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"TV Repack: Post Auction Procedures"

for

2015 IEEE Broadcast Symposium
IEEE Broadcast Technology Society
Orlando, FL
October 16, 2015

Brief Digital TV History

Mar 1998	First DTV station goes on-air (27 total in 1998)

DTV Construction Deadlines

May 1999	Top 10 Markets, 4 network affiliates
Nov 1999	Markets 11-30, 4 network affiliates
May 2002	All Commercial Stations
May 2003	All Noncommercial Stations

Many stations initially built reduced facilities and "maximized" later

July 2005	"Use it or Lose it" deadline – Commercial stations
July 2006	"Use it or Lose it" deadline – Noncommercial stations

2005-2006	Channel Elections for Post-Transition Election conflict resolution
2009	Analog operations terminate DTV operations on final channel

Revisiting TV Spectrum Reallocation

2009 +/-	Rumblings of a "Repacking" to move more spectrum from TV broadcasting to wireless carriers
Mar 2010	FCC Releases "The National Broadband Plan"
Feb 2012	"The Middle Class Tax Relief and Job Creation Act of 2012" a.k.a. "Spectrum Act"
Oct 2012	FCC NPRM, Docket No. 12-268 "Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions"
June 2014	FCC Incentive Auction 1st Report & Order
Aug 2015	"Procedures" Public Notice
March 2016	Planned Incentive Auction

Post Auction Band Plan
"All Paired, Down from 51"

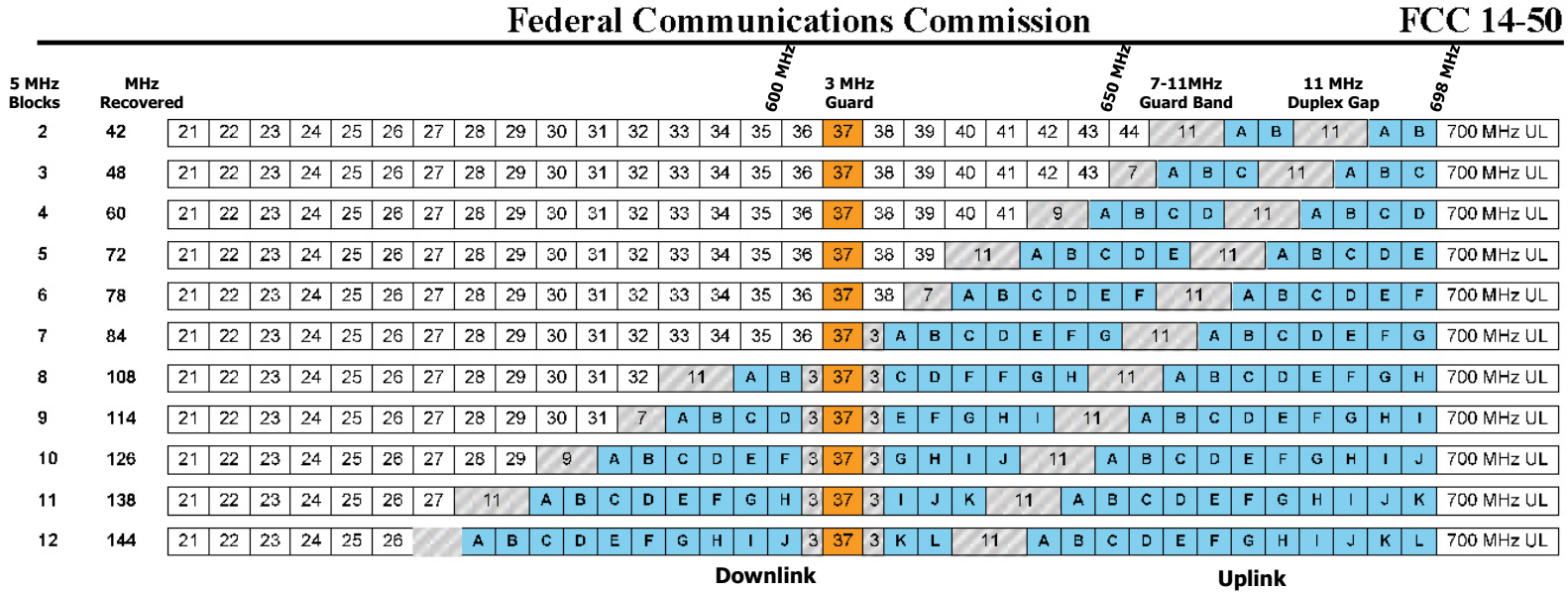


Figure 23. Band Plan Scenarios

Auction outcome to dictate final "TV Band" and Wireless "600 MHz Band"
Most markets - uniform band
Constrained markets – less spectrum recovered – impaired wireless blocks
Possible issues with inter-service interference ("ISIX" OET Bulletin 74)

Broadcaster Auction Options

Auction participation is not mandatory. Participation is confidential.

Bid options for participating stations:

1. License relinquishment
2. Change bands (U to Hi-V, U to Lo-V, Hi-V to Lo-V)
3. Share channel with another station

Post-Auction: Repacking

Non-participating stations may have to change to a new channel within the same band. Coverage areas and service population are protected.

Participating stations who exit the auction may have to change channel within the same band.

FCC to reimburse for "reasonable expenses" by involuntary channel changes
No reimbursement for stations changing bands (they get auction proceeds)

Timelines and Milestones

Incentive Auction

Participating stations must submit application (late 2015)
Reverse and Forward Auctions (begins March 29, 2016)
Auction closes when "Final Stage Rule" is satisfied

ASAP After Auction Concludes

Forward auction licenses are granted, disbursement of auction proceeds are made to broadcasters that are relinquishing spectrum

Relinquishing and channel sharing stations must vacate pre-auction channels within 3 months

Channel Reassignment Public Notice

Final TV channel assignments and parameters announced
Post-Auction period begins
t = 0 Ready Set GO!

Timelines and Milestones

Deadline at "t + 3" Months

- Repacked stations must file Construction Permit applications and estimated channel relocation costs
- Crunch time – to plan new facility and transition

After "t + 3" Months, 36 month "Broadcast Construction Period" begins

- CP's are issued ASAP
- FCC establishes construction deadlines for new channel implementation
- Deadlines to vary by region, complexity, and other factors
  - Some stations will have less than the full 36 month period
- FCC reviews cost estimates and issues initial allocation of funds
  - 80 percent of estimated to commercial stations
  - 90 percent of estimated to noncommercial stations

Timelines and Milestones

Meeting Construction Deadline

- At "t + 39" months, all operations on pre-auction channels must cease
- 6-month extension of **construction deadline** upon suitable request
- Subsequent extensions via much stricter criteria
- Must go dark if not ready at "t + 39"
- 12 months silent = automatic license expiration
  - FCC can reinstate with waiver – if involuntarily dark and if "equity and fairness" apply

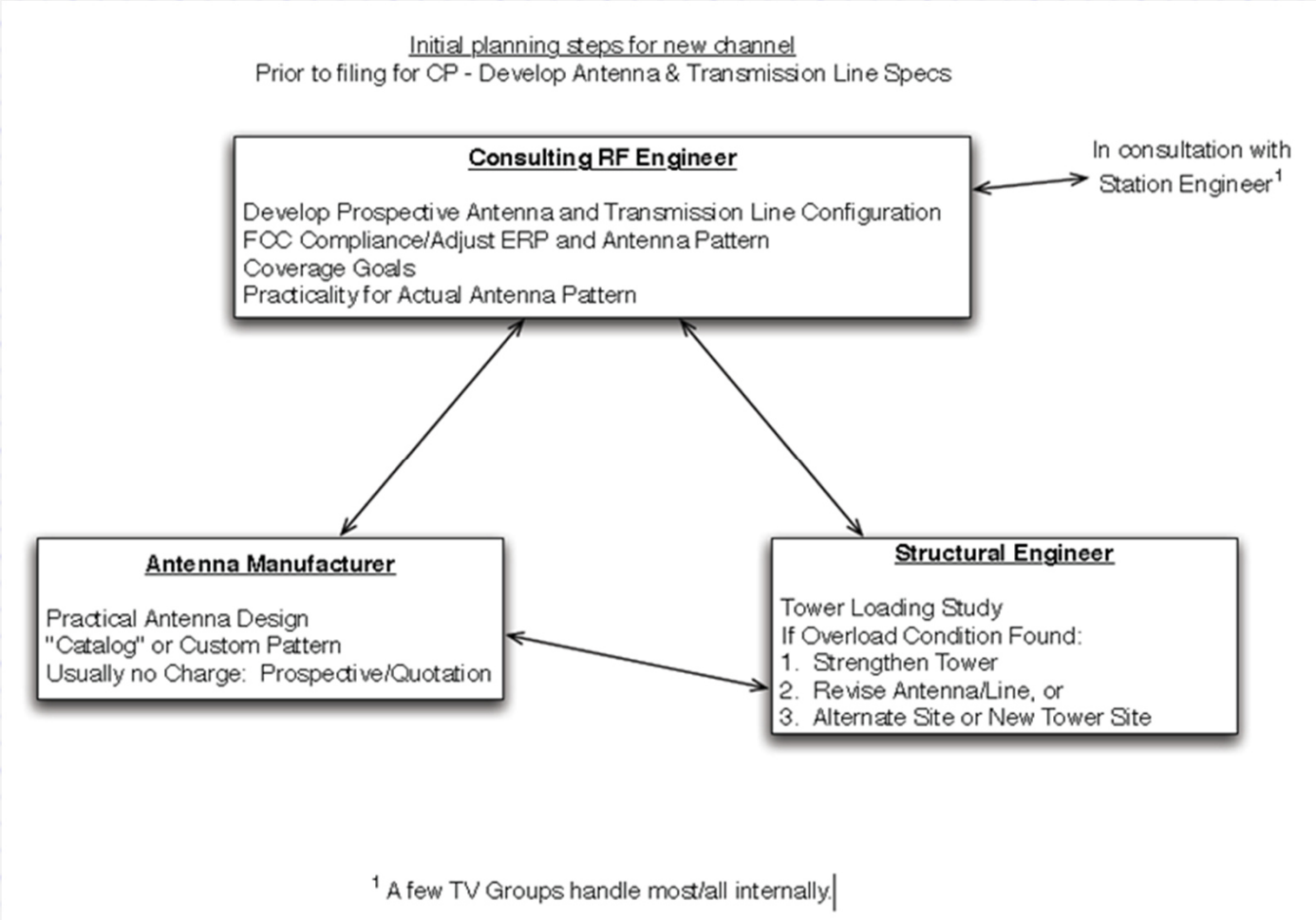
Interim operations will be necessary for many stations

- Existing or new auxiliary transmitter/antenna
- Temporary installation OK
- On pre-auction and/or post-auction channel
- Reduced facilities
- Alternate site OK
- Temporary channel OK

Facility Planning

Limited opportunity for pre-planning until repack results are available

By t = 3 months must apply for Construction Permit



Facility Planning

1. Pre-planning (t = 0)
2. RF Engineering
3. Structural Engineering
4. Negotiate with tower owners
5. Permitting
6. Estimated Costs to FCC for Reimbursement (negotiation?)

