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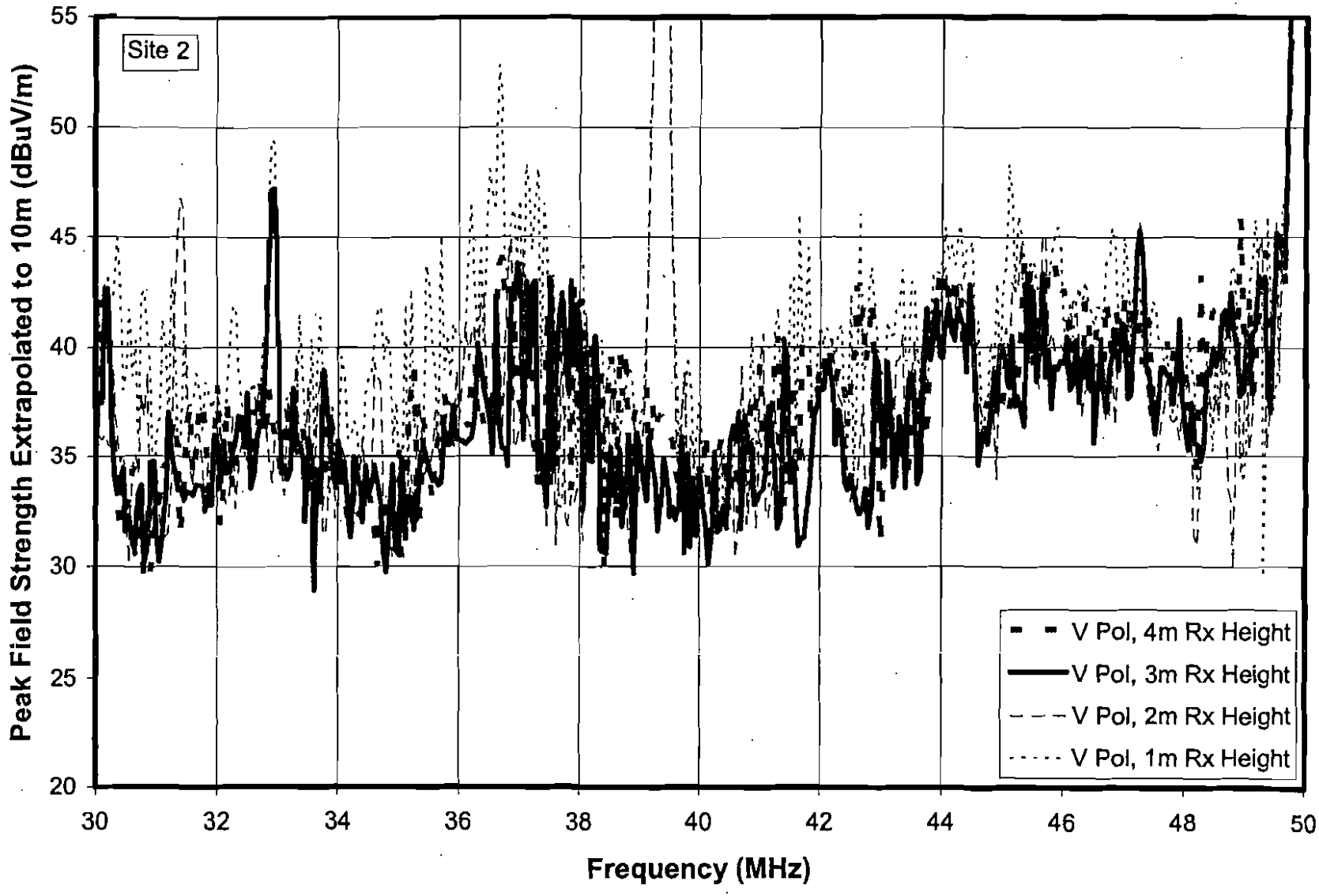
Effect of Rx Antenna Height at Site 2a: Max-Hold Spectra for V Polarization



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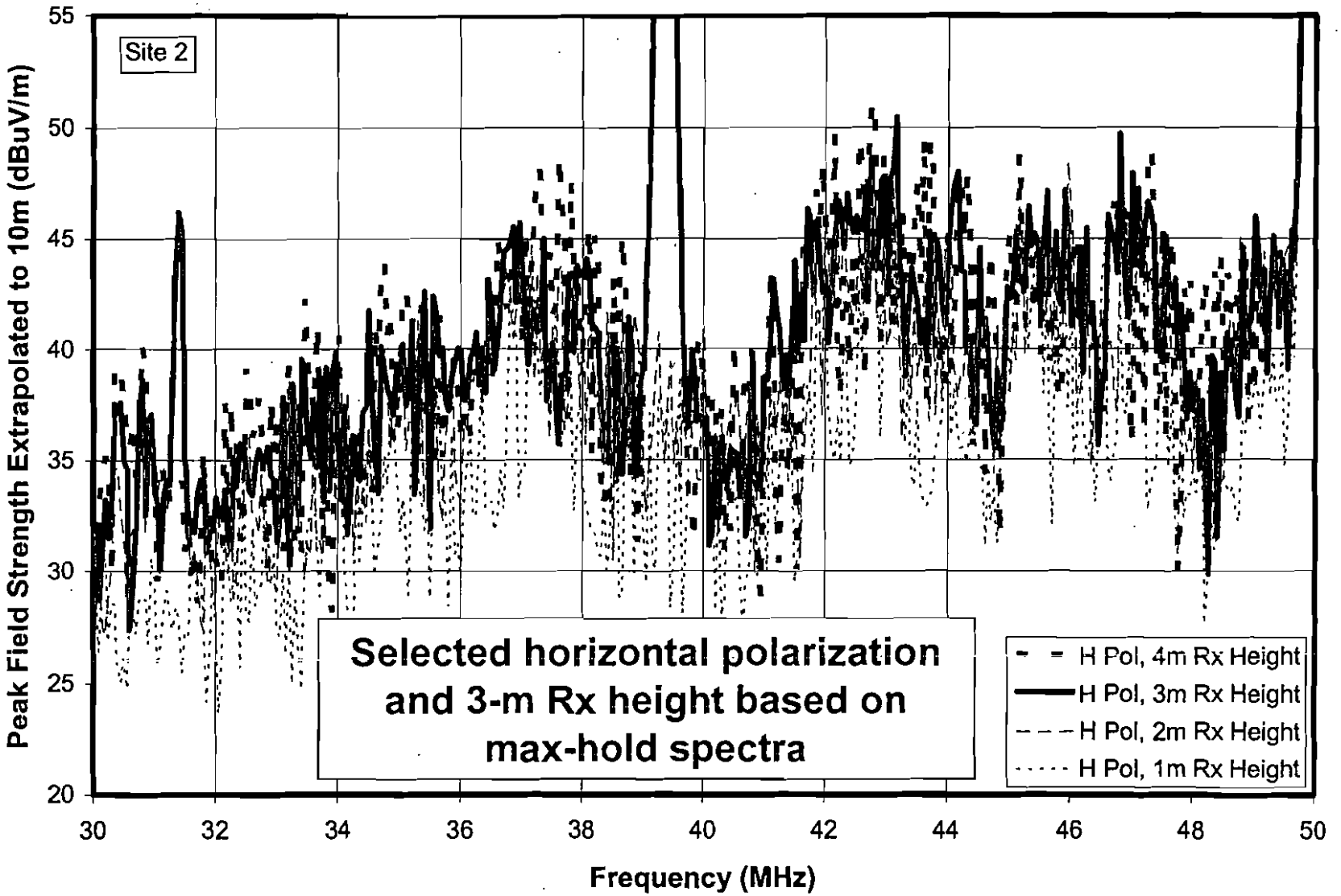
Effect of Rx Antenna Height at Site 2a: Max-Hold Spectra for H Polarization



