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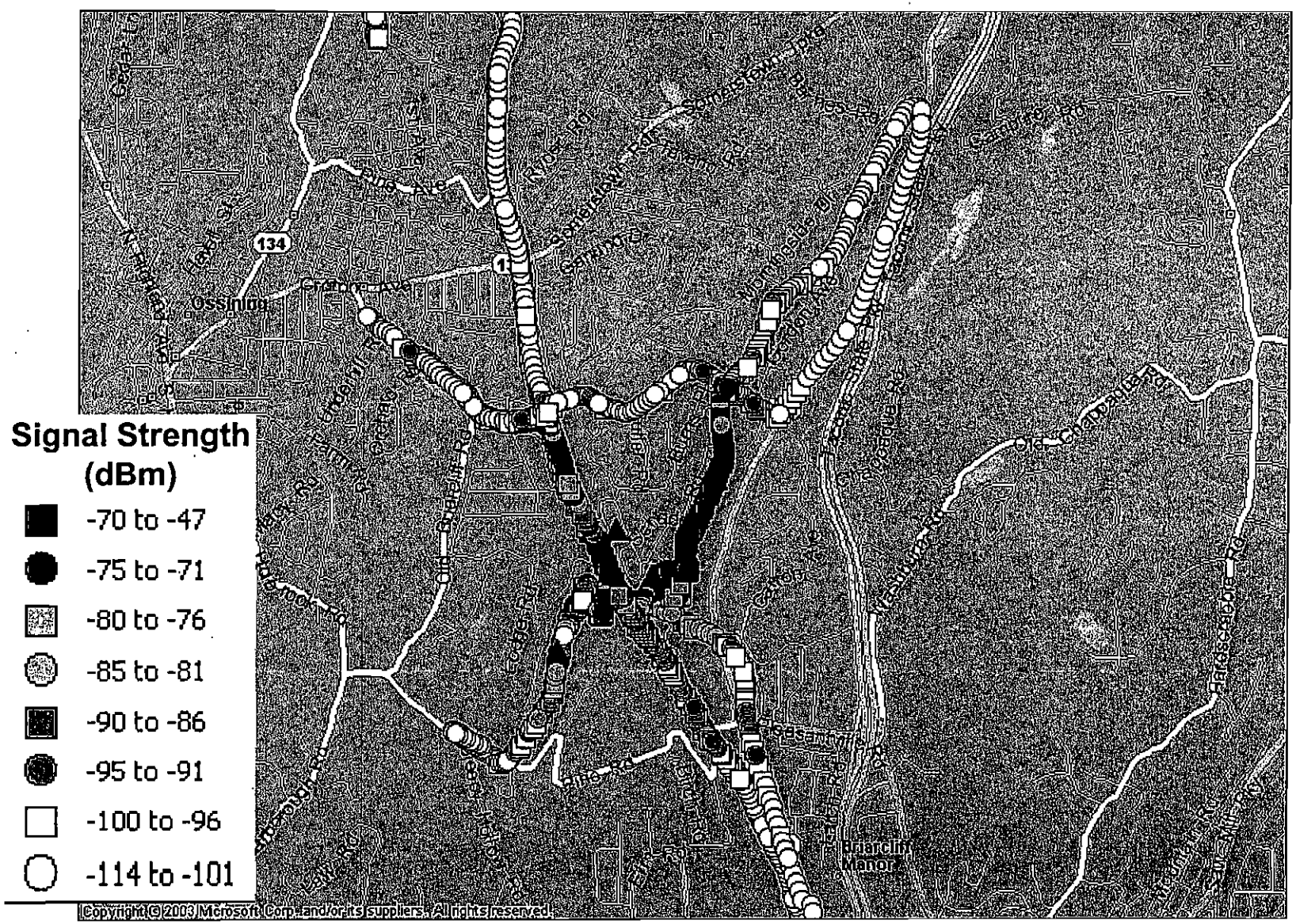
Briarcliff Manor Signal Strength Map at 21.2 MHz
(Unnotched Amateur Band)



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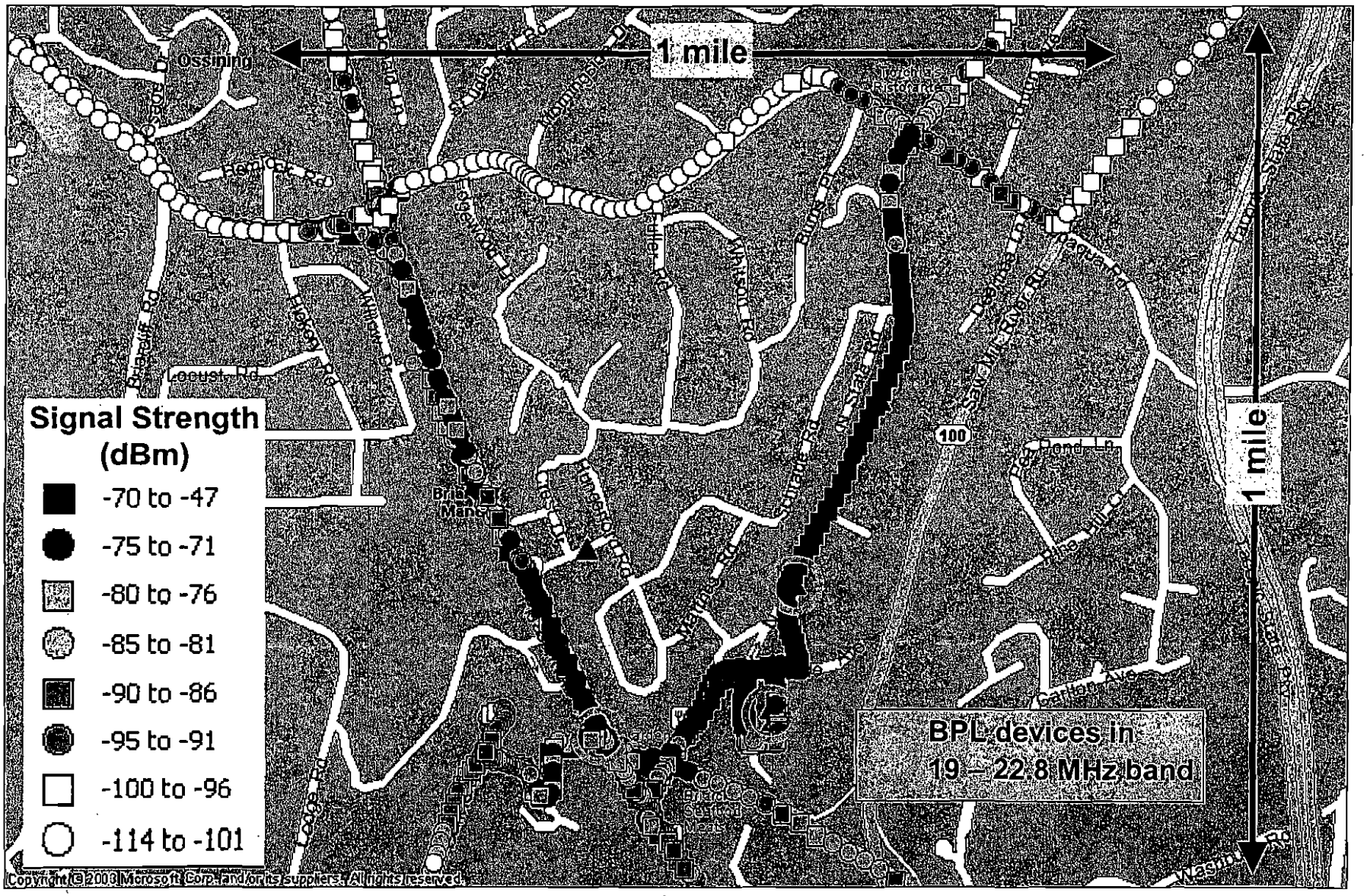
Briarcliff Manor Signal Strength Map at 21.2 MHz
(Unnotched Amateur Band)



