained, so improvements and community additions in your area stay in your area.

Source	What it provides	How it's used
OpenStreetMap	The streets and paths themselves, plus lanes, bike lanes, parking, surface	The base map (crowd-sourced, like Wikipedia for maps)
Measured speeds (federal NPMRDS data)	How fast traffic actually moves on major roads	Real speeds, not just posted limits, where stress is highest
WisDOT traffic counts	How many vehicles use a road each day	Traffic-volume layer on the map
WisDOT hourly counts	How traffic varies by hour	Time-of-day traffic patterns (weekday + Saturday)
Crash records	Where bike and pedestrian crashes happened, and how severe	Shown for context - crashes never move a route (see Part 5)
USGS LiDAR elevation	Ground elevation measured to 1 meter	Hills, sight lines, and curve safety (Part 4)
Community input	Paths and shortcuts locals know that maps miss	Added to routing after review

PART 2

How streets are scored (Level of Traffic Stress)

Every street segment and every crossing gets a score of 1 to 5 on the Level of Traffic Stress (LTS) scale - a national standard that asks, in effect, who would be comfortable riding here. LTS 1 is calm enough that most parents would let a child ride it; LTS 2 suits most adults; LTS 3-4 takes a confident, experienced rider; LTS 5 means fast or heavy traffic with nothing separating you from it. A route is only as comfortable as its worst moment, so a street's controlling score is the WORSE of the street itself and any busy crossing it forces you into - the 'weakest link' rule from the published LTS methods. Full attribution: LTS per MTI Report 11-19 (Mekuria, Furth & Nixon 2012), Furth LTS v2.2 (2022), and Montgomery County Revised LTS - the same lineage state DOTs cite. Independent research supports the approach: LTS ratings have been validated against children's perceived safety (Ferenchak & Marshall 2020), though the literature is honest that validations remain few and results on predicting travel behavior are mixed (Singleton & Clifton's Oregon study) - one more reason every output here stays planning-level.

Real speeds, not just the speed limit sign

Speed drives stress, so each road uses the best speed known for it: measured real-world driving speeds on major roads (where speeding matters most), the posted limit where one is mapped, and otherwise a typical speed for that class of road. This follows the method's own instruction - Furth's criteria call for the speed limit only where limits align with actual traffic speeds, and otherwise a measure reflecting actual speeds. Lane counts come from the map data or road-class defaults.

Traffic volume on shared two-lane streets

The published criteria say sharing an unlaned two-lane street works only when traffic is light (roughly 3,000 vehicles/day or less; Dutch guidance puts comfortable sharing below ~2,000). Where a WisDOT count site is matched to a no-centerline street, its score is raised accordingly (over ~1,500 vehicles/day moves it out of the kids tier; over 3,000 to confident-rider). Coverage is honest: counted roads are volume-adjusted, uncounted ones keep their table score.

Mixed-traffic segments (no bike facility)

The rural and residential default - speed bucket x through-lanes x presence of a centerline (local street vs collector+). Furth caps mixed traffic at LTS 4; our LTS 5 tier marks the genuinely bike-hostile subset (44+ mph AND (50+ mph or 4+ lanes)). Every road we score LTS 5 already qualifies for Montgomery County's Revised LTS 5 (assigned to everything over 40 mph), so the tier is a conservative subset of published precedent, never an expansion.

Prevailing speed	<=3 lanes, local (no centerli	<=3 lanes, w/ centerline	4-5 lanes	6+ lanes / >=50 mph
<= 25 mph	LTS 1	LTS 2	LTS 3	LTS 4
30 mph	LTS 2	LTS 3	LTS 4	LTS 4
35-45 mph	LTS 4	LTS 4	LTS 4	LTS 4
>= 50 mph or 4+ lanes	LTS 5	LTS 5	LTS 5	LTS 5

Striped on-street bike lanes

A painted or buffered bike lane is scored on its own table (Furth Tables 2-3 / Fairfax BLTS), NOT the mixed-traffic fall-through, taking the WORST of three criteria: prevailing speed, through-lanes per direction, and width. With on-street parking the width test becomes 'reach' = parking + bike lane + buffer, which captures the door zone. A frequently-blocked lane falls back to mixed-traffic stress (>= LTS 3). Separated cycle tracks are always LTS 1. As of method v1.2 a painted lane rates LTS 1 only at 25 mph or less - stricter than original Furth (30 mph), following NACTO's 2025 Urban Bikeway Design Guide and the 2026 PeopleForBikes standard: the right direction for a map families rely on.