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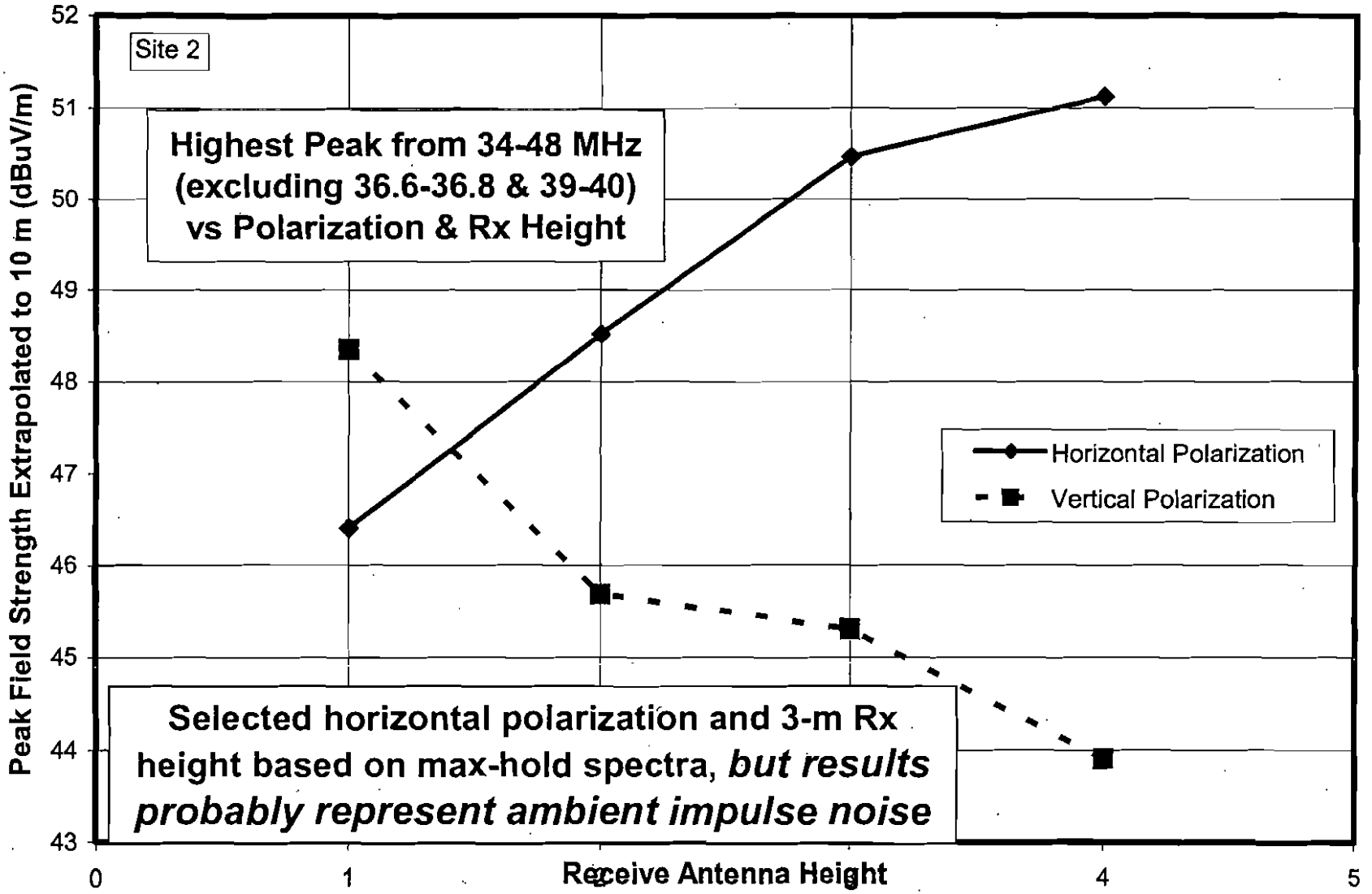
Effect of Rx Antenna Height at Site 2a: Peak Spectrum Level



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Temporal Measurements

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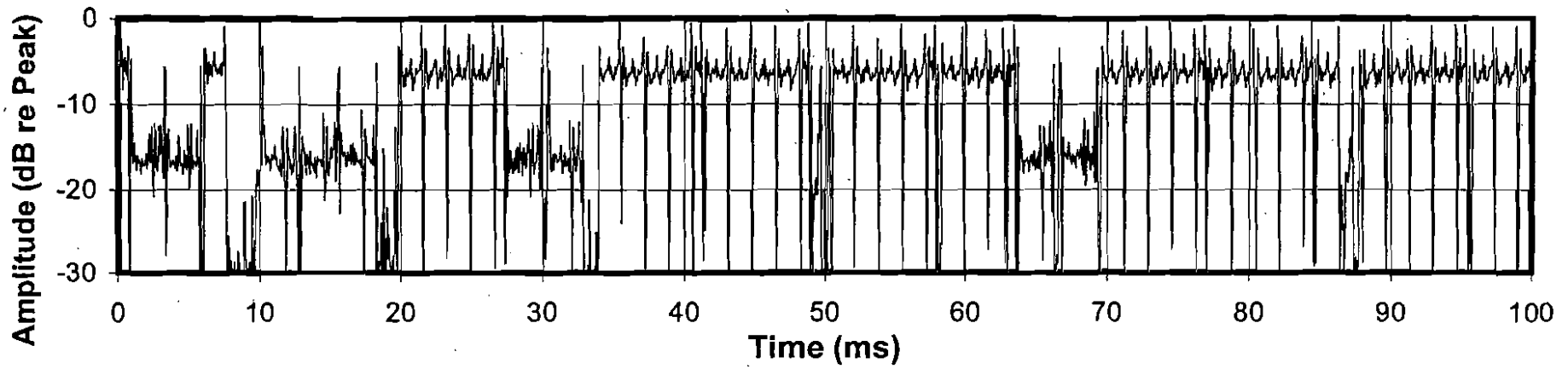
Temporal Measurements: DUT 1, Site 1



- **Desired measurement conditions achieved**
  - Requirement for >20 Hz rep-rate achieved
  - Percentage of 61-μs temporal bins containing BPL signals = 69% (avg of three, 0.5-second intervals, with signal presence defined by threshold 10 dB below peak)
- **Measurement Setup**
  - Test Config. 2
  - Analyzer settings
    - RBW=3 MHz, VBW=3 MHz
    - Center frequency 36.3 MHz (set to encompass broadband spectral peak)
    - 8192-point sweep with duration 0.5 seconds (61 μsec bin width)

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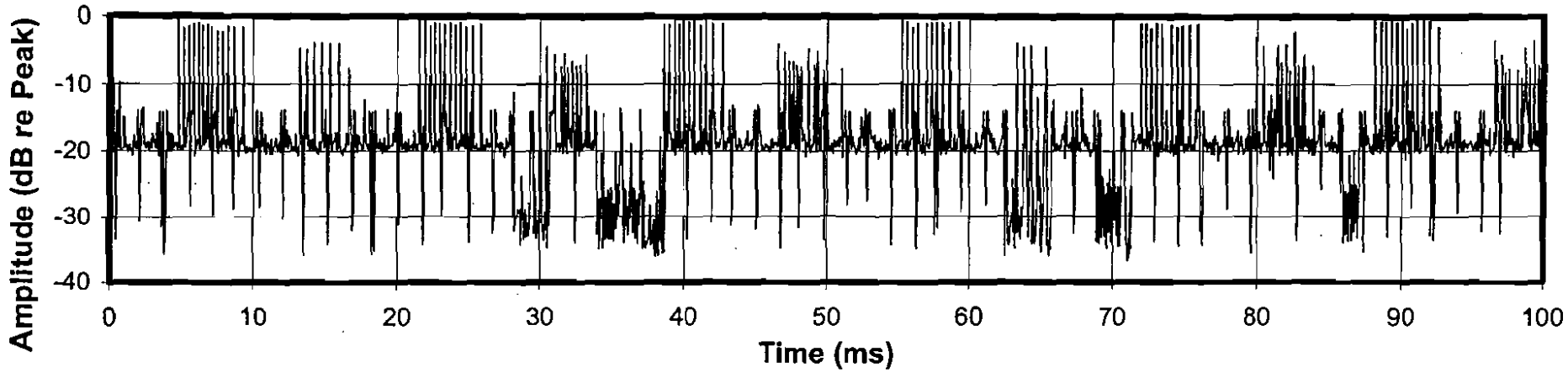
Temporal Measurements: DUT 2, Site 2a