------ t = 3 months ------

7. Acquire equipment/manufacturing
8. Tower Work
9. Field Engineering

Planning and Application Procedures

Construction Permit Applications:
Repacked stations - three filing deadlines depending on nature of proposal

1. "Initial Applications" – generally conforming – file by t=3 months

   Comply with new parameters, no contour expansion
   Interference study not required, serve > 95% reference population
   Expedited grant by FCC

   Slight contour extension up to 1 percent OK if needed to achieve the new assignment or to address a loss area on the new channel
   Interference is <0.5% to any other station
   Antenna pattern must closely conform to new assignment

   1 percent contour extension limit not applicable to winning bidders going from UHF to VHF due to pattern matching issues

Planning and Application Procedures

Last two filing deadlines follow FCC processing of first set of applications

2. "Priority" Expanded Facilities (Maximization) and Alternate Channels
   Applicable if new assignment can't be constructed for reasons beyond station's control. MB to describe standards for priority.
   Contour extension over 1 percent
   Interference is <0.5% to any other station

What is a Priority Station?

"Specifically, we will provide a priority to any station that demonstrates that it is unable to construct facilities that meet the technical parameters specified in the *Channel Reassignment PN*, or the permissible contour coverage variance discussed above, for reasons beyond its control."

"In addition, we delegate authority to the Media Bureau to define other categories of stations that may be eligible for a filing priority due to extraordinary circumstances beyond a station's control."

Footnote – an example of priority:

"We anticipate that such stations would include those that cannot submit a construction permit application for their assigned channel because they are unable to construct at their current tower site due to technical or legal issues."

Planning and Application Procedures

Last two filing deadlines follow FCC processing of first set of applications

2. "Priority" Expanded Facilities (Maximization) and Alternate Channels
   Applicable if new assignment can't be constructed for reasons beyond station's control. MB to describe standards for priority.
   Contour extension over 1 percent
   Interference is <0.5% to any other station

3. "Non-Priority" Expanded Facilities and Alternate Channels
   Contour extension over 1 percent
   Interference is <0.5% to any other station

   After processing initial CP applications in "1", MB to issue PN's with deadlines for "2" and "3", processing guidelines, cut-off and MX resolution

4. Stations that are not repacked ("Stays")
   Contour extension and channel substitution freezes lifted

Application Software: Interference

Goodbye old friend "tv_process"

Long-standing implementation of OET Bulletin 69

192.168.1.56 - PuTTY

```
   Undesired station 23A FL PANAMA CITY        NEW          0:00:49
Evaluating service and interference                         0:00:49
 00005150 00005150
Setting latitude and longitude bounds of problem area       0:00:49
Defining problem area grid                                  0:00:49
Fetching census blocks for problem area                     0:00:49
Sorting census blocks by latitude                           0:00:49
Loading problem area grid with population data              0:00:49
Initializing problem area grid                              0:00:50
Allocating memory for results                               0:00:50
Determining noise-limited contours using FCC curves         0:00:50
Calculating service fields                                  0:00:51
   Desired station 18A FL PANAMA CITY          WJHG-TV      0:00:51
Counting population covered                                 0:00:55
Computing IX fields of   1 undesired stations               0:01:00
 Undesired station 20060421ABG        18 BESSEMER
   Undesired station 18A AL BESSEMER           WDBB         0:01:00
Evaluating service and interference                         0:01:01
 WJHG-TV    18 0000001551       00005150   0
Finished                                                    0:01:02
 Note: IEEE floating-point exception traps enabled:
    overflow;  division by zero;  invalid operation;
 See the Numerical Computation Guide, ieee_handler(3M)
jmd@KC135|/space/software/pgms:
```

tv_process Sample.wri - WordPad

File Edit View Insert Format Help

Courier New 10 Western

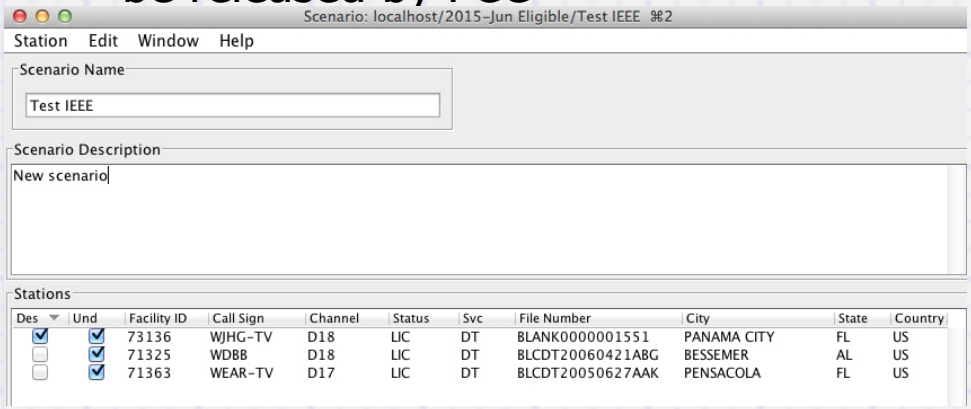
```
Analysis of current record
Channel     Call          City/State        Application Ref. No.
   18       WDBB       BESSEMER AL              BLCDT     -20060421ABG

     Stations Potentially Affecting This Station

Chan   Call      City/State           Dist(km) Status  Application Ref. No.
 18   WJHG-TV  PANAMA CITY FL           396.1  LIC    BLANK      -0000001551
 18   WJHG-TV  PANAMA CITY FL           387.1  PLN    DTVPLN     -DTVP0623
 18   WKYU-TV  BOWLING GREEN KY         407.7  LIC    BLEDT      -20040803AAG
 18   WMAU-TV  BUDE MS                  392.0  LIC    BLEDT      -20090327ABW
 19   WIIQ     DEMOPOLIS AL             131.9  LIC    BLEDT      -20090511AHE
 19   WHNT-TV  HUNTSVILLE AL            161.0  LIC    BLCDT      -20111118COZ
 19   WHNT-DR  HUNTSVILLE AL            161.0  APP    BPRM       -20090423ADN

 Total scenarios =   3


Result key:        1
Scenario        1  Affected station        2
Before Analysis

Results for: 18A AL BESSEMER             BLCDT     20060421ABG  LIC
   HAAT  675.0 m, ATV ERP  350.0 kW
                                     POPULATION   AREA (sq km)
   within Noise Limited Contour     1591742      39621.4
   not affected by terrain losses   1571861      38666.0
   lost to NTSC IX                        0          0.0
   lost to additional IX by ATV       30646       1402.8
   lost to ATV IX only                30646       1402.8
   lost to all IX                     30646       1402.8

 Potential Interfering Stations Included in above Scenario     1

18A KY BOWLING GREEN        BLEDT     20040803AAG  LIC
18A MS BUDE                 BLEDT     20090327ABW  LIC
19A AL DEMOPOLIS            BLEDT     20090511AHE  LIC
19A AL HUNTSVILLE           BLCDT     20111118COZ  LIC
18A FL PANAMA CITY          DTVPLN    DTVP0623     PLN
```

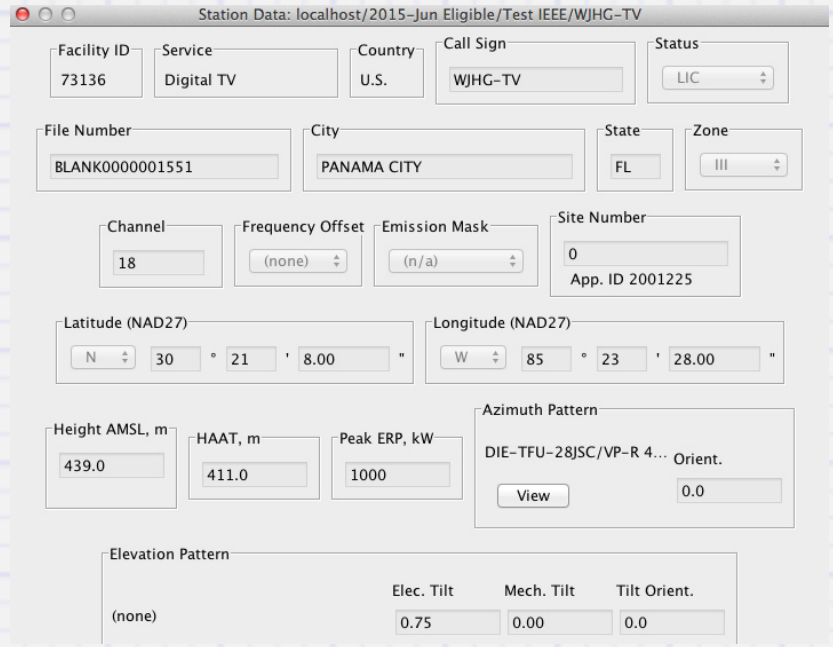
For Help, press F1 NUM

Application Software: Interference

Hello to "TVStudy"

