NVIS Antennas for EmComm

Near Vertical Incidence Skywave & Building a 20/40 Linked Dipole

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The Problem: The Skip Zone

- **Standard HF antennas radiate at a low angle toward the horizon**
- **The signal skips off the ionosphere — lands hundreds of miles away**
- **Leaves a "dead zone" from 0 to ~400 miles where nothing is heard**
- **VHF/UHF fills some of that gap — but depends on repeaters**
- **When the repeater goes down, your region goes silent**

Low-angle HF

500–2000 miles
(skips over your region)

VHF/UHF repeater

0–50 miles
(repeater-dependent)

NVIS (tonight's build)

0–400 miles
Fills the gap!

ARES mission = regional coordination.
That dead zone is exactly where we operate.

How NVIS Works

Near Vertical Incidence Skywave

- Fire RF nearly straight up — 75°–90° elevation angle
- Reflects off the ionosphere's F-layer, comes back down in a circle
- Coverage: ~0 to 400 miles — fills the HF dead zone exactly
- Low antenna is the secret: 0.1 wavelength or lower above ground
- 40m ideal NVIS height: ~4 meters / 13 ft — electric fence posts nail this

Best Bands for NVIS

40m — 7 MHz

Daytime regional / Our primary EmComm band

80m — 3.5 MHz

Nighttime / shorter range

60m — 5 MHz

Excellent NVIS, FCC EmComm channels

20m — 14 MHz

Too high for NVIS — use for longer reach

The F-layer is stronger by day (40m works) and fades at night (switch to 80m).

Why NVIS for ARES?

The Scenario	Without NVIS	With NVIS ✓
▸ Major disaster — grid is down ▸ Repeaters off or overloaded ▸ Cell networks jammed or failed ▸ Need EOC-to-EOC contact ▸ Hospital ↔ shelter coordination ▸ Stations 50–300 miles apart	▸ VHF/UHF: can't reach without repeater ▸ Low-angle HF: skips right over them ▸ Satellite: expensive, slow, limited ▸ Radio silence in your region ▸ The mission fails	▸ 40m dipole, low to the ground ▸ Direct contact, no infrastructure ▸ SSB voice in minutes ▸ Winlink over 40m NVIS ▸ Proven in real disasters ▸ Military has used this 80+ years

Antenna Design: Why a Linked Dipole?

Why a dipole?

- **Simple — anyone can build it**
- **Efficient — no matching losses**
- **Lightweight and portable**
- **Easy to repair in the field**
- **Works great low to the ground**

20m = longer reach / POTA
40m = NVIS / regional EmComm
80m = night ops (easy upgrade after tonight!)

Why linked, not trapped?

Linked ✓	Trapped ✗
No trap losses — full efficiency	Traps absorb power = lossy
Lighter weight	Heavier — traps are coils
Simple to repair	Traps need retuning to fix
Add bands by adding wire	Fixed bands only
Cheaper to build	Traps cost money/time

Wire Length Math

468 ÷ f (MHz) = total dipole length in feet

142.6 ÷ f (MHz) = total length in meters ← easier in the field!

Why 142.6? Free-space half-wavelength = 150/f. Dipoles run ~95% of that (end effects). Both formulas work — metric is faster math outdoors.

	Frequency	Total (ft)	Total (m)	Each Leg (ft)	Each Leg (m)	Cut Long At (ft)
20m inner	14.2 MHz	33.0 ft	10.0 m	16.5 ft	5.0 m	17.0 ft
40m (full)	7.2 MHz	65.0 ft	19.8 m	32.5 ft	9.9 m	—
40m ext/leg	—	—	—	16.0 ft	4.9 m	16.5 ft

Always cut LONG — trim to best SWR with the RigExpert on-site. Small cuts, re-check each time.

Parts List (per antenna)

20AWG Silicone Wire	Cut to lengths in the table + 6" extra per leg. Silicone = flexible, kink-resistant, lightweight.
BNC Terminal Block (female)	Feedpoint center — wire legs connect directly. amazon.com → search 'BNC terminal block'
4× Bullet / Butt Connectors (heat shrink)	Band links — disconnect for 20m, connect for 40m. 2 link points × 2 connectors each.
Heat Shrink Tubing (large diameter)	Extra pieces for strain relief at BNC block exits and at each link joint.
3D Print: BNC Dipole Center	Hanger + housing for BNC block · makerworld.com/en/models/1494742-bnc-dipole-center
3D Print: Antenna Links (×2)	Insulating spacers at each link point · makerworld.com/en/models/1679368-antenna-links-efhw-dipole-etc
3D Print: Wire Winders	Keeps wire organized· makerworld.com/en/models/2605937-wire-winder-sota-portable-ham-radio-antennas
BNC Coax to Radio	Your own cable — connects feedpoint to radio's BNC port.