- **Impulse noise exceeds signal level by ~ 15 dB (peak)**
- **Desired PLC signal conditions achieved**
  - Requirement for >20 Hz rep-rate achieved
  - Percentage of 61-μs temporal bins containing BPL signals = 77% (single 0.5-second trace, with signal presence defined by threshold 22 dB below max impulse peak)
- **Measurement Setup**
  - Test Config. 2
  - Analyzer settings
    - RBW=3 MHz, VBW=3 MHz
    - Center frequency 42.7 MHz (set to encompass broadband spectral peak)
    - 8192-point sweep with duration 0.5 seconds (61 μsec bin width)

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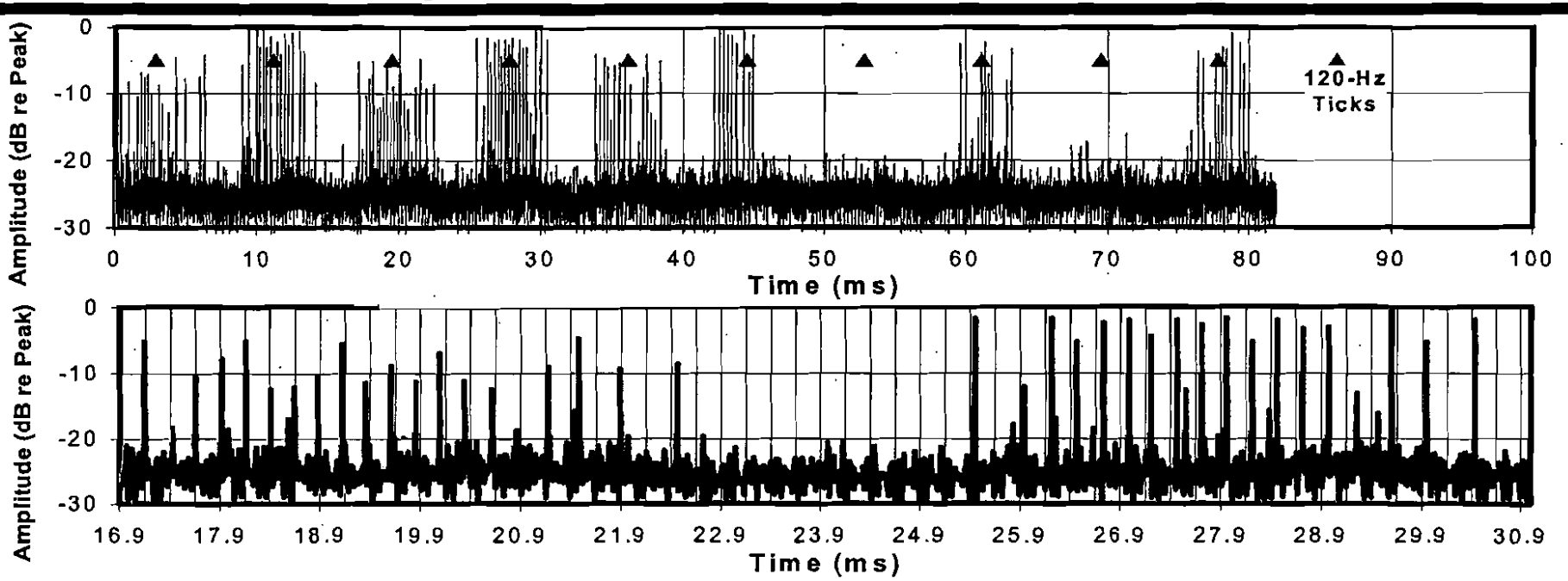
Site 2b—Impulse Noise Measurement (BPL coms terminated)



- **Impulse noise source not identified**
  - High level when measured at Site 2a (25-m downline from DUT), with coms terminated, and outside BPL operating band suggested DUT was not the source
- **Characteristics**
  - 120-Hz burst rate
  - 4.0 kHz pulse rate within a burst
  - 1.3% of 10-μs temporal bins contain impulse signals **(82 ms trace, based on threshold 15 dB below max impulse peak)**
- **Measurement Setup**
  - Test Config. 1, less the bandpass filter
  - Analyzer settings
    - RBW=3 MHz, VBW=3 MHz, Center frequency 50 MHz (set to encompass broadband spectral peak)
    - 8192-point sweep with duration 81.9 ms (10 μsec bin width)

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Site-1 Spectra

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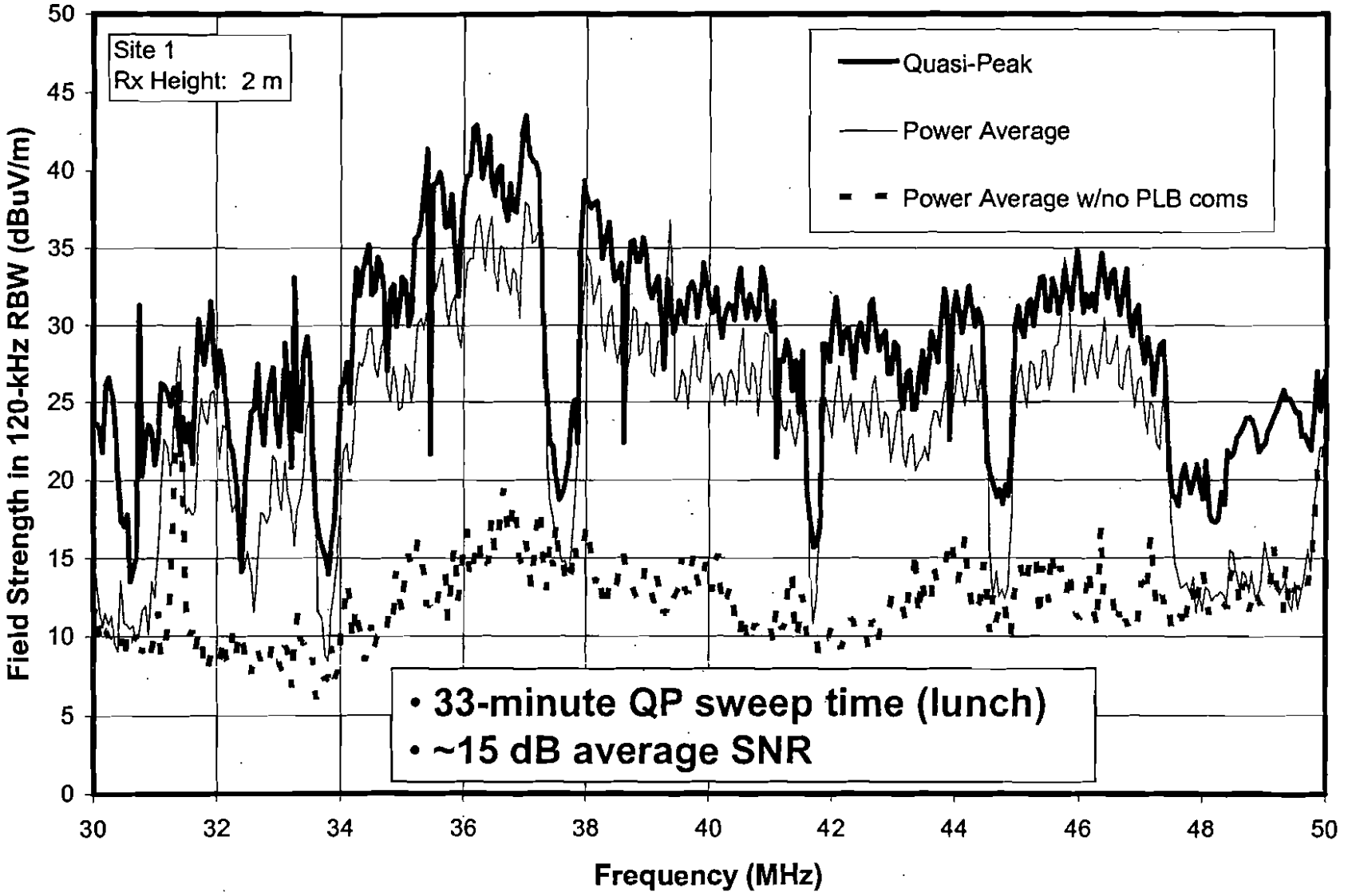
Site 1—Full-Band Quasi-Peak and Average Spectra