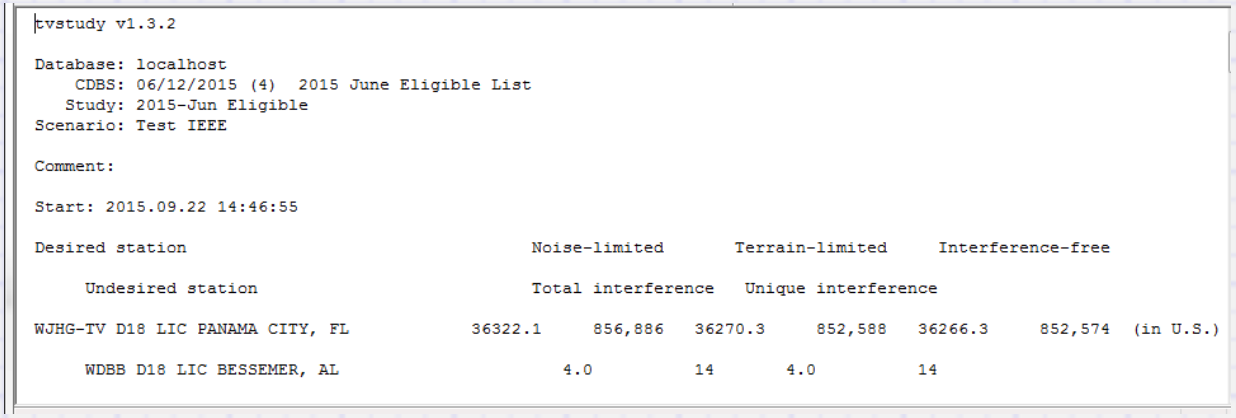
Application processing version to be released by FCC





Interference analysis for station expansion proposals in TV band

Contour extension NOT LIKELY for stations in Wireless "600 MHz Band"



```
tvstudy v1.3.2

Database: localhost
    CDBS: 06/12/2015 (4)  2015 June Eligible List
   Study: 2015-Jun Eligible
Scenario: Test IEEE

Comment:

Start: 2015.09.22 14:46:55

Desired station                                  Noise-limited       Terrain-limited     Interference-free

     Undesired station                           Total interference   Unique interference

WJHG-TV D18 LIC PANAMA CITY, FL            36322.1     856,886   36270.3     852,588   36266.3     852,574  (in U.S.)

     WDBB D18 LIC BESSEMER, AL                   4.0          14       4.0          14
```

Replication to New Channel

New channel assignment based on licensed antenna location and height

No change to directional pattern

UHF Power changes with dipole factor

Normalized to 615 MHz (Ch. 38)

-2.31 dB on Ch. 14

+1.03 dB on Ch. 51

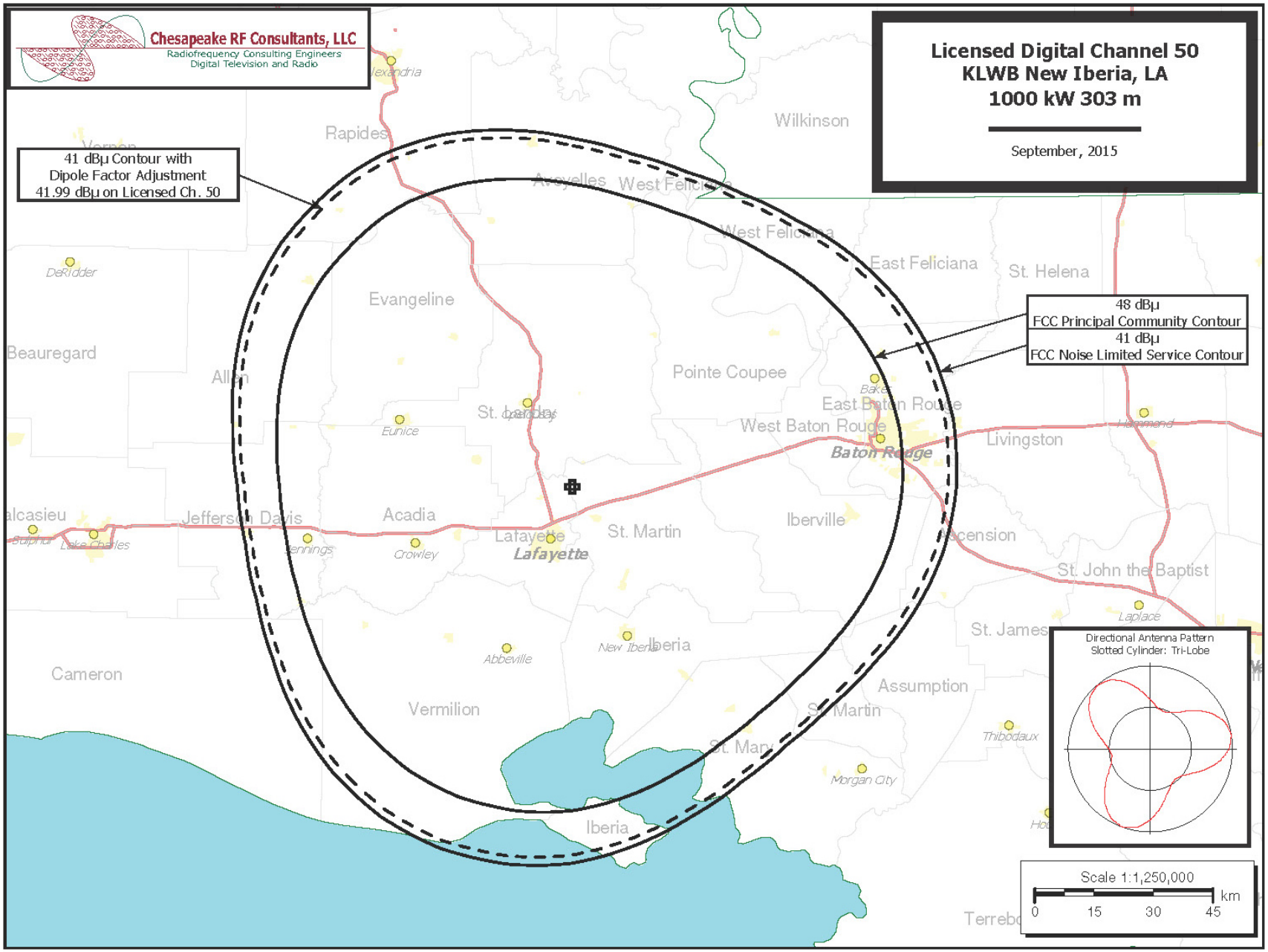
1000 kW on Ch. 50 = 546 kW on Ch. 20

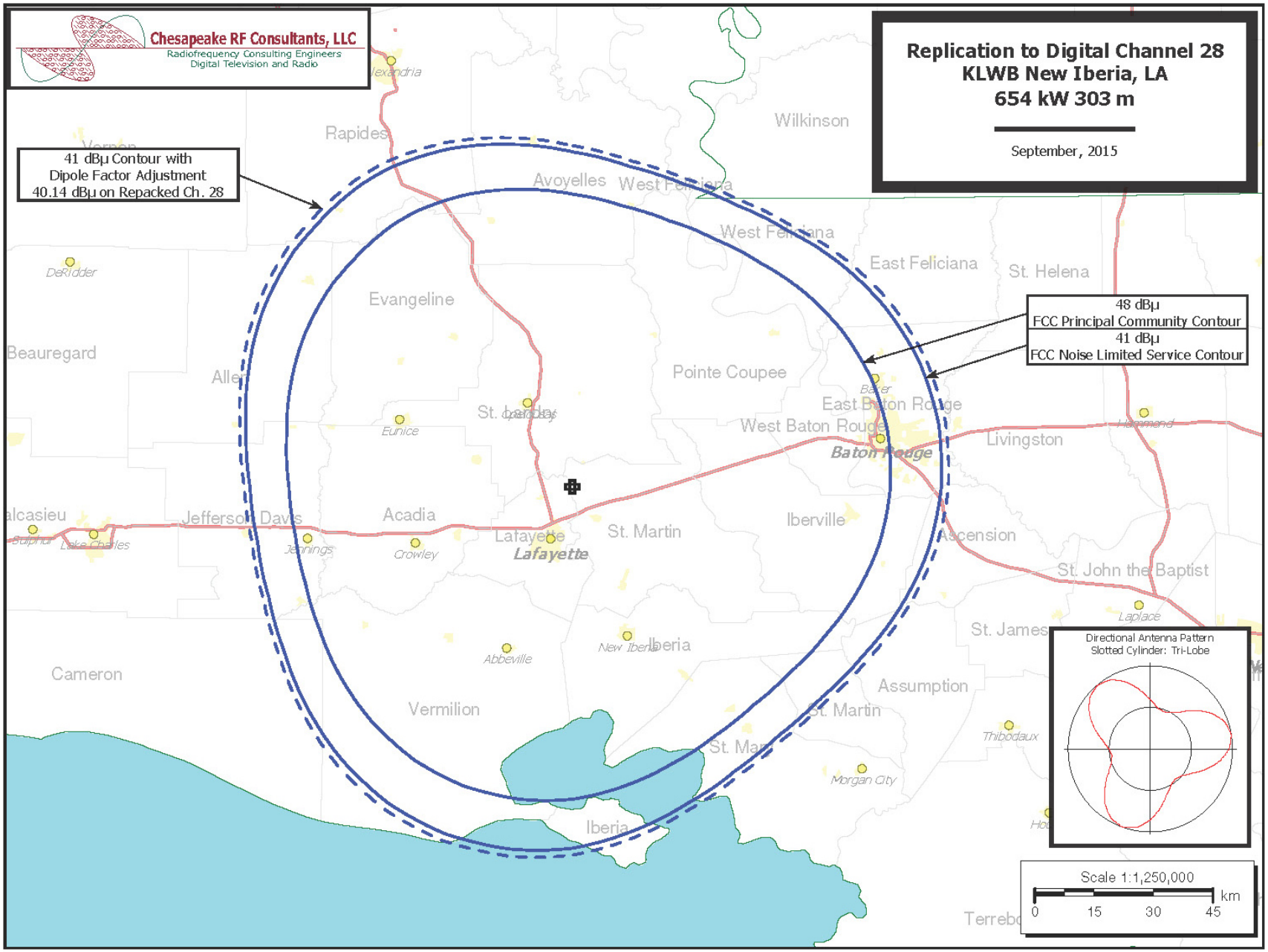
1000 kW on Ch. 18 = 1256 kW on Ch. 28 (cap at 1000 kW)