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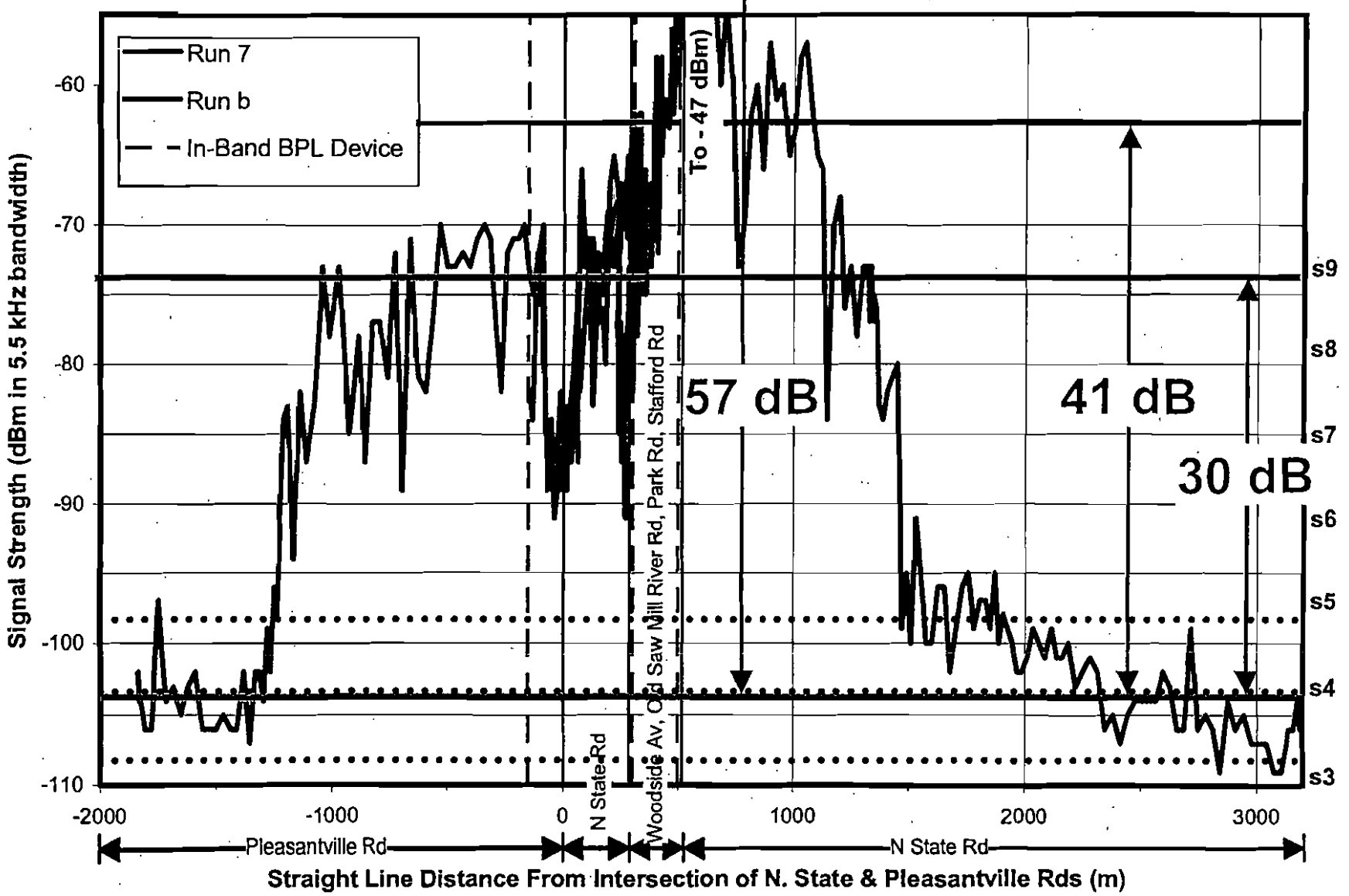
Briarcliff Manor Received Levels at 21.2 MHz

(Unnotched Amateur Band)



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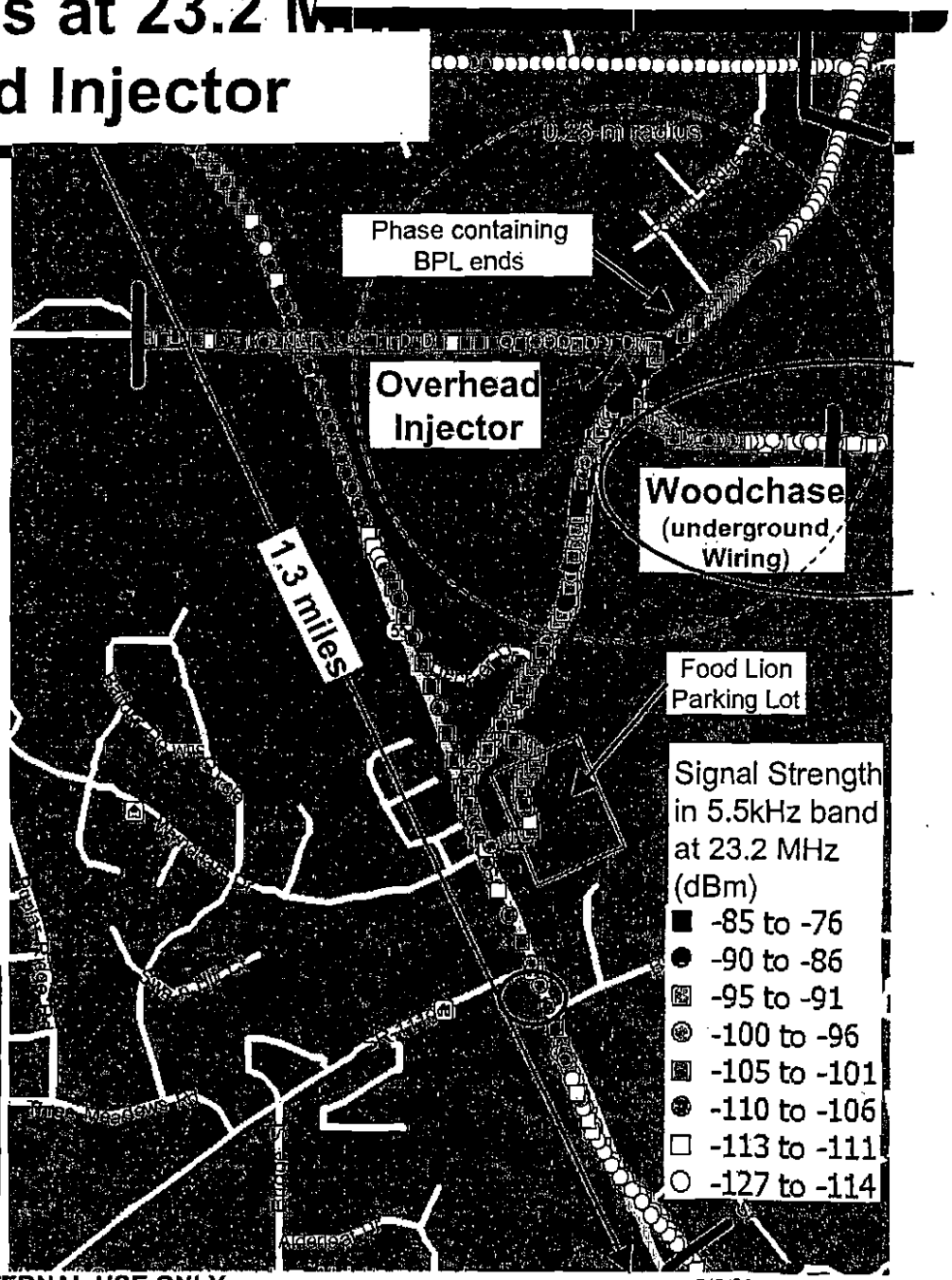
Raleigh Received Levels at 23.2 M[redacted] From One Overhead Injector