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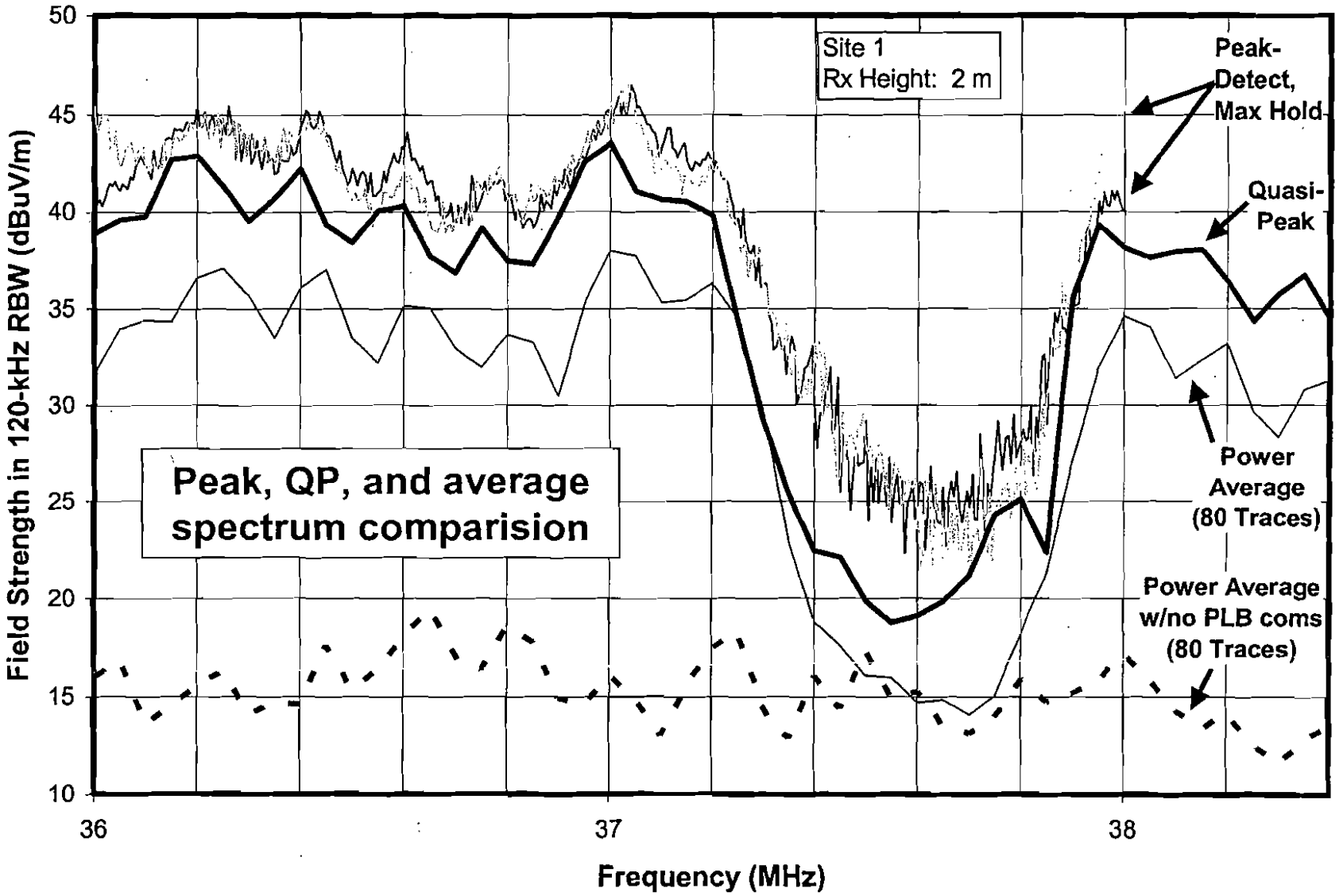
Site 1—Expanded Spectrum Comparison



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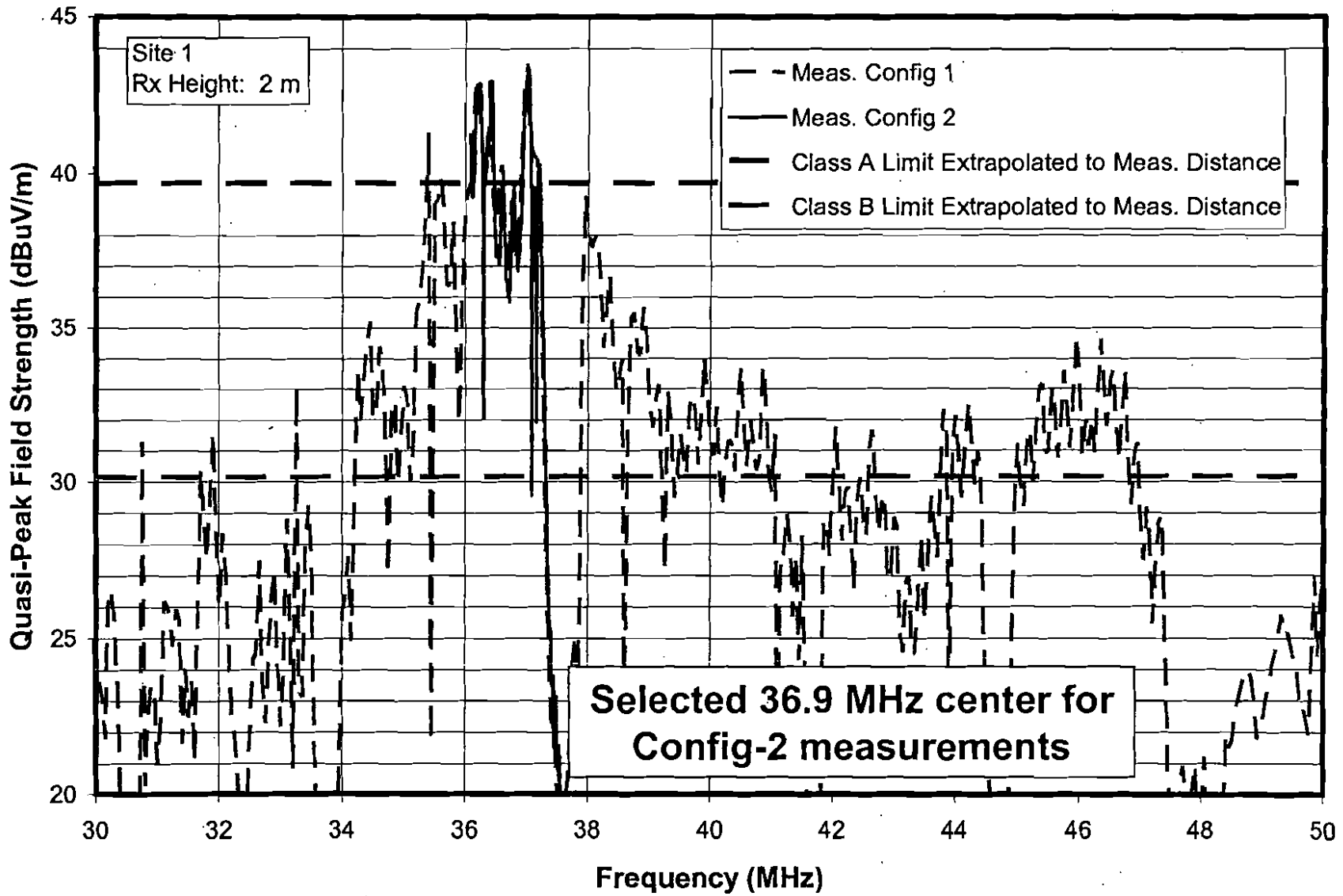
Site 1—Full-Band Quasi Peak Spectra and Limits