Table 2

Field Strengths Defining the Area subject to Calculation for DTV Stations

Channels	Defining Field Strength, dBu, to be predicted for 50% of locations, 90% of time
2 - 6	28
7 - 13	36
14 - 69	41 - 20 log[615/(channel mid-frequency in MHz)]


Chesapeake RF Consultants, LLC
Radiofrequency Consulting Engineers
Digital Television and Radio
Licensed Digital Channel 50
KLWB New Iberia, LA
1000 kW 303 m
September, 2015
41 dBμ Contour with
Dipole Factor Adjustment
41.99 dBμ on Licensed Ch. 50
48 dBμ
FCC Principal Community Contour
41 dBμ
FCC Noise Limited Service Contour
Rapides
Wilkinson
Avoyelles
West Feliciana
East Feliciana
St. Helena
Evangeline
Beauregard
Allen
Pointe Coupee
East Baton Rouge
West Baton Rouge
Baton Rouge
Livingston
Eunice
Jefferson Davis
Acadia
Lafayette
St. Martin
Iberville
Crowley
Ascension
St. John the Baptist
Laplace
St. James
Cameron
Abbeville
New Iberia
Iberia
Vermilion
Assumption
St. Martin
St. Mary
Thibodaux
Morgan City
Directional Antenna Pattern
Slotted Cylinder: Tri-Lobe
Scale 1:1,250,000
0
15
30
45
km


Chesapeake RF Consultants, LLC
Radiofrequency Consulting Engineers
Digital Television and Radio
Replication to Digital Channel 28
KLWB New Iberia, LA
654 kW 303 m
September, 2015
41 dBμ Contour with
Dipole Factor Adjustment
40.14 dBμ on Repacked Ch. 28
48 dBμ
FCC Principal Community Contour
41 dBμ
FCC Noise Limited Service Contour
Rapides
Avoyelles
Wilkinson
West Feliciana
East Feliciana
St. Helena
Evangeline
Beauregard
Allen
Pointe Coupee
East Baton Rouge
West Baton Rouge
Baton Rouge
Livingston
Jefferson Davis
Acadia
Lafayette
St. Martin
Iberville
Ascension
St. John the Baptist
St. James
Assumption
Cameron
Vermilion
Iberia
Directional Antenna Pattern
Slotted Cylinder: Tri-Lobe
Scale 1:1,250,000
km
0
15
30
45

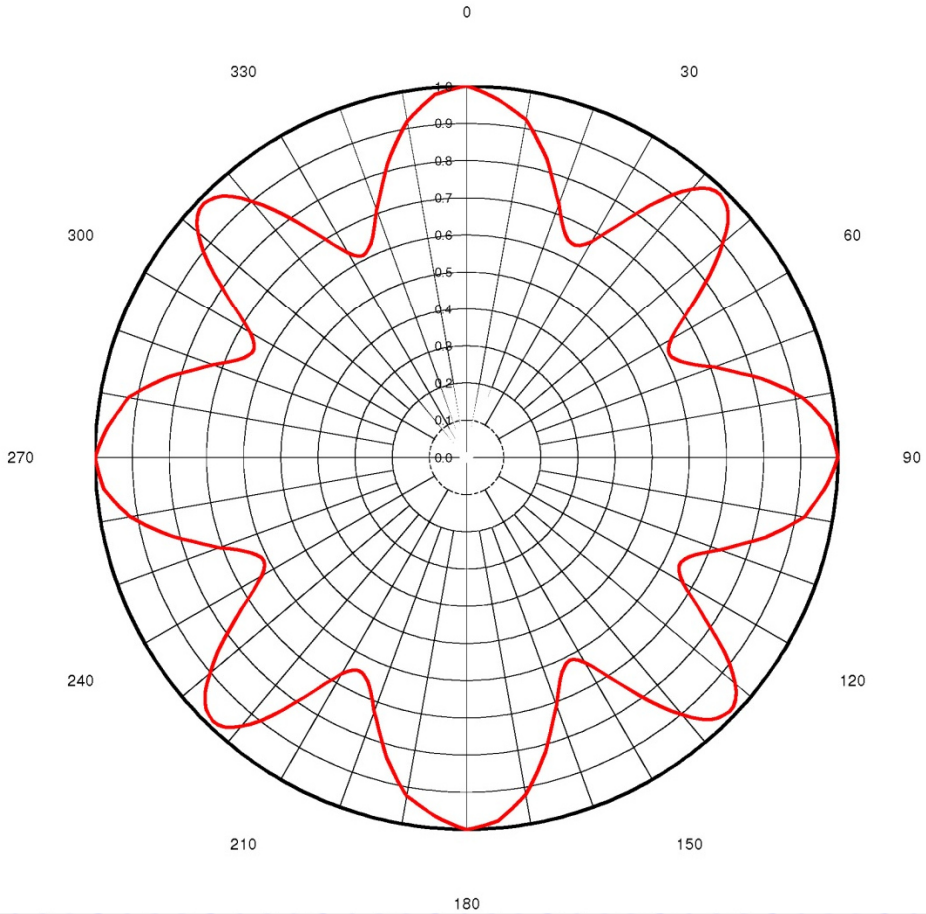
UHF Panel Antenna Azimuthal Patterns: Nondirectional

Dielectric

Serial Number:	TUA6-R001
Channel	42
Antenna Type	TUA-O4-2/8U-1-S

AZIMUTH PATTERN

Gain	1.45	(1.61 dB)	Frequency	641.00 MHz
Calculated / Measured		Calculated	Drawing #	TUA-O4-6410

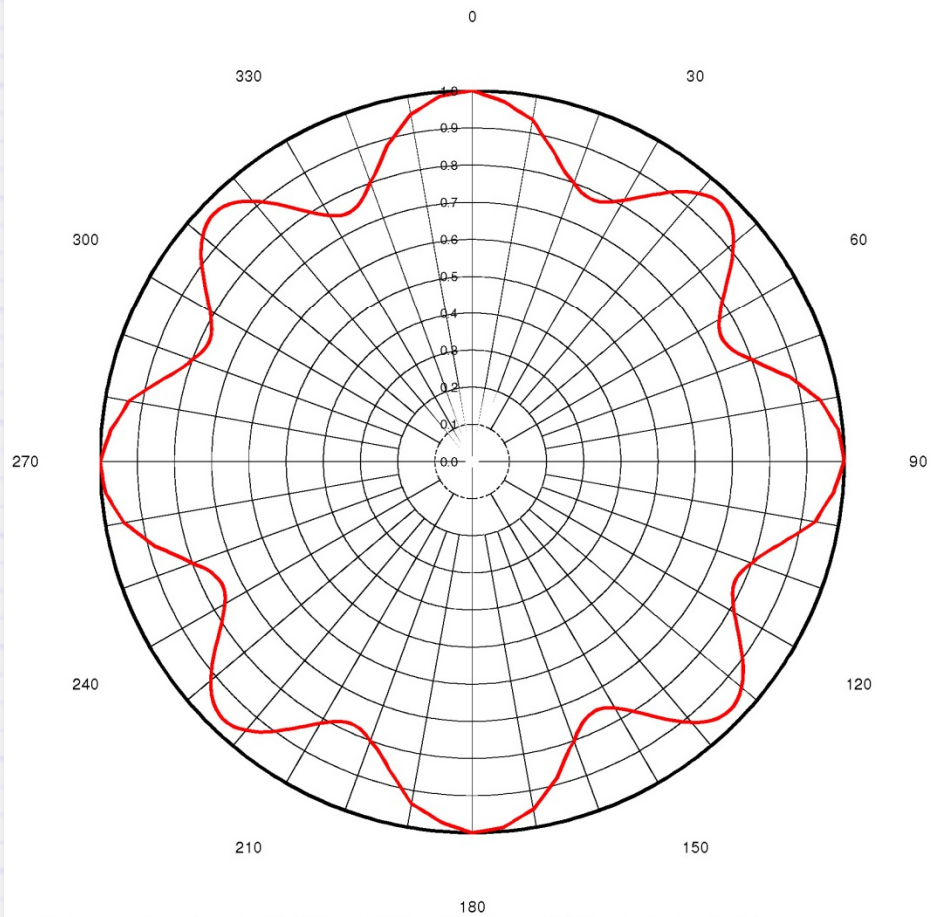


Dielectric

Serial Number:	TUA6-R001
Channel	23
Antenna Type	TUA-O4-2/8U-1-S

AZIMUTH PATTERN

Gain	1.30	(1.14 dB)	Frequency	527.00 MHz
Calculated / Measured		Calculated	Drawing #	TUA-O4-5270