- **Noise floor measurement prevented by inefficient antenna**
  - Designed for 27-MHz
- **Yellow levels** (0.6 mi of James Slaughter Rd & Old Powell Rd)
  - 14 to 23 dB above measurement floor
  - **~27 – 36 dB** above probable ambient noise floor
- **Red levels**
  - 24 to 38 dB above measurement floor
  - **~37 to 51 dB** above probable ambient noise floor

s-0 level observed on s-meter during much of test, is ~13 dB below floor of digital output indicator (-114 dBm)



Probable noise floor increases are comparable to Briarcliff Manor:

- 30 dB for ~0.5 mile of road per in-band BPL device
- Larger increases occur near the device

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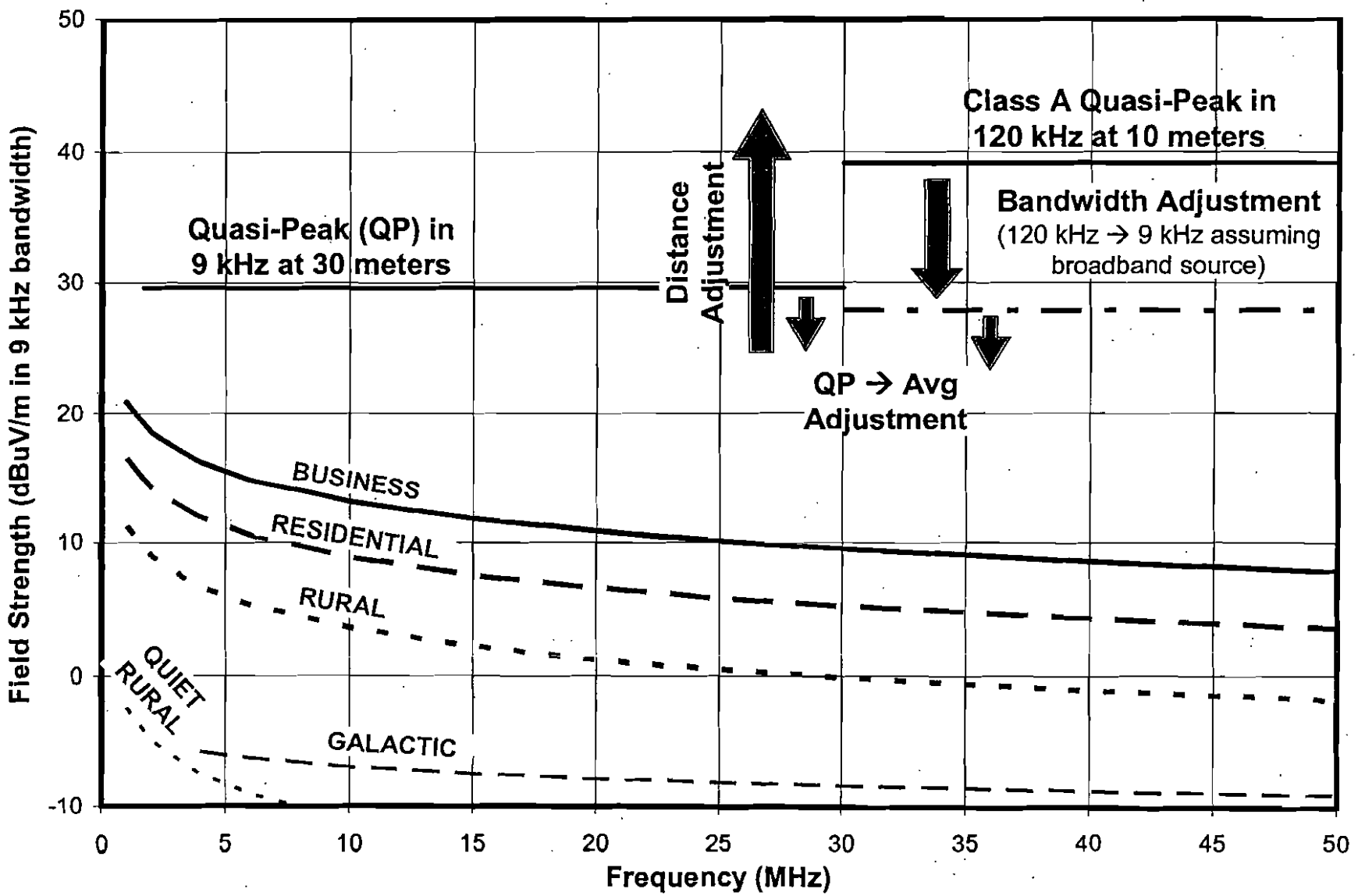
Part 15 Emission Limits and ITU Noise Curves