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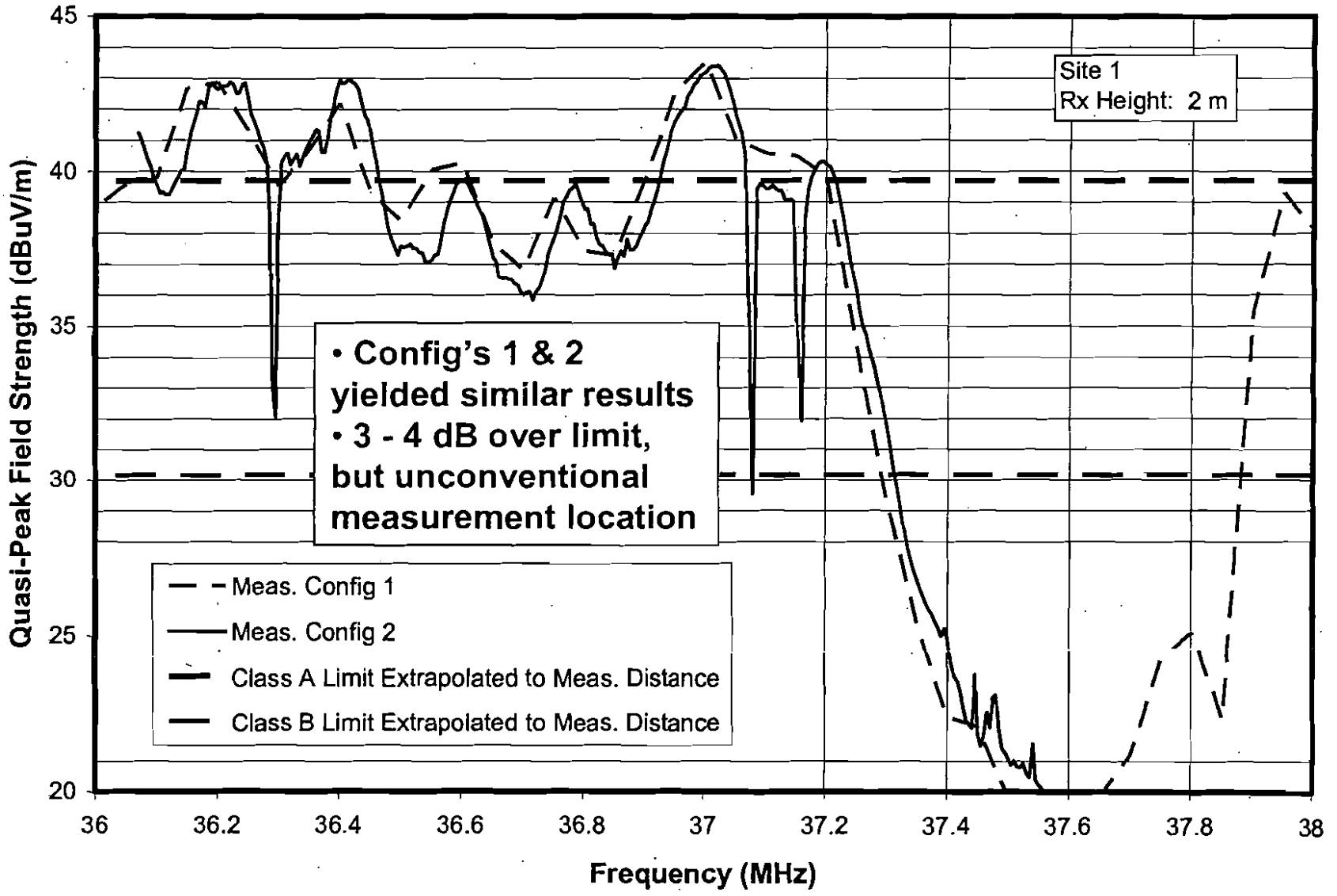
Site 1—Expanded Quasi Peak Spectra and Limits



Site-2 Spectra

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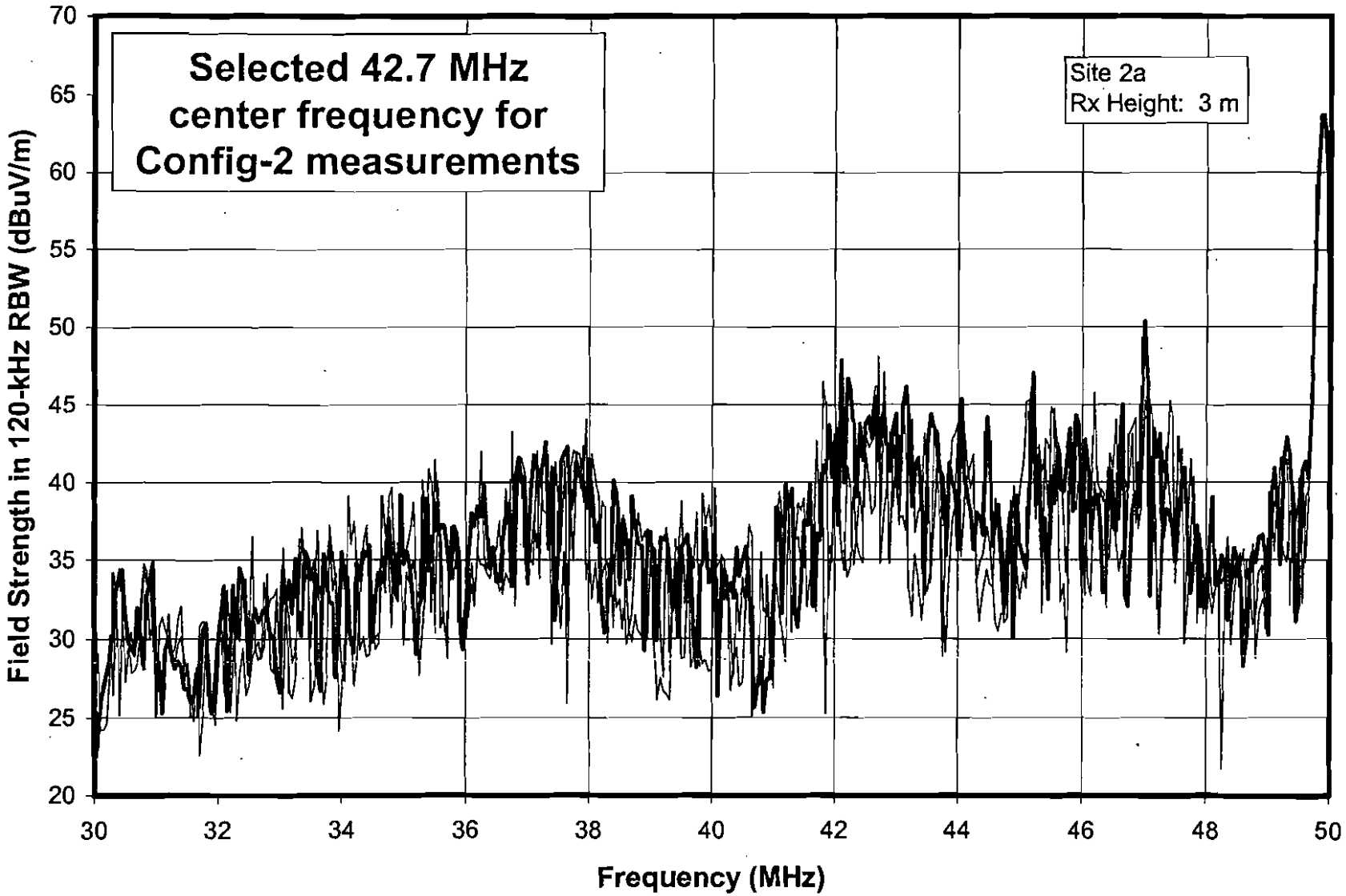
Site 2a—Three Max-Hold Spectra