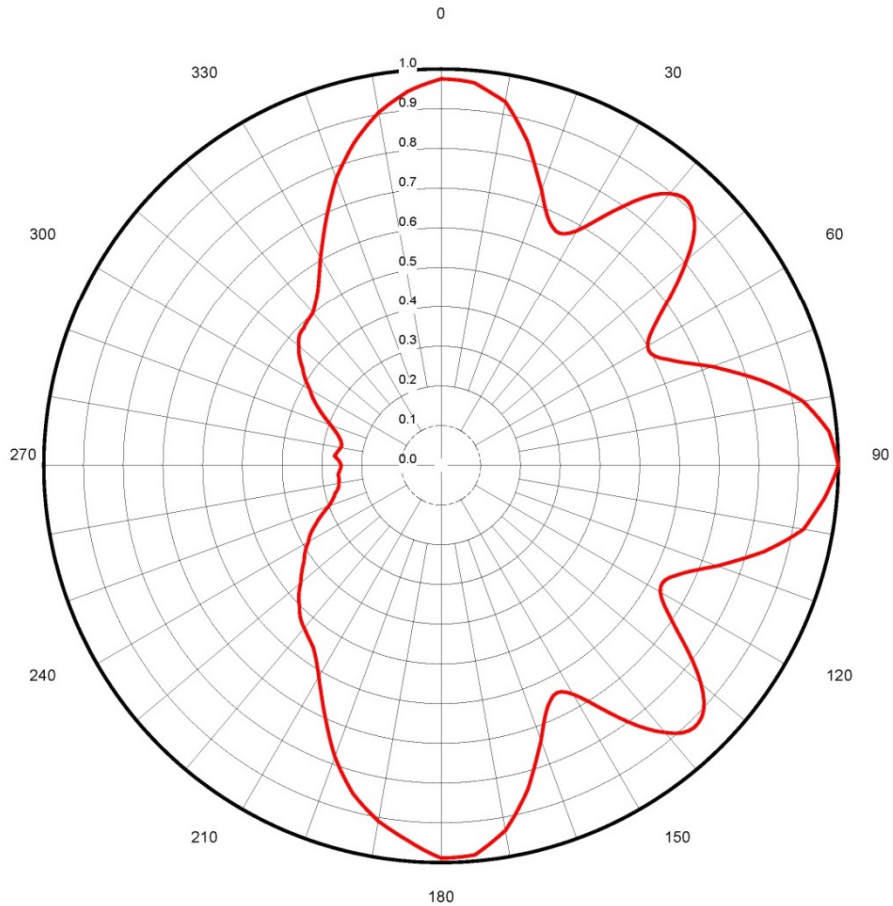
UHF Panel Antenna Azimuthal Patterns: Directional

Dielectric

Proposal Number	C		
Date	8-Mar-07		
Call Letters	K----DT	Channel	44
Location			
Customer			
Antenna Type	TUA-C4SP-12/40U-1-S		

AZIMUTH PATTERN

Gain	2.00	(3.01 dB)	Frequency	653.00 MHz
Calculated / Measured	Calculated		Drawing #	TUA-C4SP-6530