Condition	LTS 1	LTS 2	LTS 3
Bike lane, no parking - by width	>= 6 ft & <= 30 mph	4-5.5 ft (rises w/ speed)	narrow + 38-43 mph
Bike lane w/ parking - by reach	>= 15 ft & <= 25 mph	14-14.5 ft	<= 13.5 ft (door zone)
Speed criterion (no parking)	<= 25 mph	<= 37 mph	<= 43 mph
Frequently blocked	-	-	falls back to mixed traffic

Crossings (unsignalized, weakest-link)

Where a low-stress street forces a crossing of a busier one, the crossing stress = speed crossed x lanes crossed x median refuge. A quiet street that dead-ends into an uncontrolled 5-lane 40 mph arterial is scored by that crossing, not the quiet street. Signalized and marked crossings are downgraded.

Lanes crossed	<= 25 mph	30 mph	35 mph	40 mph
2-3 lanes (no refuge)	LTS 1	LTS 2	LTS 2.5	LTS 3
4-5 lanes (no refuge)	LTS 2	LTS 2.5	LTS 3	LTS 4
6+ lanes (no refuge)	LTS 4	LTS 4	LTS 4	LTS 4
With median refuge	lowered one step or more (see table)			

PART 3

How your route is chosen

The route finder minimizes stress-weighted distance, not raw distance. Each street 'costs' its length multiplied by a factor that grows sharply with its stress score, so the router will happily add distance to keep you comfortable - one block of LTS 4 costs as much as eight blocks of LTS 1. That's why the suggested route sometimes goes the long way around: to the router, the long way is cheaper. Busy crossings add a penalty the same way.

LTS	1	2	2.5	3	4	5
Cost multiplier (vs LTS 1)	1.0x	1.5x	2.5x	4.0x	8.0x	20.0x

A single dial trades safety against directness, exposed to the rider as three presets. Each option is shown with its extra distance versus the shortest path, so you can apply your own detour tolerance (PeopleForBikes' 2026 standard treats a low-stress route over ~25% longer as not real access - a useful rule of thumb):

- **Safest:** strongest avoidance - keeps children and casual riders on LTS 1-2 wherever a connected low-stress path exists.
- **Balanced:** the default - low-stress where reasonable, accepting short higher-stress links to avoid large detours.
- **Most direct:** shortest rideable path, still excluding freeways and non-public ways, with stress shown for transparency.

The network deliberately excludes private driveways and gated ways so the router can't fabricate a shortcut, and de-prefers parking aisles and tracks so they're reachable as destinations but never through-routes.

Grade-aware routing (directional)

Hills are priced as DIRECTIONAL added distance on top of stress: the same road segment costs more climbed than descended, so an uphill detour isn't penalized on the way back down. The uphill cost uses the Broach, Dill & Gliebe (2012) revealed-preference GPS coefficients - how much extra distance real cyclists accept to avoid a climb - by grade band:

Upslope (climb direction)	Added cost per 100 m climbed	Effect
2-4 %	+37 m	mild
4-6 %	+120 m	strong
6 %+	+324 m	cyclists detour far to avoid

A separate, smaller DOWNHILL safety adjustment reflects that descending raises crash risk independent of effort (Teschke et al. 2012 found roughly 2.3x the odds), and it is strengthened on hills the LiDAR screen (Part 4) already flags for short sight lines. The Hill-avoidance dial in the app controls how strongly all of this applies - full strength on Safest, half on Balanced, off on Most direct. In testing on Washington County, hill-aware routing cut a sample trip's climbing from 187 to 134 feet over the same 4.7 miles.

PART 4

The hidden-hazard screen (laser-measured terrain)

Traffic stress captures who you share the road with - not whether the road's own shape is safe to ride: a hill crest you can't see over, a curve that's sharper than it looks, a downgrade where a bike builds real speed. A second layer measures the ground along every corridor using USGS LiDAR elevation data (accurate to about 1 meter) and flags locations that fall short of AASHTO highway-design criteria - evaluated from the CYCLIST's perspective, not just the driver's.

- **Crest sight distance:** vertical curves where the available sight line falls short of stopping sight distance.
- **Sharp curves:** horizontal curves below the minimum radius for the design speed.
- **Steep grades:** sustained downgrades (>= 6%) where a descending cyclist builds dangerous speed.