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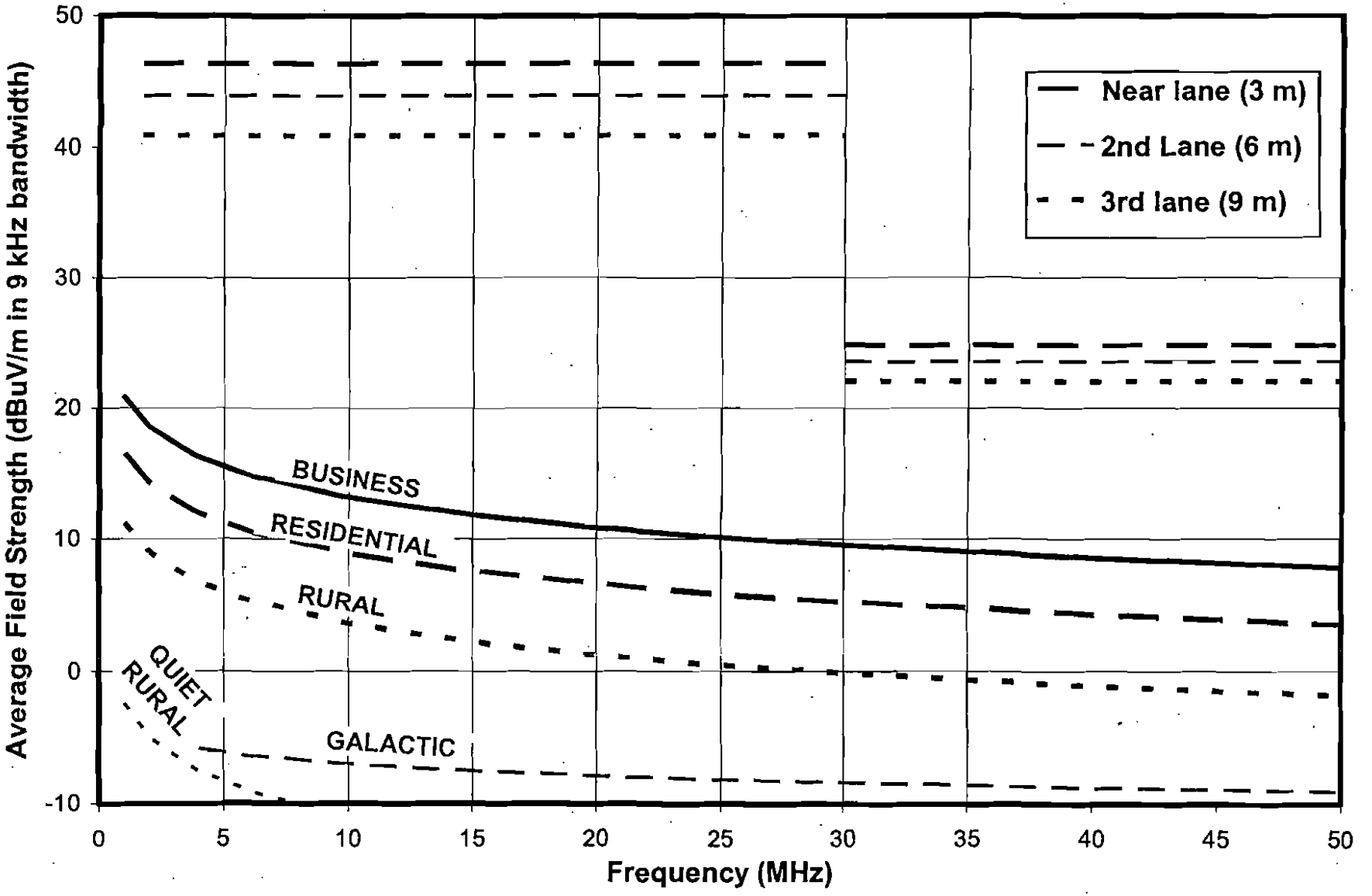
Part 15 Emission Limits Extrapolated to Land Mobile Distances From Power Lines



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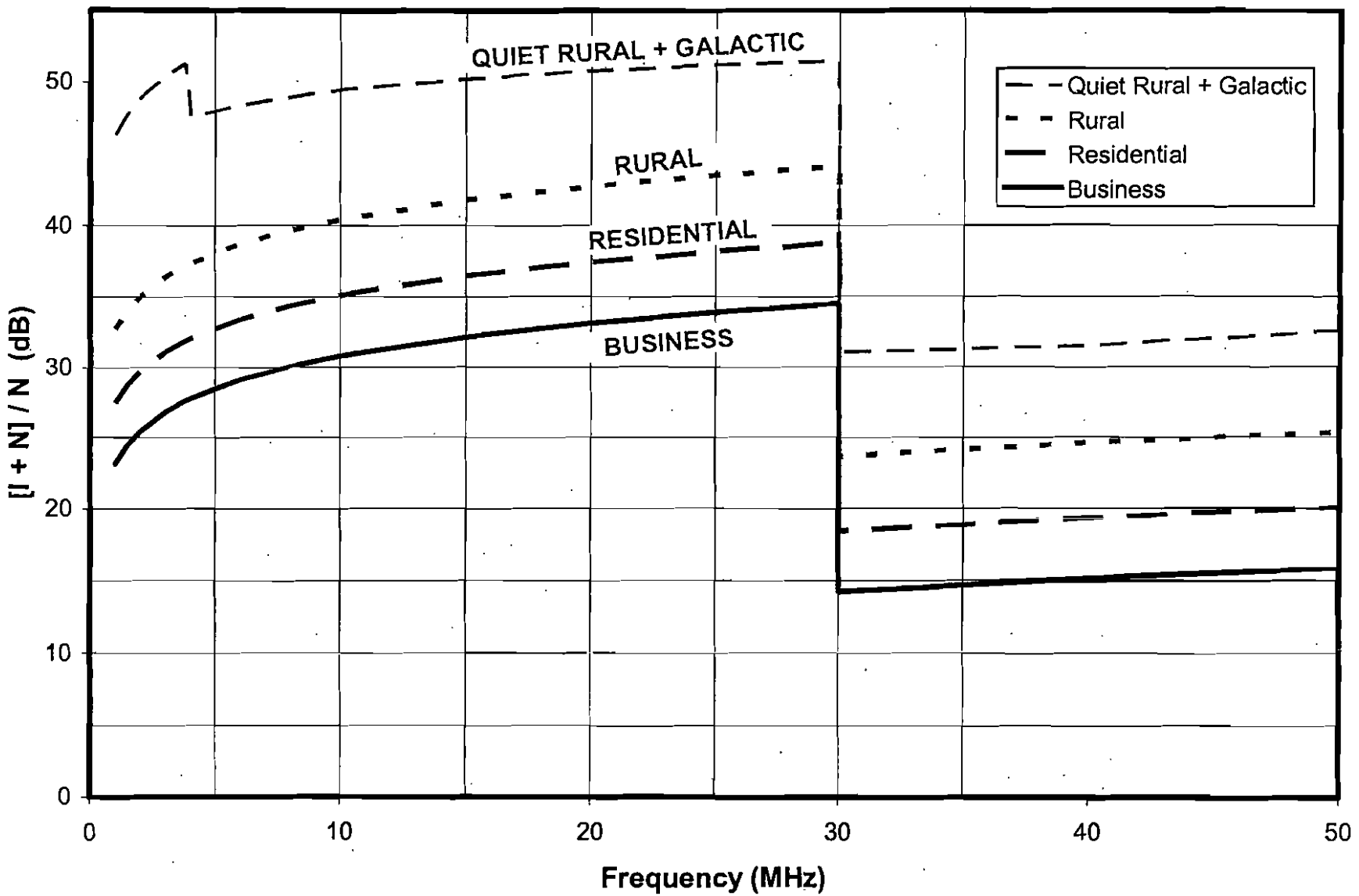
Mobile Radio Noise Floor Rise ([I+N]/N) Permitted by Current BPL Emission Limits