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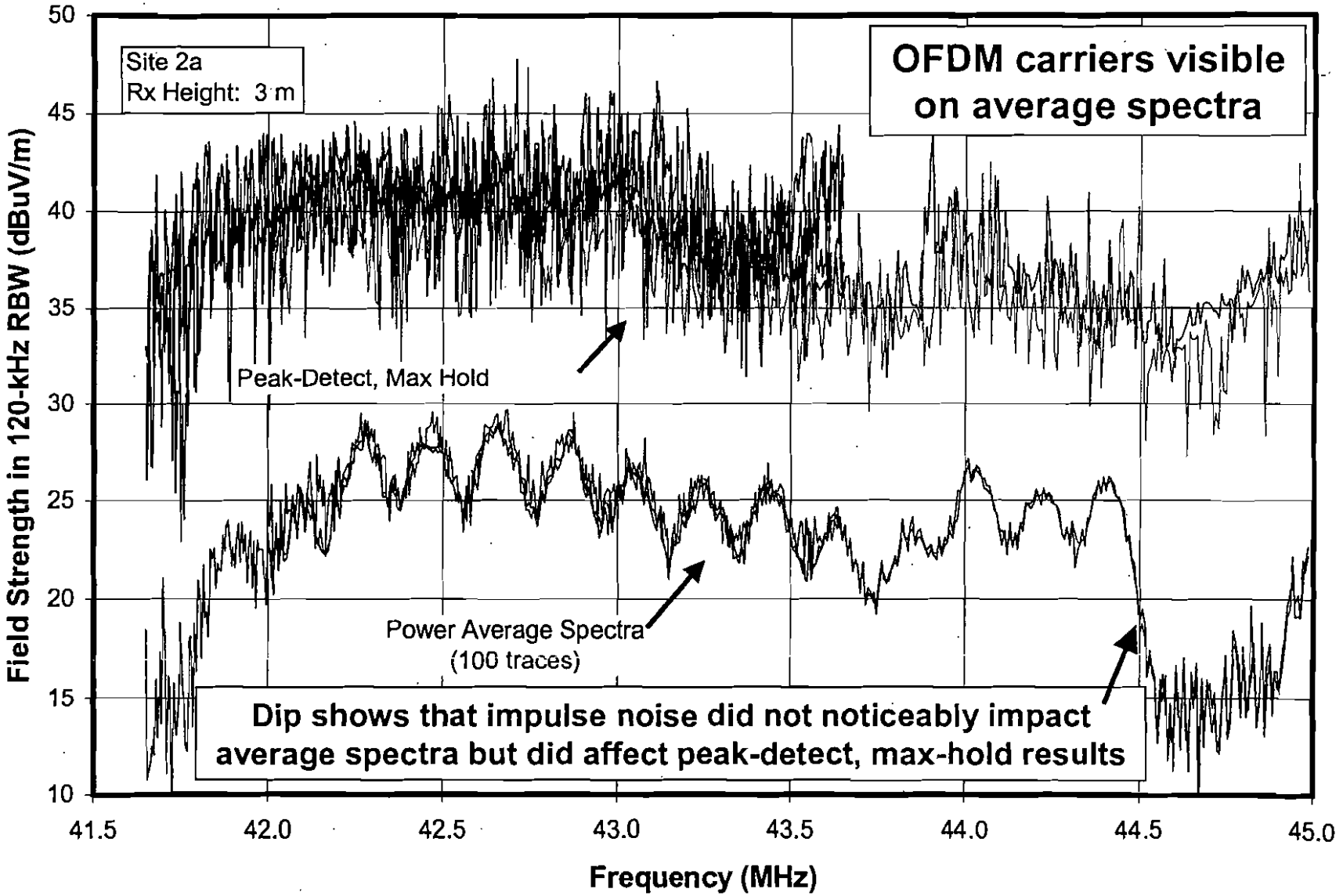
Site 2a—Expanded Max-Hold and Average Spectra



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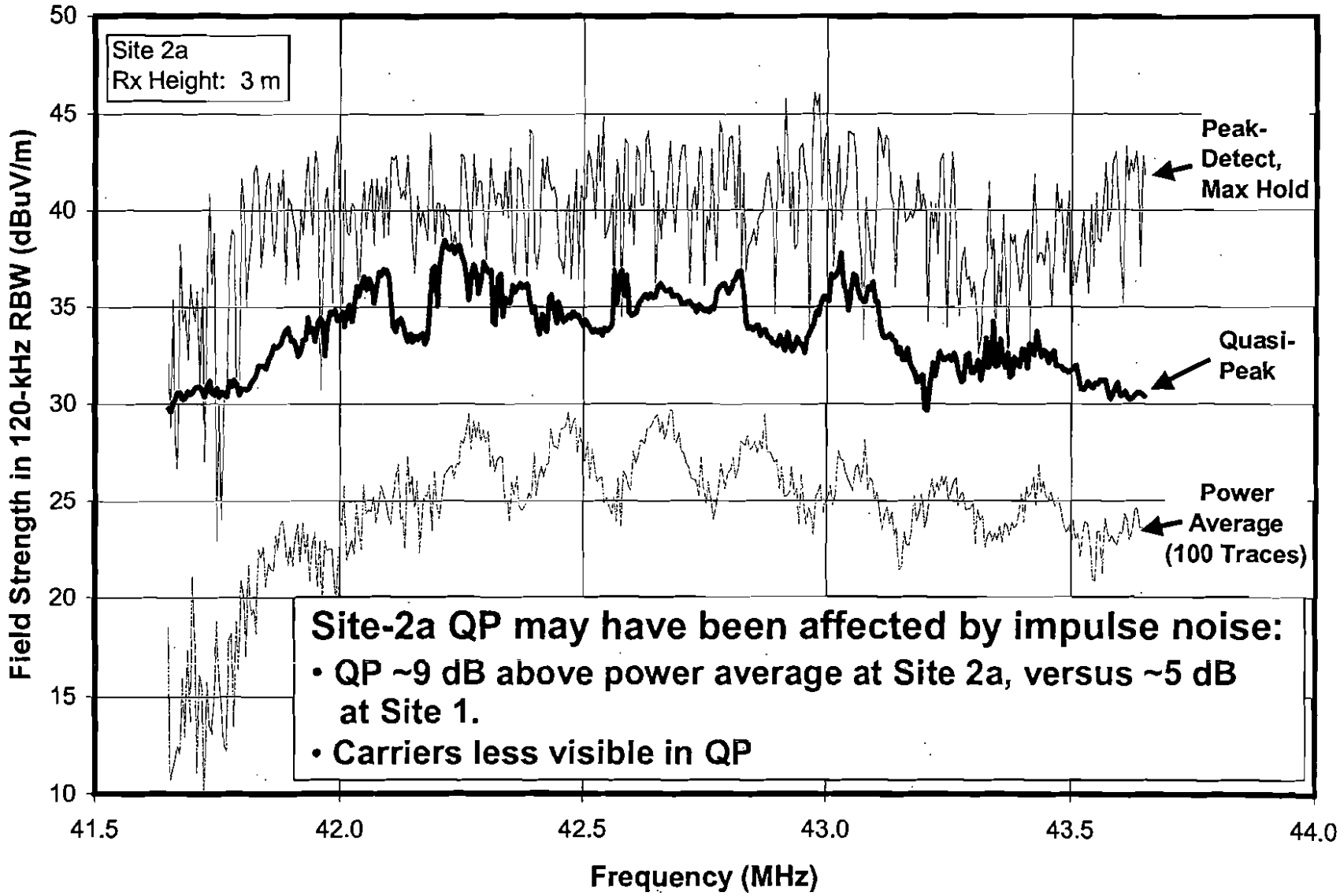
Site 2a—Comparison of Max-Hold, Quasi-Peak, and Average Spectra



Site-2a QP may have been affected by impulse noise:

- QP ~9 dB above power average at Site 2a, versus ~5 dB at Site 1.
- Carriers less visible in QP