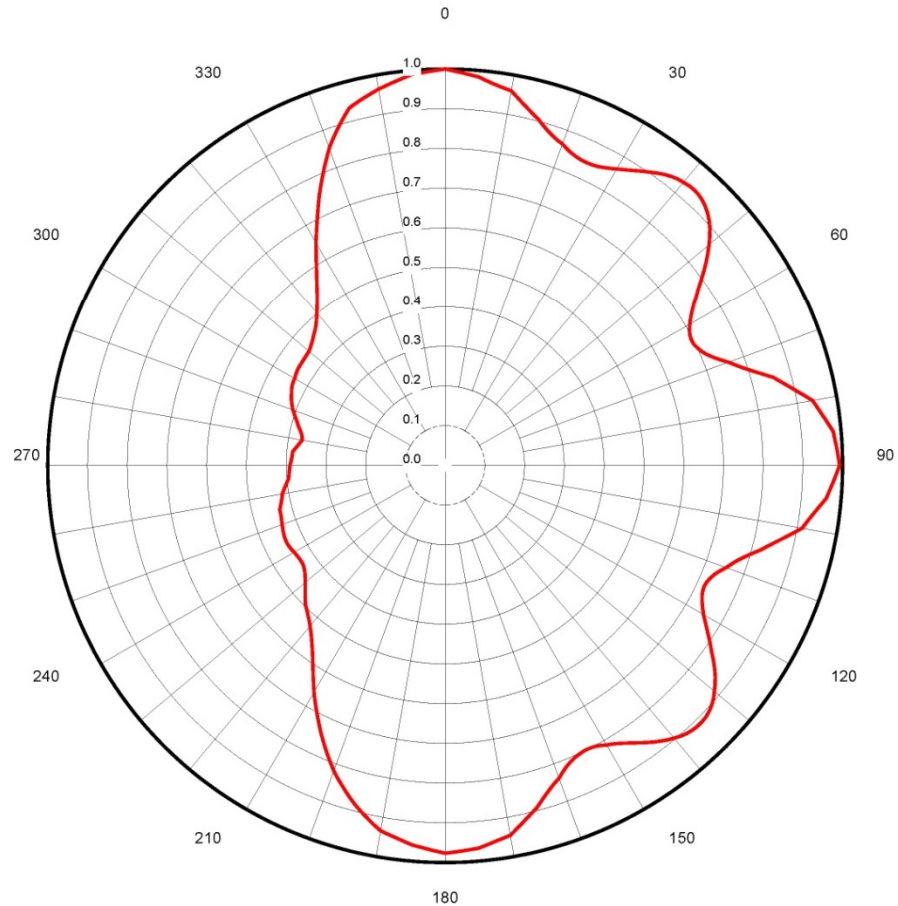


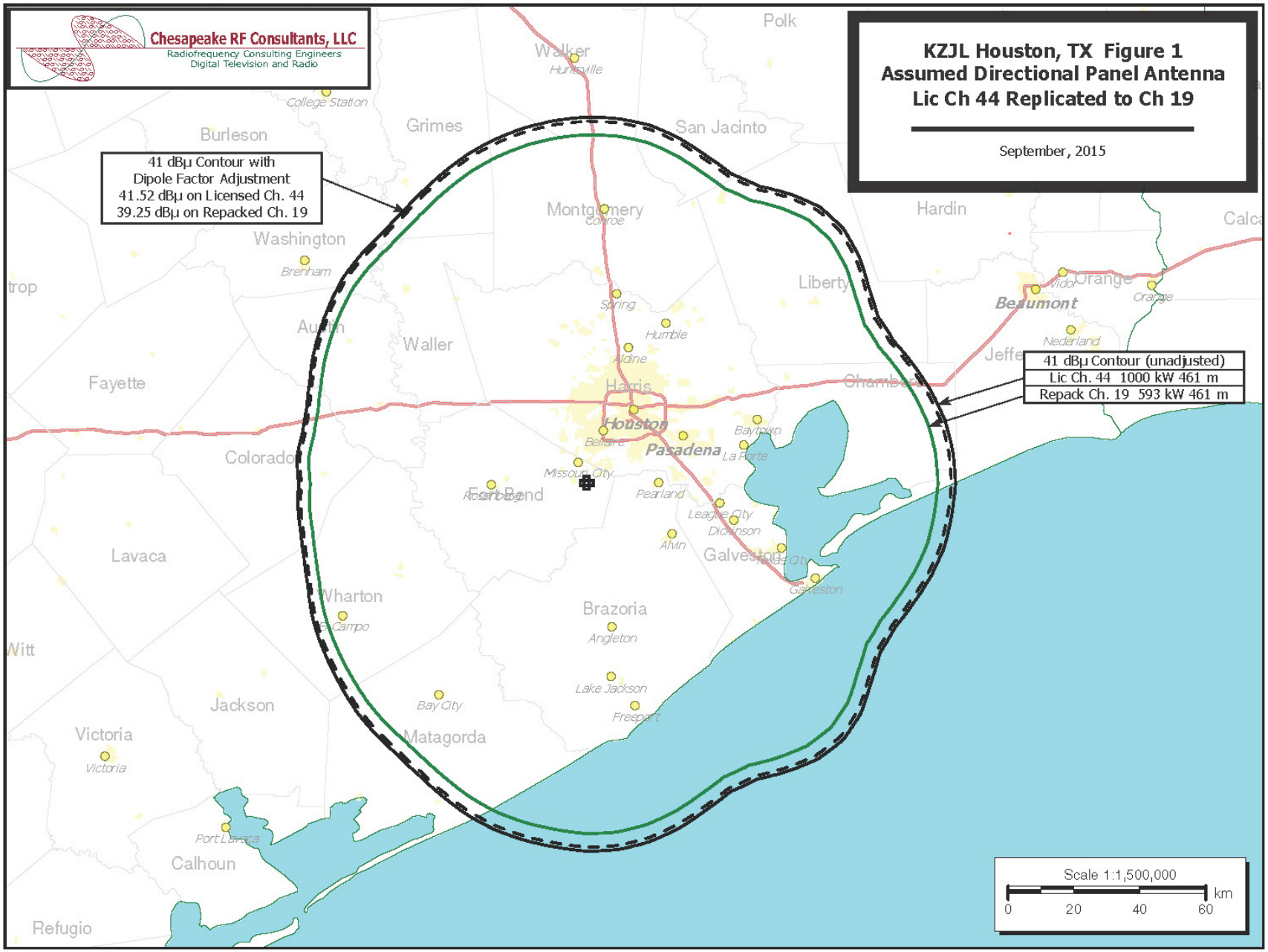
Dielectric

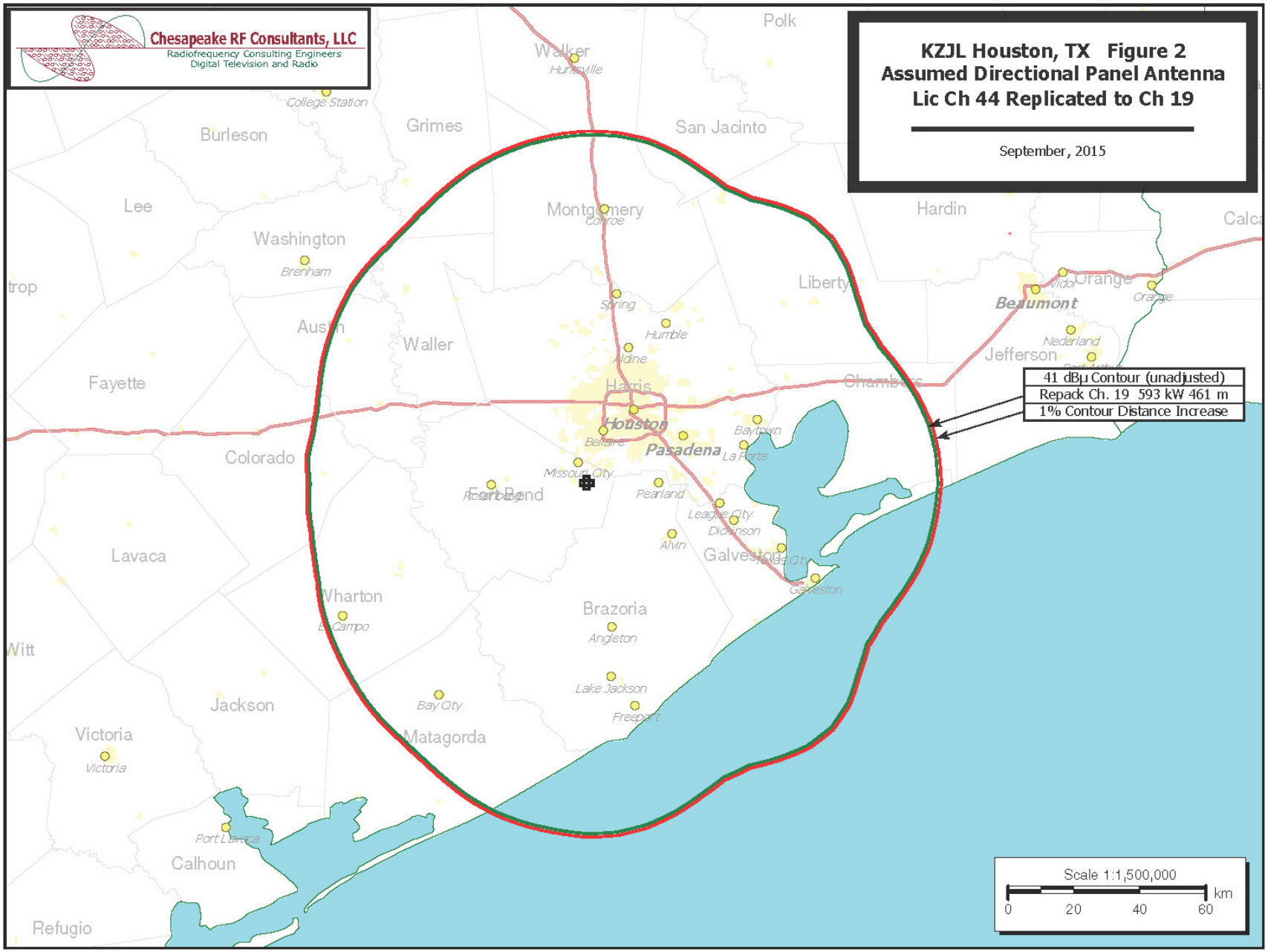
Proposal Number	C		
Date	8-Mar-07		
Call Letters	K-----DT	Channel	19
Location			
Customer			
Antenna Type	TUA-C4SP-12/40U-1-S		

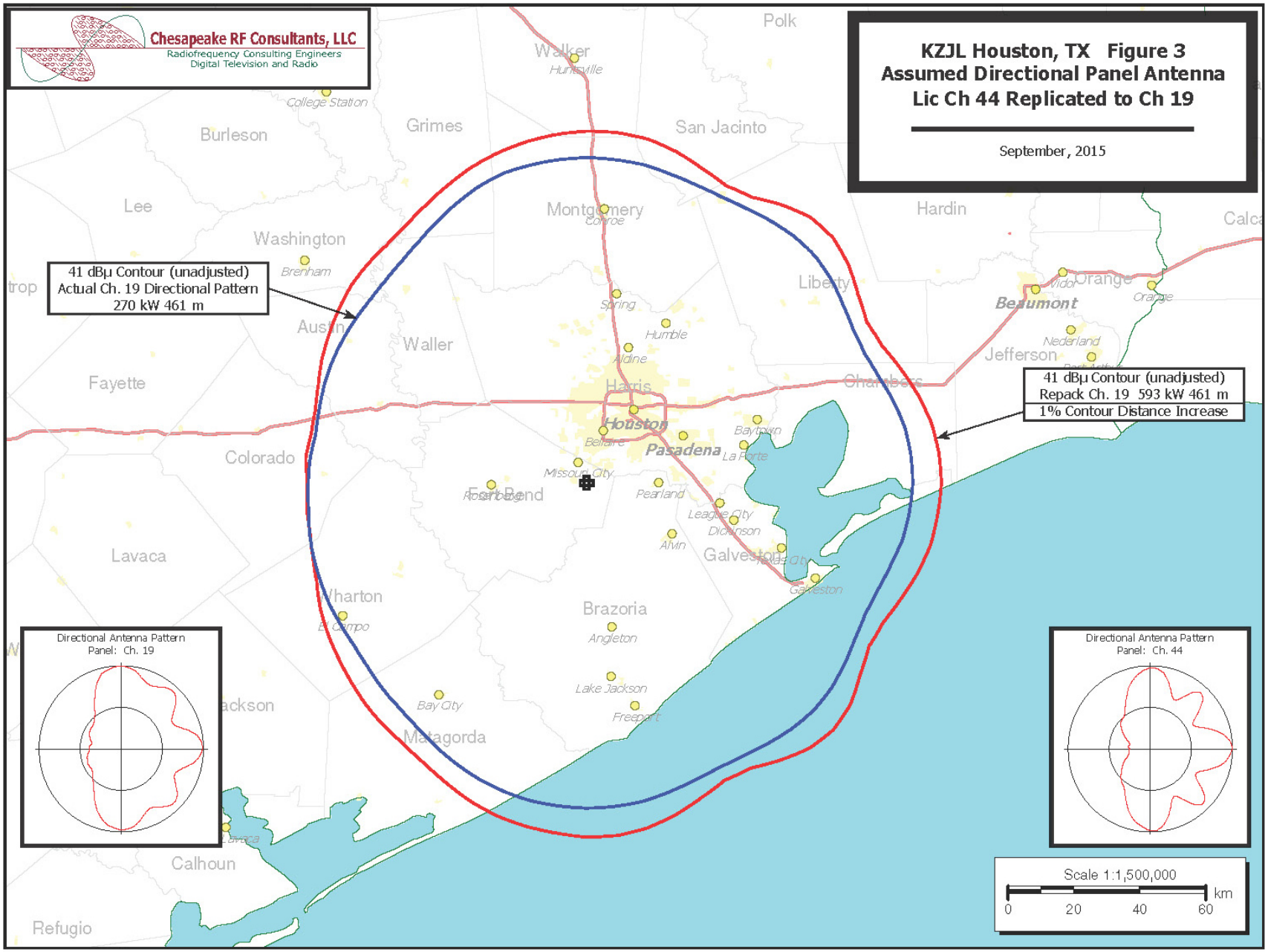
AZIMUTH PATTERN

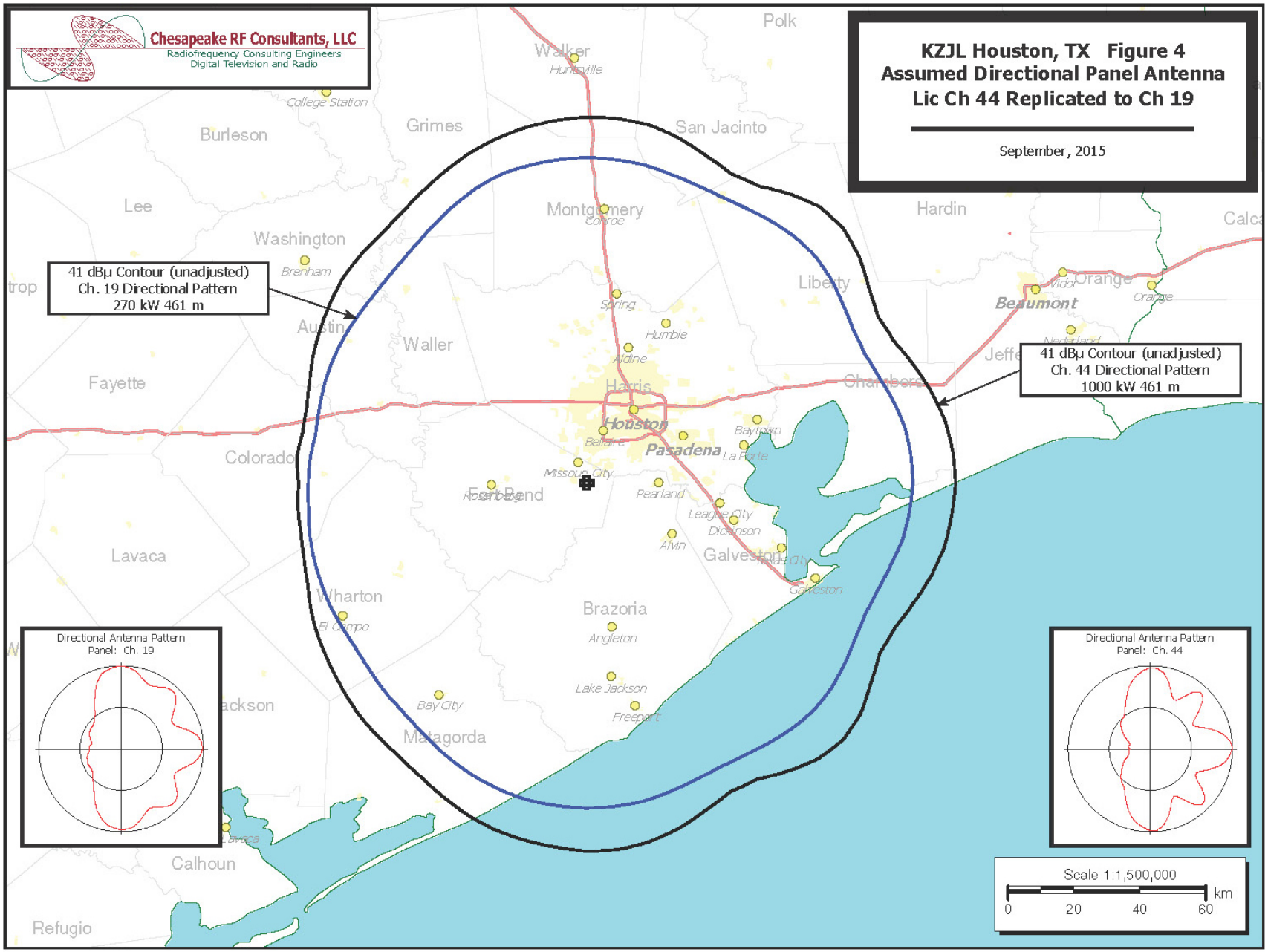
Gain	1.70	(2.30 dB)	Frequency	503.00 MHz
Calculated / Measured	Calculated		Drawing #	TUA-C4SP-5030