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NTIA Results

- **NTIA predictions are consistent w/FCC measurements**
  - In ITU ***Residential*** noise, BPL increases noise floor for land mobile ***<15 meters*** horizontal distance from power line by
    - 30 dB at mid/upper HF
    - 10 dB above 30 MHz

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% of Points Exceeding Specified Interference Level for Land-mobile Receiver Along 340-meter BPL Power Line (NTIA Report Vol I, Table 6-3)

Frequency (MHz)	3 dB (I+N)/N	10 dB (I+N)/N	20 dB (I+N)/N	30 dB (I+N)/N	40 dB (I+N)/N	50 dB (I+N)/N
4	99.3%	93.2%	54.7%	6.2%	0.0%	0.0%
15	99.8%	99.7%	95.7%	59.5%	4.3%	0.0%
25	99.8%	99.0%	92.1%	58.5%	18.5%	0.0%
40	87.9%	49.2%	10.0%	0.0%	0.0%	0.0%

- **NTIA measurements: ambient noise levels < ITU *Residential* Hence, BPL increases noise by more than predicted above**

  "The occasional sampling of environmental noise power levels ... with the BPL system turned off were lower than the levels predicted by ITU-R Recommendation P.372-8. Thus, ... use of the higher noise power levels predicted by ITU-R Recommendation P.372-8 in our analyses may bias results toward underestimation of interference levels."

- ***NTIA would have argued to protect it's HF mobile assets, but...***

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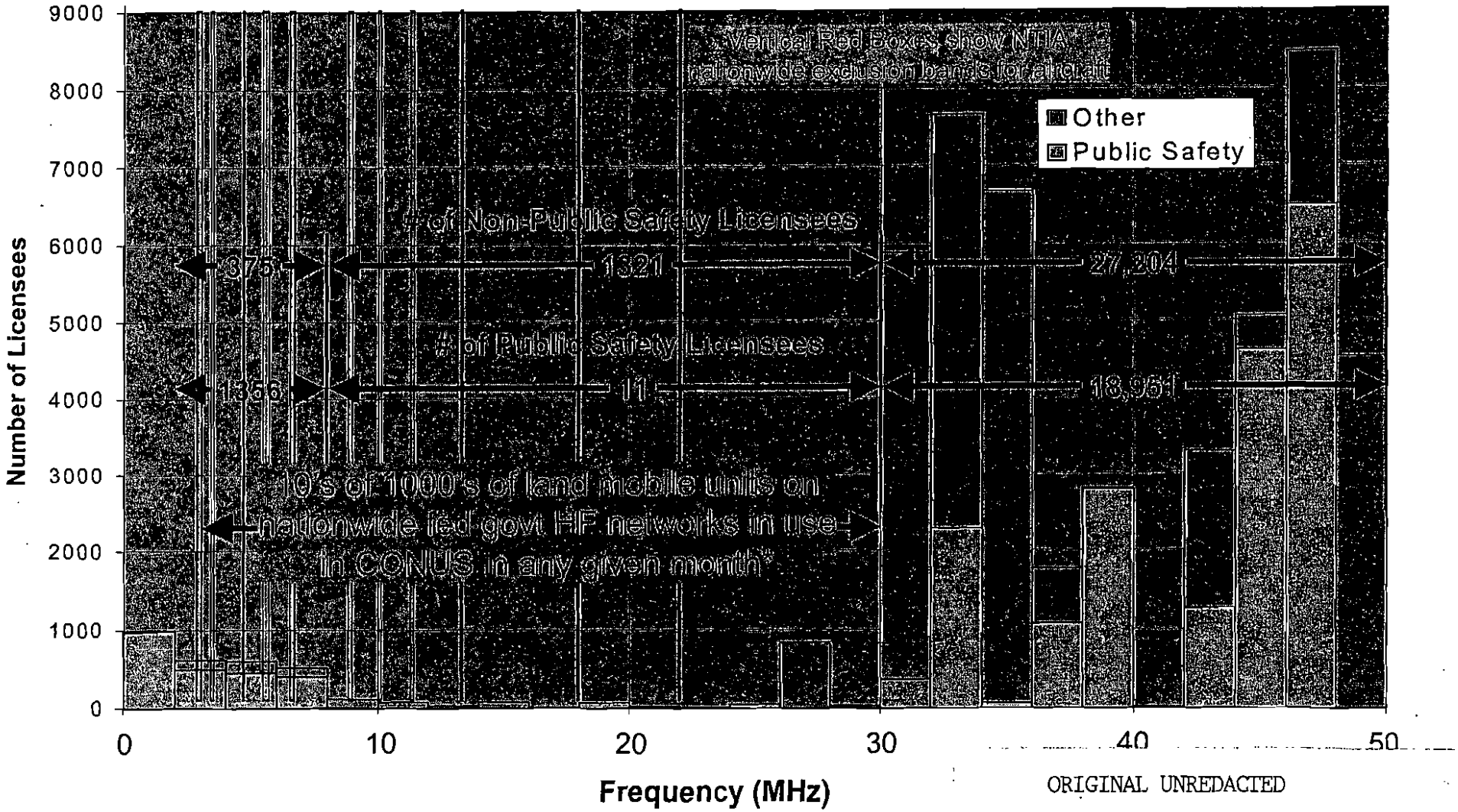
of Part 90 Land Mobile Licensees

by Band in 2-MHz Increments



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* - E.g., Customs Over-the-Horizon Enforcement Network (land mobile in residential neighborhoods)

Other Issues

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Skywave (<30 MHz)

- **NTIA Tech Appendix:**
  - *"it would take **hundreds of thousands** of Access BPL devices [nationwide] operating under existing rules to cause a 1 dB increase in median noise."*
- **This assumed ITU *Residential noise* levels**
- **With Quiet Rural/Galactic noise levels, …**
  - *# of devices is reduced by a factor of ~24*
  - *Factoring uncertainty, problems could occur as soon as next year*

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NTIA sees need for a follow-on NPRM to possibly limit deployment densities or impose other restrictions on Access BPL in HF (<30 MHz)

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New Information Arguing for Caution on HF BPL

- **Strong fields follow the power line for 0.5 mile. Not a point source.**
- **Emerging ARINC / PHONEX carrier-current case [for internal FCC discussion only]**
  - ARINC interference now traced to carrier current devices. Interference distance at least 5 miles
  - ARINC and ***most FCC DF stations*** ***are affected***
  - Emissions are believed to exceed limits, but compliant BPL may be worse, because…

	Phonex Carrier Current	Access BPL
Radiator	House wiring → 20-30 m extent	Overhead power lines → 800 m extent
# of com channels overlapped	2	~1500

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What To Do

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HF Issues and Options

1a) Ban BPL in HF on overhead MV lines
(Permit in-house and underground access BPL in HF)

- Protects HF land mobile
  - NTIA did not request protection of federal HF nationwide networks, but…
- Eliminates skywave risk
- **Eliminates interference between HF in-house BPL and access BPL**

2a) Impose 5 dB height correction & 20 log R extrapolation
(6-dB hit)

- Postpones skywave problem
- Reduces interference to fixed stations

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3a) No change

Note: w/options 2a or 3a, NTIA sees need for a follow-on NPRM to possibly limit deployment densities or impose other restrictions

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Low VHF Options

30 – 50 MHz

1b) Require *notching* for some or all local public safety

2b) Require *coordination* for some or all local public safety

50 – 54 MHz (amateur band; 51 – 54 MHz is used mobile)

1c) ?