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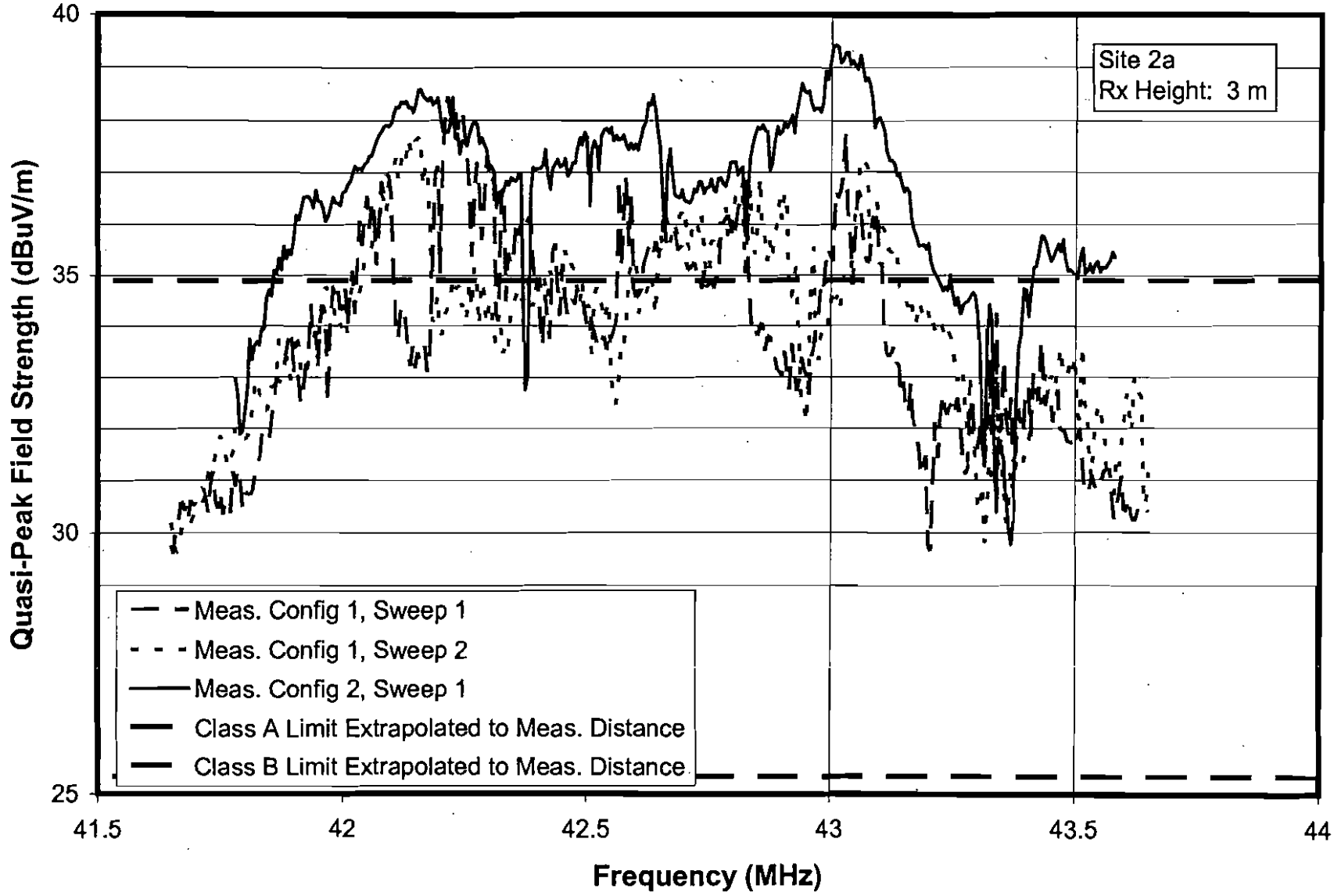
Site 2a—Three Quasi-Peak Spectrum Measurements



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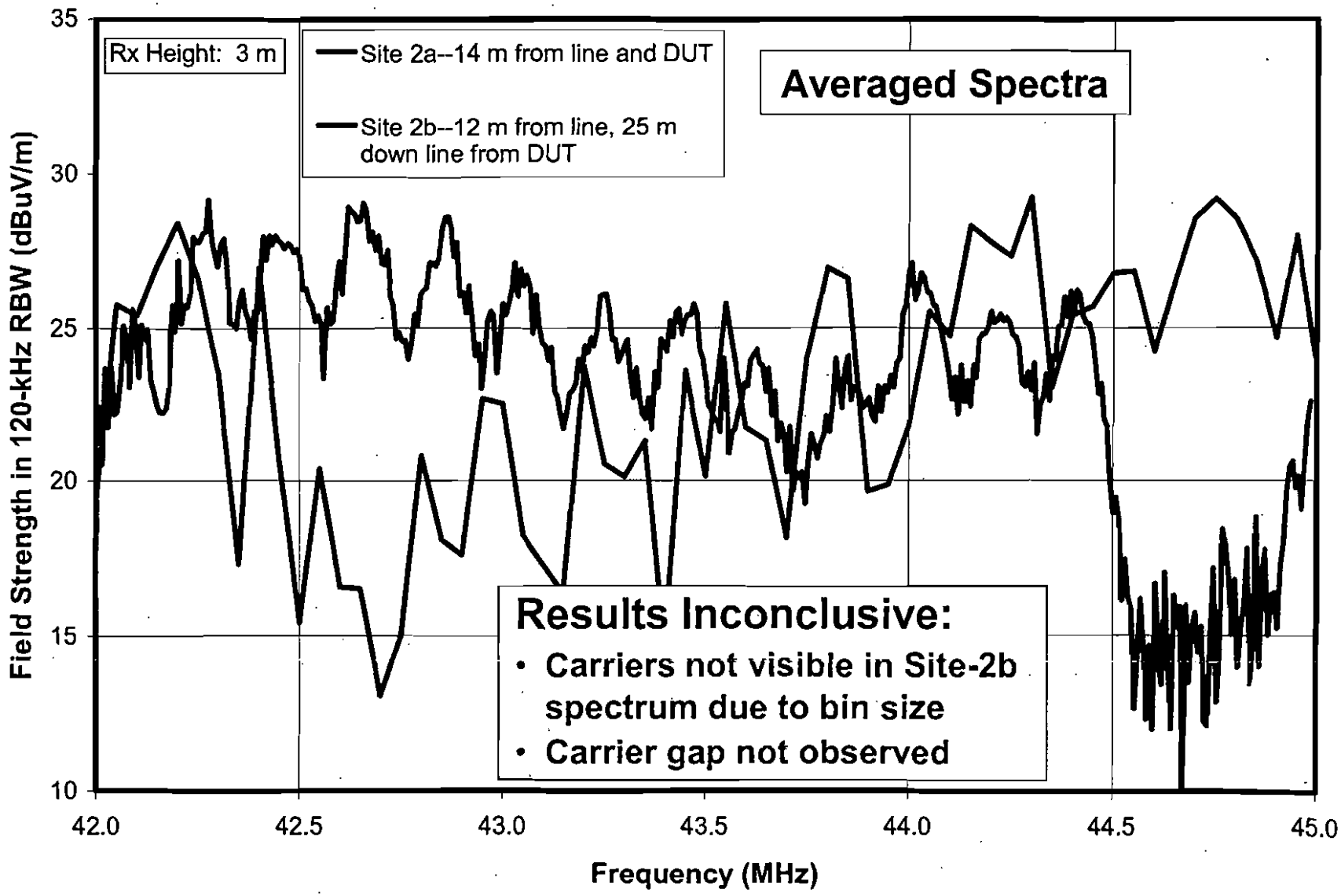
Effect of Distance Down Line



Results Inconclusive:

- Carriers not visible in Site-2b spectrum due to bin size
- Carrier gap not observed

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Conclusions

- **Communication conditions for measurement were achieved**
  - > 20 pps rate & high duty factor communications
- **Impulse noise at 2nd site corrupted peak-detect/max-hold & probably quasi-peak results**
  - Power average spectra not affected
- **Receive antenna height has a significant effect**
  - Under power line, maximum over 1 – 4 meter scan occurred at 2 m
  - For typical geometries, maximum over 1 – 4 meter scan occurred at 3 – 4 m, but results were influenced by impulse noise
  - Maximization using average spectrum measurements would have eliminated impulse noise effect
- **Effect of distance down line (point source versus distributed source) was not determined conclusively**
- **No conclusions regarding compliance with levels requested in waiver**
  - Full compliance testing not performed
  - Site 1 measurement was 3-4 dB over Class A limit, but was not the preferred geometry for compliance testing
  - Site 2a quasi-peak results may have been influenced by impulse noise

ORIGINAL UNREDACTED

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Recommended Future FCC Tests
(To understand technology)

- **Effect of Rx Antenna Height**
  - Use power-average spectra, full-band, but increase # of spectral points to show individual carriers
  - Measure for < 30 MHz and > 30 MHz
    - < 30 MHz: Set coms to download-- maximizing pole-mounted HomePlug emissions; minimize indoor HomePlug emissions during test
- **Effect of Distance Down-Line**
  - Use power-average spectra, full-band, but increase # of spectral points to show individual carriers
  - Measure under line to maximize SNR
  - Measure at several distances down line
  - Antenna orientation based on current in line
- **Extend QP measurements to frequencies with no BPL carriers**
  - To allow assessment of QP measurement SNR
- **Cal Issues**
  - New antenna calibration
  - Use attenuator (and amplifier if necessary) between antenna & filter for impedance matching (if possible while maintaining adequate SNR and headroom for ambients)