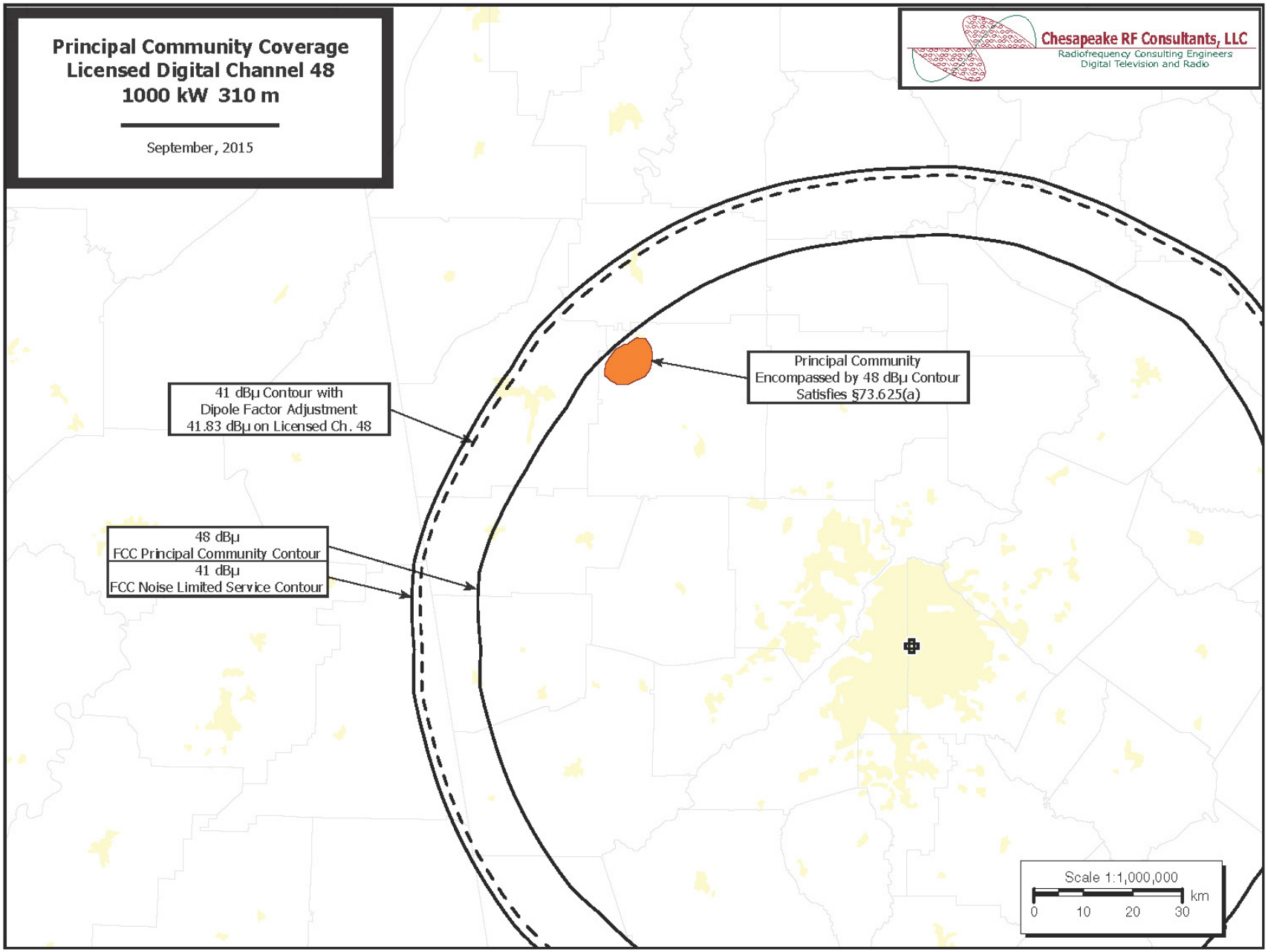


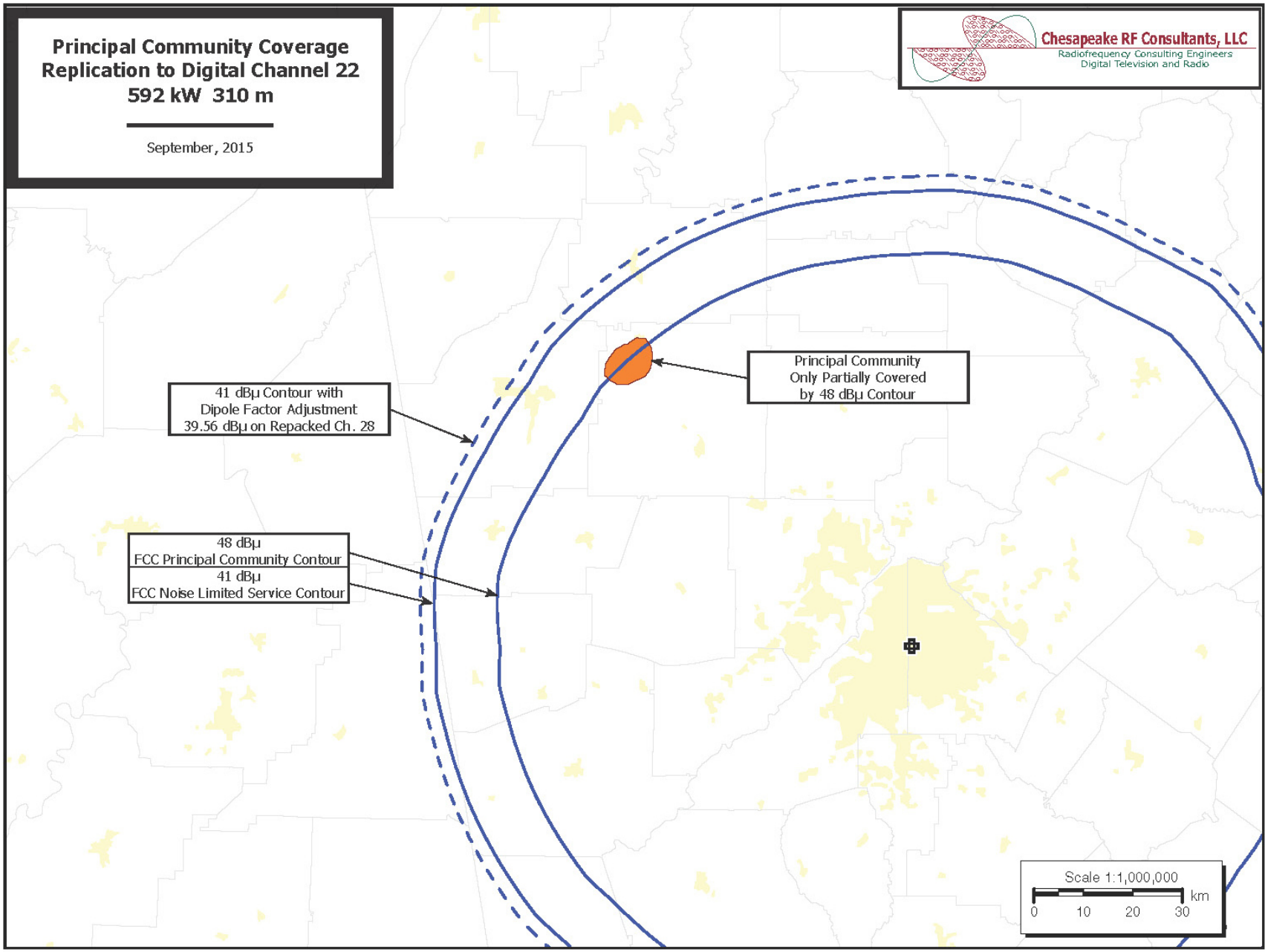

Chesapeake RF Consultants, LLC
Radiofrequency Consulting Engineers
Digital Television and Radio
KZJL Houston, TX Figure 1
Assumed Directional Panel Antenna
Lic Ch 44 Replicated to Ch 19
September, 2015
41 dBμ Contour with
Dipole Factor Adjustment
41.52 dBμ on Licensed Ch. 44
39.25 dBμ on Repacked Ch. 19
41 dBμ Contour (unadjusted)
Lic Ch. 44 1000 kW 461 m
Repack Ch. 19 593 kW 461 m
Polk
Walker
Huntsville
College Station
Burleson
Grimes
San Jacinto
Montgomery
Conroe
Hardin
Washington
Brenham
Liberty
Orange
Beaumont
Nederland
Spring
Humble
Aldine
Waller
Harris
Houston
Pasadena
Baytown
La Porte
Fayette
Colorado
Missouri City
Fort Bend
Rosenberg
Pearland
League City
Dickinson
Alvin
Galveston
Texas City
Lavaca
Wharton
El Campo
Brazoria
Angleton
Lake Jackson
Freeport
Bay City
Matagorda
Jackson
Victoria
Port Lavaca
Calhoun
Refugio
Scale 1:1,500,000
0 20 40 60 km