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BPL Spectrum Tradeoffs and Proposal

		2 – 8 MHz	8 – 30 MHz	30 – 50 MHz	50 – 54 MHz	54 – 72 MHz
RULES & PHYSICS	[I + N] / N for Mobile Radio	High	Very High	Moderately High	Moderately High	Moderately High
	Skywave Propagation	Yes	Yes	Very Little	None	None
	Ix Distance to Fixed Station (1 BPL device, 50%, 3dB ITU Residential)	62 m	400 m	54 m		
POTENTIAL LOCAL VICTIMS	Public Safety Mobile	1,356 licenses	11 licenses	18,951	2	5
	Other Mobile	375 licenses	1,321 licenses	27,204	26	31
	Federal Mobile	10's of thousands in CONUS		Fewer, Less Critical & Vulnerable	?	?
	Amateurs	Yes	Yes	None	Yes	None
	Broadcast Services	Shortwave	Shortwave			TV Ch 2-4

Proposal

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- **Near Term**
  - **Overhead BPL** — Effective Limit: -5 dB (Height) -6 dB (20 log)? — 30-54 MHz w/local public safety notched
  - **Underground BPL** — 2-54 MHz
- **Far Term**
  - Allocate a VHF band for BPL (e.g., abandoned low-VHF TV channels)
  - Raise emission limits in that band

TBD

BPL Emission Tests
Near Raleigh, North Carolina
June 28 – July 2, 2004

August 4, 2004

Steve Martin & Andy Leimer – FCC Laboratory

On site support: Joe Husnay & Luther Bolden – FCC Norfolk Resident Agent Office
Radio, GPS, S/W, & expertise: Dave Larrabe & Jim Higgins – FCC Monitoring Station

Outline

- Introduction
- Compliance with Emission Limits
- Emissions at Unprotected (Un-notched) Frequencies
- BPL Notch Effectiveness
- Fixed Amateur Sites

Introduction

- **Tests of emissions from BPL systems deployed near Raleigh, NC were performed in response to complaints of interference to**
  - mobile amateur radio in the vicinity of three BPL installations
  - three fixed amateur installations at homes located 0.4 to 0.7 miles from overhead BPL installations

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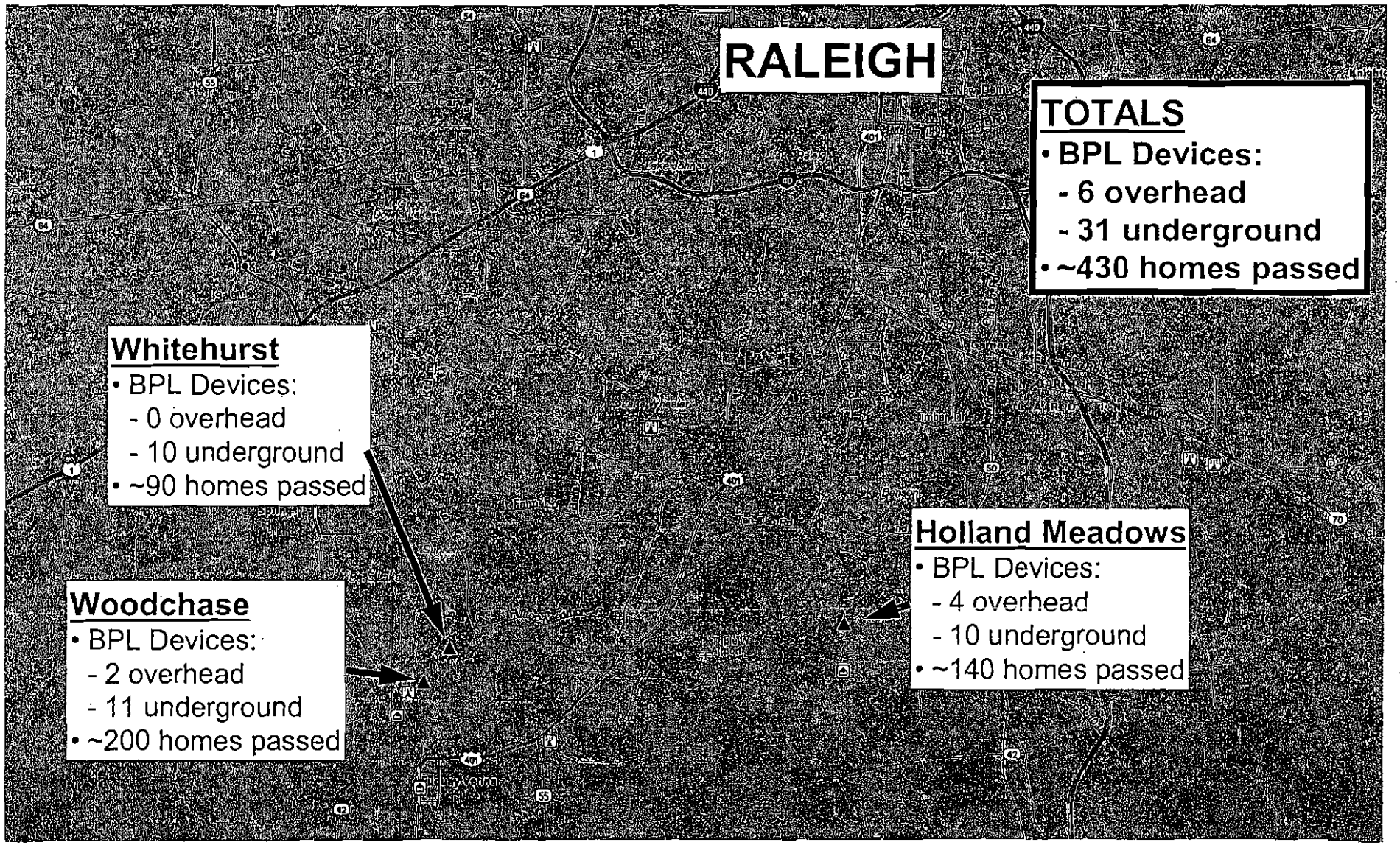
Amperion/Progress-Energy BPL Deployments Near Raleigh