ORIGINAL UNREDACTED

BPL Summary
After Briarcliff Manor, NY Test

To OET

September 8, 2004

Steve Martin & Andy Leimer – FCC Laboratory

On site support provided by Ambient during emission testing

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Briarcliff Manor BPL Test Results

wrt Interference Complaint in Notched Amateur Band

- **Tested one device**
- **Compliant w/emission limits within measurement uncertainty**
- **Notch performed poorly**
  - Vendor forgot to notch device 0.7 miles away
  - Vendor admitted bug in notching & plans a fix

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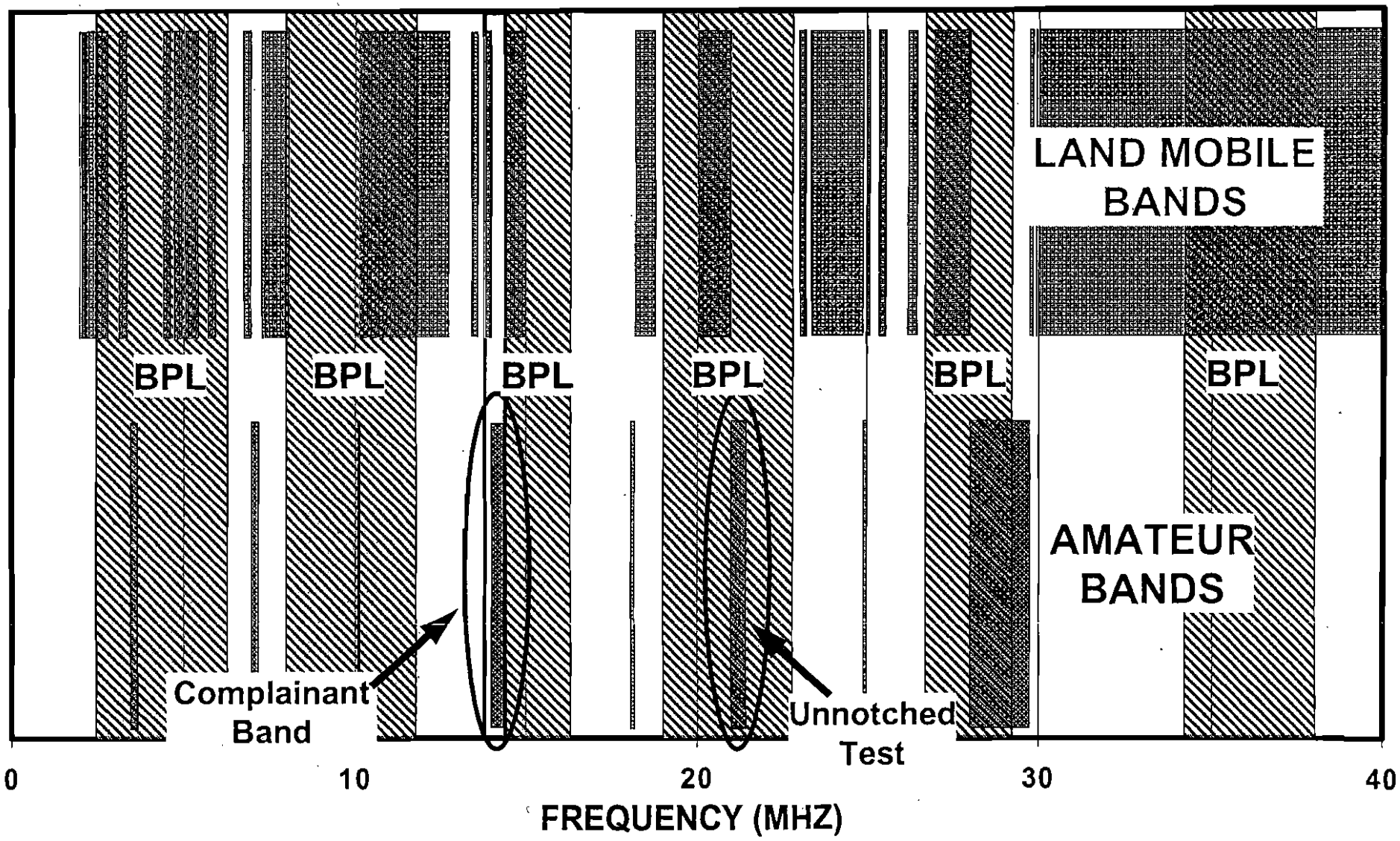
Frequency Allocations and Briarcliff Manor BPL Bands



Interference to Mobile Radio in Un-Notched Bands

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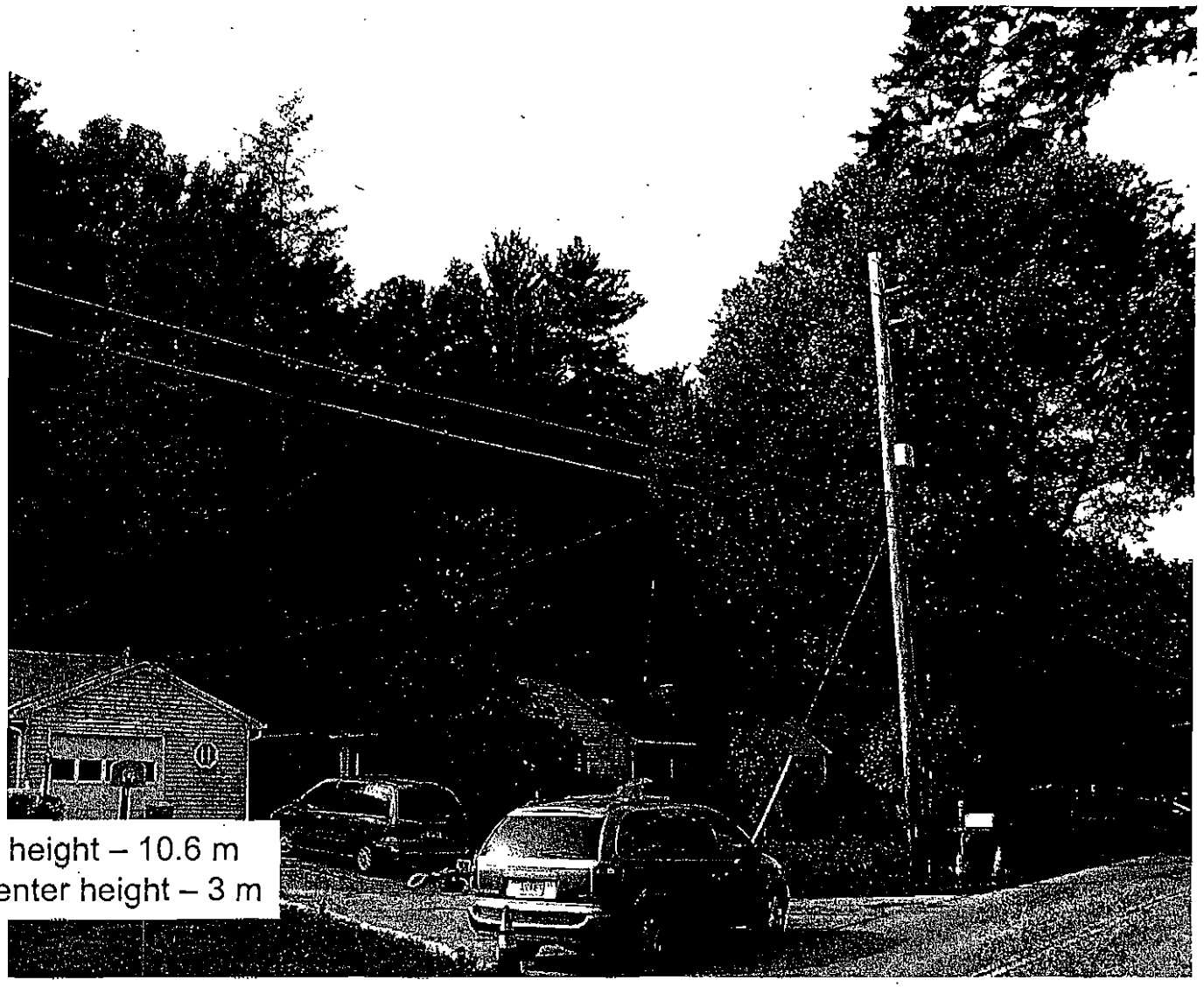
Van and HF Amateur Antenna



Power line height – 10.6 m
Antenna center height – 3 m