Chesapeake RF Consultants, LLC
Radiofrequency Consulting Engineers
Digital Television and Radio
KZJL Houston, TX Figure 2
Assumed Directional Panel Antenna
Lic Ch 44 Replicated to Ch 19
September, 2015
41 dBμ Contour (unadjusted)
Repack Ch. 19 593 kW 461 m
1% Contour Distance Increase
Scale 1:1,500,000
0 20 40 60 km
Polk
Walker
Huntsville
College Station
Burleson
Grimes
San Jacinto
Lee
Montgomery
Conroe
Hardin
Washington
Brenham
Liberty
Orange
Vidor
Beaumont
Austin
Waller
Spring
Humble
Aldine
Nederland
Jefferson
Fayette
Harris
Chambers
Houston
Baytown
Bellaire
Pasadena
La Porte
Colorado
Missouri City
Fort Bend
Rosenberg
Pearland
League City
Dickinson
Alvin
Galveston
Texas City
Lavaca
Wharton
El Campo
Brazoria
Angleton
Witt
Lake Jackson
Freeport
Jackson
Bay City
Matagorda
Victoria
Victoria
Port Lavaca
Calhoun
Refugio


Chesapeake RF Consultants, LLC
Radiofrequency Consulting Engineers
Digital Television and Radio
KZJL Houston, TX Figure 3
Assumed Directional Panel Antenna
Lic Ch 44 Replicated to Ch 19
September, 2015
41 dBμ Contour (unadjusted)
Actual Ch. 19 Directional Pattern
270 kW 461 m
41 dBμ Contour (unadjusted)
Repack Ch. 19 593 kW 461 m
1% Contour Distance Increase
Directional Antenna Pattern
Panel: Ch. 19
Directional Antenna Pattern
Panel: Ch. 44
Scale 1:1,500,000
0 20 40 60 km
Polk
Walker
Huntsville
College Station
Burleson
Grimes
San Jacinto
Lee
Montgomery
Conroe
Hardin
Washington
Brenham
Liberty
Orange
Beaumont
Austin
Waller
Spring
Humble
Aldine
Nederland
Jefferson
Fayette
Harris
Chambers
Houston
Baytown
Bellaire
Pasadena
La Porte
Colorado
Missouri City
Fort Bend
Rosenberg
Pearland
League City
Dickinson
Alvin
Galveston
Texas City
Lavaca
Wharton
El Campo
Brazoria
Angleton
Lake Jackson
Freeport
Bay City
Matagorda
Calhoun
Refugio


Chesapeake RF Consultants, LLC
Radiofrequency Consulting Engineers
Digital Television and Radio
KZJL Houston, TX Figure 4
Assumed Directional Panel Antenna
Lic Ch 44 Replicated to Ch 19
September, 2015
41 dBμ Contour (unadjusted)
Ch. 19 Directional Pattern
270 kW 461 m
41 dBμ Contour (unadjusted)
Ch. 44 Directional Pattern
1000 kW 461 m
Directional Antenna Pattern
Panel: Ch. 19
Directional Antenna Pattern
Panel: Ch. 44
Scale 1:1,500,000
0 20 40 60 km
Polk
Walker
Huntsville
College Station
Burleson
Grimes
San Jacinto
Lee
Montgomery
Conroe
Hardin
Washington
Brenham
Liberty
Beaumont
Orange
Austin
Waller
Spring
Humble
Aldine
Harris
Houston
Pasadena
Baytown
La Porte
Fayette
Chambers
Colorado
Missouri City
Fort Bend
Rosenberg
Pearland
League City
Dickinson
Alvin
Galveston
Texas City
Lavaca
Wharton
El Campo
Brazoria
Angleton
Lake Jackson
Freeport
Bay City
Matagorda
Calhoun
Refugio


Principal Community Coverage
Licensed Digital Channel 48
1000 kW 310 m
September, 2015
Chesapeake RF Consultants, LLC
Radiofrequency Consulting Engineers
Digital Television and Radio
41 dBμ Contour with
Dipole Factor Adjustment
41.83 dBμ on Licensed Ch. 48
48 dBμ
FCC Principal Community Contour
41 dBμ
FCC Noise Limited Service Contour
Principal Community
Encompassed by 48 dBμ Contour
Satisfies §73.625(a)
Scale 1:1,000,000
km
0
10
20
30


Principal Community Coverage
Replication to Digital Channel 22
592 kW 310 m
September, 2015
Chesapeake RF Consultants, LLC
Radiofrequency Consulting Engineers
Digital Television and Radio
41 dBμ Contour with
Dipole Factor Adjustment
39.56 dBμ on Repacked Ch. 28
Principal Community
Only Partially Covered
by 48 dBμ Contour
48 dBμ
FCC Principal Community Contour
41 dBμ
FCC Noise Limited Service Contour
Scale 1:1,000,000
km
0
10
20
30

Reimbursement for Eligible Expenses

$1.75 billion available
Reimbursement to broadcasters involuntarily repacked

"Hard" and "Soft" channel change costs are eligible

Hard: Equipment replacement & installation
Modification of existing equipment
Tower work

Soft: Legal fees
Engineering fees (RF and structural consultants)
Health care facility notification

Can opt to forego reimbursement for a waiver of "service" rule ("Flex use")
Non-ATSC transmission
Still must provide at least 1 free TV program stream
Case-by-case review of waiver request

Reimbursement for Eligible Expenses

Cost estimates due by t=3 months

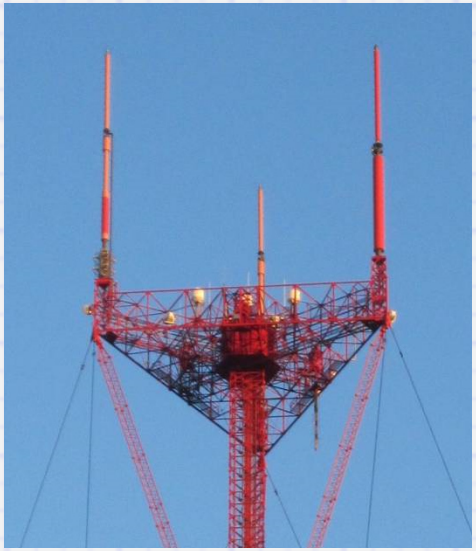
Funds deposited in individual US Treasury account, available to draw as actual expenses are incurred, documented, and approved

After t = 3 months
80 percent of estimated to commercial stations
90 percent of estimated to noncommercial stations
can vary depending on overall totals of all stations
Update estimated costs as circumstances change & final costs known

"True-Up" (t~39 mos) Upon completion or by a deadline TBD by FCC, file actual expense info and any remaining estimates. Excess goes back to FCC (details TBD).

All FCC payments to Treasury account must be made by t = 39 months (statutory 3 year)

Reimbursement for Eligible Expenses



Reimbursement goes to station involuntarily repacked

Impact at shared sites:

- TV stations not changing channel
- FM stations, other tower users
- Does contract specify obligations?

Reimbursement for Eligible Expenses

What if $1.75 billion not enough? MB to prioritize claims

FCC to hire contractor to administer reimbursement process

Waste & Fraud

- Progress reports required
- Keep receipts & documentation 10 years
- Audit, site visit, data validation by FCC or contractor
  - During and following reimbursement period

For transition concluding after t = 39 months, submit final expense docs

- Money recovered where actual < estimated can be disbursed to those stations where actual > estimated

Can dispose of old equipment at will

- Re-use at another station or donate

Reimbursement for Eligible Expenses

Only costs "reasonable to provide facilities comparable to those that a broadcaster… had prior to the auction"

Reasonable costs determined case-by-case

- must take reasonable steps to mitigate costs and share expenses

FCC "Catalog of Costs" to be released – general guidance not guarantee

- Provide justification for estimates that exceed catalog

Will not cover incremental costs for certain optional items

- Optional features beyond existing equipment's options
- New models may have improved functionality built-in – OK
- Expansion beyond 1% for non-priority stations (OK for priority)

Will cover interim facilities (additional transmitter, antenna, alternate site, temporary channel, modification to existing backup, purchase or rental)

No reimbursement for lost revenues or employee salary

Vendor and Service Provider Capacity

Depressed marketplace for equipment, industry has contracted since 2009

Threat of repacking, FCC freezes, general economy

Severe domestic impact

High-power TV antenna manufacturers

Tower crews capable of working on tall and complicated towers

Vendor and Service Provider Capacity

Transmitter Manufacturers, high power

Supply of new transmitters vs support for existing or orphaned

Engineering Resources – Limited Capacity

Structural Engineers

Field Engineering – Transmitter installation & modification

RF Consulting Engineers

Impact to LPTV, Television Translator, DRT

Not protected through repack
Many expected to be displaced by spectrum reallocation or repacked station
No reimbursement for channel change

FCC Mitigation
Special filing window for displaced operating facilities
opens after t = 3 months and DTV expansion/alternate channel filing
MX apps – settlement window, DRT priority, then auction

Additional DRT's "digital-digital" (losses brought by repack)

Facilities in 600 MHz band may continue to operate until notified by new licensee (120 day notice); if on guard band must cease at t = 39 months

Work in Progress - Open NPRM to address further
Channel reservation for unlicensed use?

"Perfect Storm" of challenges and shortages

Stations involuntarily repacked

Winning full power bidders for band changes

Site consolidation / expansion opportunity for others

STA's and interim operations

LPTV and translator station displacement and digital buildout

All will draw from the <u>same manufacturer and service provider resources</u>

Chesapeake RF Consultants, LLC
Radiofrequency Consulting Engineers
Digital Television and Radio

Comments, Questions?

Must be Miller Time…

Thank You!

Joseph M. Davis, P.E.

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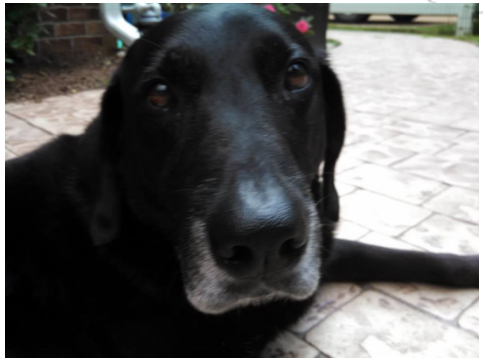

"RF Sniffer"