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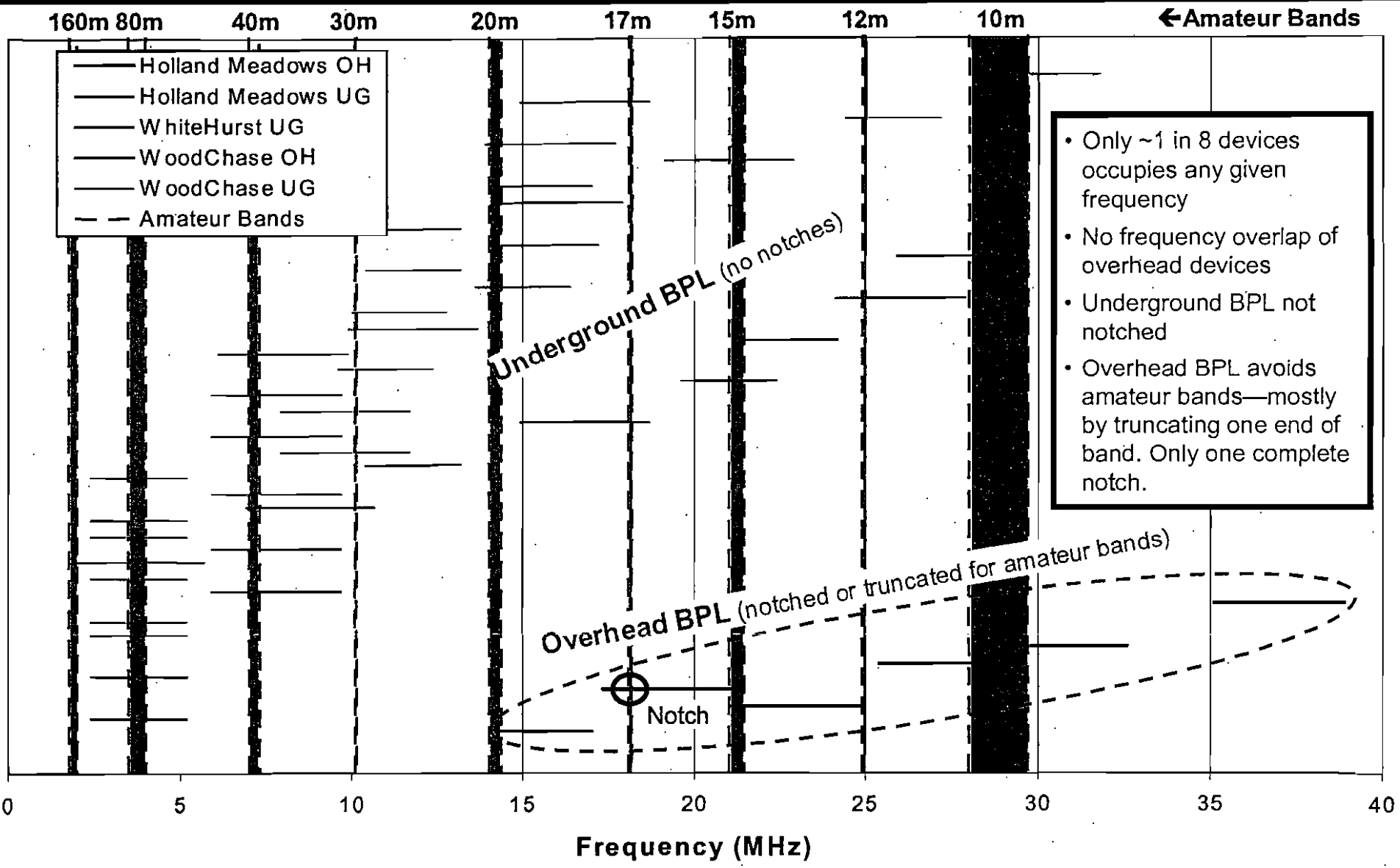
BPL Device Frequencies in Raleigh Deployments



- Only ~1 in 8 devices occupies any given frequency
- No frequency overlap of overhead devices
- Underground BPL not notched
- Overhead BPL avoids amateur bands—mostly by truncating one end of band. Only one complete notch.

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Amperion BPL System

- **Unusual Design Characteristics**
  - Frequency division multiplexing with relatively small bandwidth per device (2.75 or 3.75 MHz)
  - WiFi link to customers--No use of low voltage lines
    - Minimal emissions from building wiring ➔ few above-ground emission sources where power lines are underground
- **Other Characteristics**
  - OFDM
  - Remote band selection & Remote "notching" by omitting OFDM carriers

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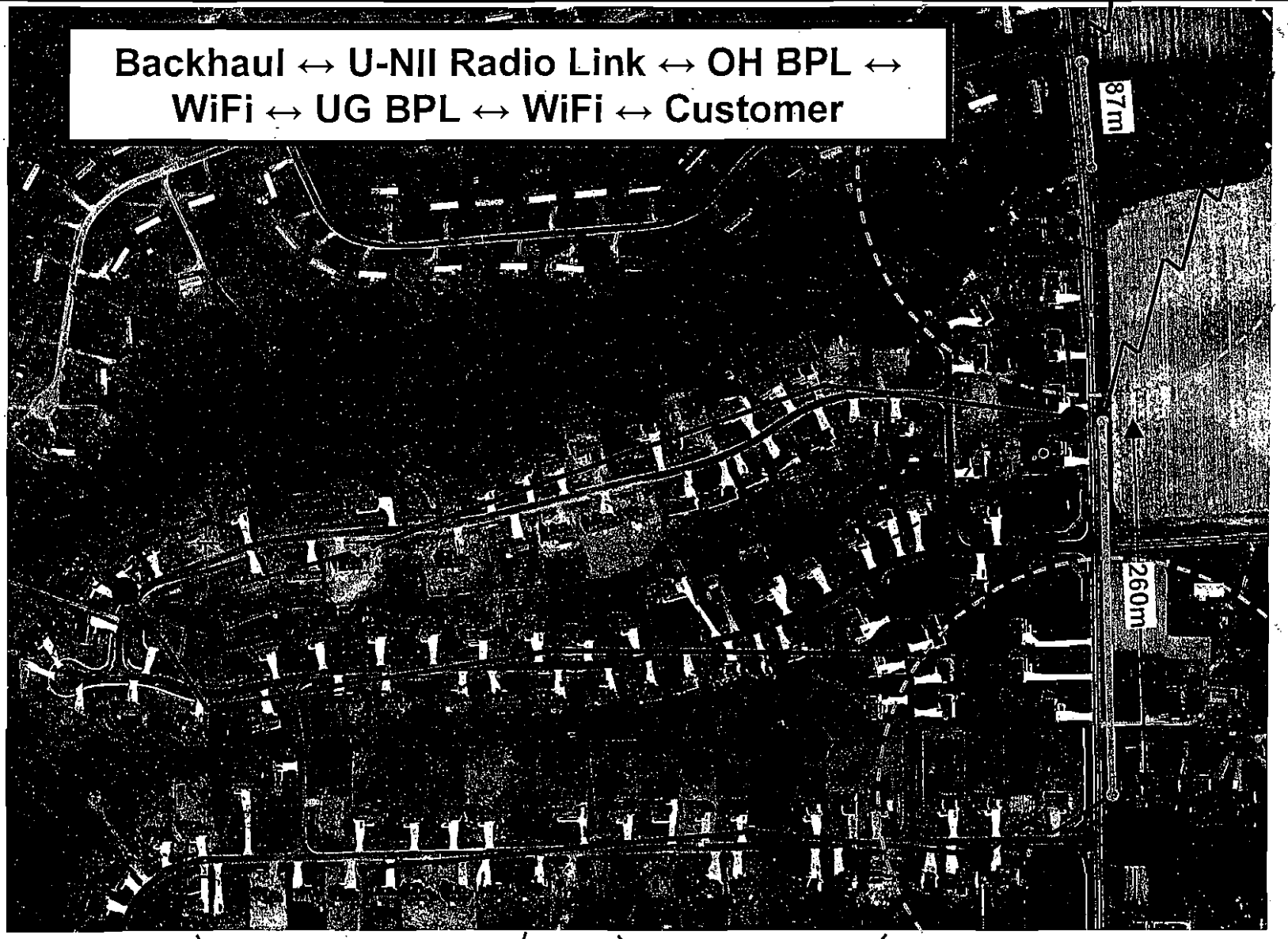
Network Topology at Holland Meadows