The key move: on a downgrade we evaluate the bicycle's likely DESCENDING speed (an AASHTO Bike Guide terminal-velocity model), not the posted limit, then apply bicycle stopping-sight-distance and curve criteria. Each location is flagged on the WORSE of driver-at-posted vs cyclist-at-descending - which is why rolling rural roads a posted-speed screen would pass are correctly caught.

Downgrade	Cyclist descending speed	Bicycle sight distance required	Driver req. @ 25 mph
2%	18 mph	113 ft	155 ft
4%	25 mph	187 ft	159 ft
6%	31 mph	281 ft	164 ft
8%	36 mph	388 ft	169 ft
10%	40 mph	502 ft	175 ft

Each flagged location carries a candidate fix an agency can field-verify (advance warning signs and speed management, curve chevrons with an advisory speed, or added shoulder width for descending bikes). As a sense of scale: screening Washington County's full network of 25 mph-and-up roads flagged 1,926 hill crests, 569 curves, and 870 steep grades - 3,365 sites worth a closer look that a stress map alone would never surface.

PART 5

Layers that inform but never steer

Three map layers add context for you (and for agencies) but deliberately do NOT change stress scores or routing. Crashes in particular are too sparse to score individual streets fairly - a street with no recorded crashes is not proven safe - so they stay informational:

- **Crash history:** where bike and pedestrian crashes occurred, colored by injury severity (the standard police-report scale).
- **Traffic volume:** WisDOT count-site volumes with 24-hour weekday and Saturday patterns. Where WisDOT counted hourly at a site, the pattern is measured (and labeled with its month); everywhere else the map shows the typical pattern for similar roads - built by averaging thousands of measured Wisconsin counts by road type and traffic level (the federal Traffic Monitoring Guide's factor-group method), scaled to the site's own daily volume, and labeled 'estimated'.
- **Lighting:** mapped street lighting, for after-dark comfort.

PART 6

What the model can't see - and what's next

An honest tool tells you where it's blind. These are the known limits of the current model, and the improvements planned for each.

Known limits

- **Conditions right now:** the map knows nothing about construction, closures, weather, debris, or traffic at the moment of your ride. Always preview a route and trust your eyes over any score.
- **Map completeness:** OpenStreetMap is crowd-sourced; a missing bike lane tag or an unmapped path means a wrong score until it's fixed. This is exactly where community input helps most.
- **Traffic volume in scores:** volume now adjusts scores on two-lane no-centerline streets where a WisDOT count exists (Part 2); uncounted local streets still keep their table score, so a busy uncounted back road can read calmer than it is.
- **Crossing protection detail:** signalized and marked crossings are recognized where mapped, but finer tiers (flashing beacons, HAWK signals) will make crossing scores sharper.
- **Community knowledge:** park trails, protected crossings, and crash history are modeled in every county, but informal neighborhood cut-throughs exist nowhere in public data - riders add them through the app's reviewed submission queue, so coverage deepens where communities engage.

What's planned

- **Wider volume coverage** - extending the two-lane volume adjustment beyond counted roads with network-level volume estimates.
- **A richer crossing model** that grades each crossing by its actual protection: uncontrolled, marked, beacon, or full signal.
- **Surface quality and connectivity analysis** - finding low-stress neighborhoods stranded behind a single busy road, which are often the highest-value fixes a community can make.
- **Field validation** - ground-truthing speeds, widths, and the terrain flags against real-world measurements.

How you can help

The model improves fastest where residents engage: add the paths and cut-throughs the map misses (every submission is reviewed before it changes routing - the community contributes connections, never safety judgments), log the trips you take or wish you could take, and report anything that looks wrong.

Method versions

- **v1.0 (June 2026):** LTS segment + crossing scoring, stress-weighted routing, statewide map.
- **v1.1 (June 2026):** striped-bike-lane tables; grade-aware directional routing; LiDAR geometric screen.
- **v1.2 (July 2026):** painted-lane LTS 1 capped at 25 mph (NACTO 2025 / BNA 2026 alignment); volume adjustment on counted two-lane no-centerline streets; full citation stack on every output.

> **How to read all of this**
> Every score in this document is a planning-level estimate built from public data - a way to compare streets and find candidate routes and fixes, not a guarantee about any street on any day. Use your own judgment, preview routes before riding them with children, and field-verify before design decisions. Questions, corrections, methodology critiques: eric@bikesafewi.com.