Tools You'll Need Today

Long Tape Measure	100 ft / 30 m — you need it for the 40m legs
Crimping Tool	For bullet connectors — ratchet crimper preferred
Marker / Tape	Mark trim points before cutting
Electric Fence Posts (2–4)	~4 ft posts to stake wire ends — available at Lowes
Optional: Radio + BNC Coax	Test on-air after tuning
Wire Cutters or Sharp Scissors	Sharp edges = clean cuts
Heat Gun or Lighter	Shrink the heat shrink on connectors and strain relief
RigExpert Stick (shared)	Antenna analyzer for tuning — we'll share one on-site
Optional: Military Mast	A little center height for an inverted-V shape

Build Steps 1–4: Wire & Feedpoint

Step 1

Measure & cut inner elements (20m legs)

2 pieces at 17 ft / 5.2 m each — long for trimming. Mark each piece as you cut.

Step 2

Strip wire ends

Strip ~½ inch of insulation from both ends of each inner element.

Step 3

Attach to BNC terminal block

Center conductor → center pin. Shield/other leg → second lug. Tighten screws firmly.

Step 4

Add strain relief heat shrink / zip ties at BNC block

Larger-diameter heat shrink or zip ties over each wire exit from the terminal block. Heat to shrink.

Build Steps 5–8: Link Points & Extensions

Step 5

Crimp bullet connector (male) to far end of each inner element

Crimp male bullet connector, heat shrink to seal and protect.

Step 6

Add 3D-printed link spacer over each connector

Insulates the link and keeps the joint tidy in the field.

Step 7

Measure & cut outer extensions (40m)

2 extension pieces at 16.5 ft / 5.1 m each (long for trimming).

Step 8

Crimp female bullet connector + heat shrink to inboard end of each extension

Female on inboard end. Outboard end stays open — for trimming, or future 80m links.

Build Steps 9–14: Final Assembly & Tuning

Step 9	**Add strain relief at each link point**	Larger-diameter heat shrink over the connected bullet joint — prevents pull-out stress.
Step 10	**Attach 3D-printed spacer to link assembly**	Snap spacer over the joint — keeps everything aligned and insulated.
Step 11	**Wind elements onto winders**	Wind each of the 4 sections onto its own 3D-printed winder. Keep sections separate.
Step 12	**Hang BNC center hanger from support point**	Clip the 3D-printed BNC hanger to rope or mast. This is your antenna center.
Step 13	**Connect elements for your band**	40m: links connected (all 4 sections out). 20m: links disconnected (inner sections only).
Step 14	**Tune with RigExpert**	40m (links in): trim outer extensions near 7.2 MHz. 20m (links out): trim inner near 14.2 MHz. Small cuts, re-check.

Field Deployment

- Drive electric fence posts at each end of the antenna (~4 ft height)
- Tie off wire ends — keep roughly horizontal and LOW
- Optional: military mast at center for slight inverted-V shape
- Plug BNC coax from terminal block into radio
- Re-check SWR once deployed — ground affects it slightly
- To change bands: plug in links (40m) or unplug (20m)

Why keep it low?

- Low antenna fires energy nearly vertically
- High antenna = lower angle = DX skip
- 3–13 ft is the sweet spot for 40m NVIS
- Electric fence posts nail this perfectly

Orientation

- Dipole is broadside — strongest ⊥ to wire
- Orient wire N–S to radiate E–W
- NVIS very low = nearly omnidirectional
- Don't overthink it — get it up and on-air

Antenna deployed at park — fence posts and feedline

The 80m Upgrade: Same Antenna, More Bands

After tonight's build you can extend to 80m with just two more wire sections and a couple more bullet connectors. Same center, same feedline.

When to use 80m

- **Nighttime — 40m F-layer fades after dark**
- **Very close stations (<100 miles)**
- **GA ARES Sunday net: 3.975 MHz LSB**
  Sundays 5pm EST / 6pm EDT
- **Backup when 40m is noisy**

Target	Frequency	Add per leg (ft)	Add per leg (m)	Cut Long At (ft)
General 80m EmComm	3.750 MHz	+29.9 ft	+9.1 m	30.5 ft
GA ARES Sunday Net	3.975 MHz	+26.4 ft	+8.0 m	27.0 ft

Your antenna tonight is 80m-ready.
The outboard ends of the 40m extensions are just waiting for more links.

How to add the extension

- **Cut 2 wires to length + 6" for trimming**
- **Male bullet connector on inboard end**
- **Plug onto outboard ends of 40m extensions**
- **Same 3D-printed link spacers**
- **Hang, tune — trim to SWR as usual**

Let's Build!

- Grab your wire and parts — everything is pre-cut to start length
- We'll walk through each step together
- Ask questions any time
- RigExpert tuning station available once you're assembled
- Optional on-air test after tuning
- Questions after? W4KIB — kevin@w4kib.com