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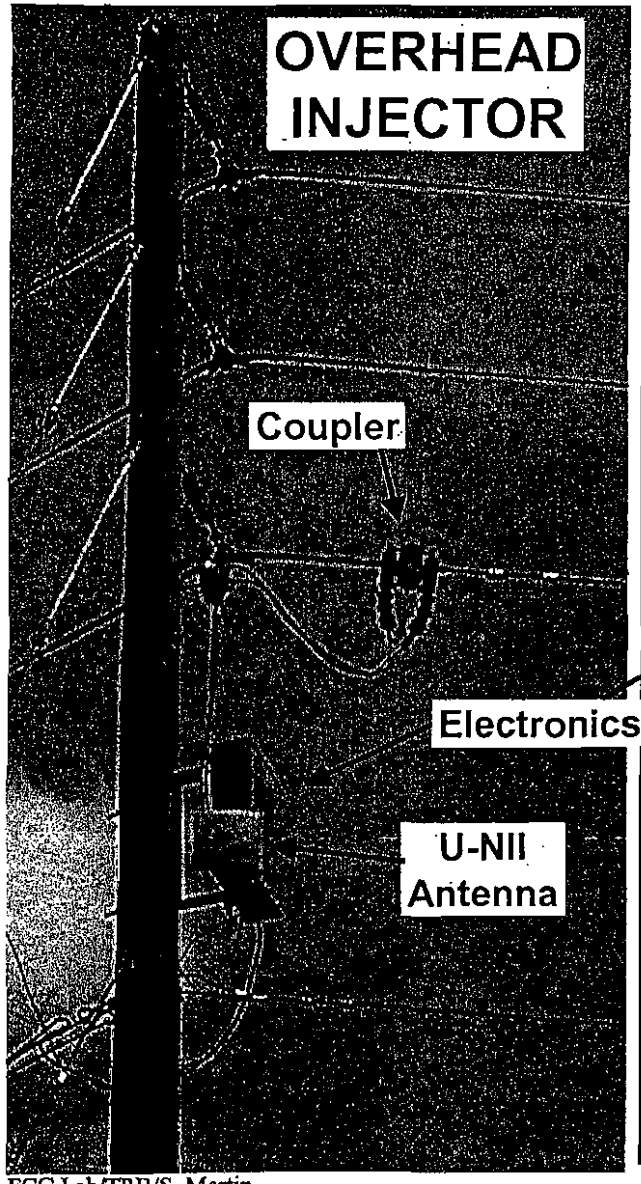
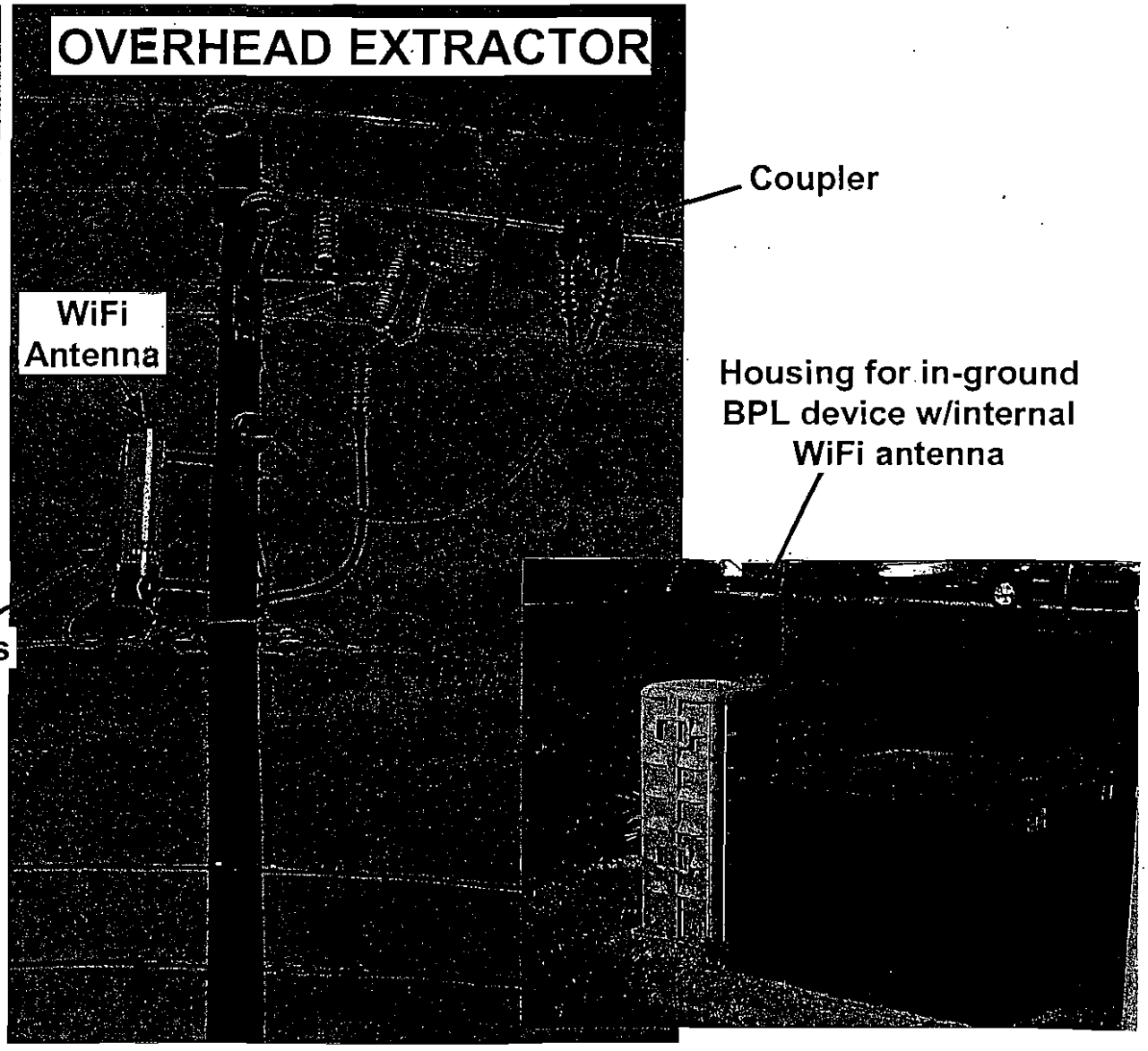
Amperion BPL Hardware





Compliance with Emission Limits