PierCon Solutions LLC
Specialists in Wireless Systems

Independent Radio Frequency Report Regarding a Proposed Wireless Communications Facility For T-Mobile Northeast, LLC

Site ID: "NJ06856D"

600 Frank E. Rodgers. Blvd. N.

Harrison, NJ 07029

Hudson County

Prepared for
T-Mobile Northeast, LLC

By

PierCon Solutions, LLC
April 9th, 2019

63 BEAVER BROOK RD., SUITE 201, LINCOLN PARK, NJ 07035 PHONE 973-628-9330 * FAX 973-628-9321

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1 PURPOSE AND SCOPE

PierCon Solutions LLC, an engineering firm specializing in wireless communications, performed an independent analysis regarding the radiofrequency engineering aspects of the proposal by T-Mobile Northeast, LLC to construct and operate a wireless telecommunications facility consisting of 12 antennas (4 per sector) at 600 Frank E. Rodgers Blvd. N., Harrison, NJ 07029. The purpose of this site is to relieve a significant gap in service in T-Mobile's network caused by insufficient capacity. The following report describes the results of this analysis and how those results apply to the purpose of the proposed site.

In preparation for conducting this analysis, PierCon Solutions obtained applicable engineering data from T-Mobile, considered the potential for alternative site locations, and considered relevant portions of the Town of Harrison ordinance for a wireless telecommunications facility.

The following report results from a thorough independent study and analysis (from a radiofrequency engineering perspective) of the applicant's proposal in consideration of the Town of Harrison's stated zoning goals and restrictions. It includes responses to specific sections of the conditional use ordinance of the Town of Harrison, addressing those provisions outlined in the ordinance.

2 GENERAL OVERVIEW

T-Mobile is a commercial wireless communications service provider licensed by the Federal Communications Commission (FCC) to provide wireless service in various frequency bands throughout Hudson County. The frequency bands to which T-Mobile is licensed for are the 600, 700, 1900, and 2100 MHz frequency bands. The wireless telecommunications facility proposed in this application is to provide coverage for voice and data in the form of technologies such as Third Generation (3G) data (speeds of 500Kbit/sec to 1000 Kbit/sec) and (4G) data (4 Mbit/sec to 10 Mbit/sec) and future regards to (5G) data.

In the T-Mobile network, the 700 MHz frequency band is reserved for a small 5 MHz LTE channel (4G), the 600 & 1900 MHz frequency bands are reserved for medium 10 MHz LTE channels, and the 2100 MHz frequency band is reserved for a large 20 MHz LTE channel and a small 5 MHz UMTS (3G) channel.

In order for T-Mobile to support existing legacy customers as well as transition to the latest 4G LTE service T-Mobile must operate their frequency bands on multiple technologies. Therefore, based upon spectrum allocation, T-Mobile operates both 3G UMTS and 4G LTE services on their 2100 MHz frequency band; and only 4G LTE service on their 600, 700 & 1900 MHz bands. The 2100 and 1900 MHz bands provide 4G LTE data in areas where high capacity is needed; such as Harrison, NJ. The 600 & 700 MHz frequency bands mainly provide 4G LTE data as a coverage overlay in areas where the higher frequencies have difficulties covering due to topography, terrain, and other clutter; however, the 600 & 700 MHz bands are limited in capacity due to the 10/5 MHz of licensed spectrum and may still require coverage at 1900/2100 MHz in specific areas of high utilization. All 4G LTE services provide access to voice calls with a technology called Voice over LTE (VoLTE).

The current 4th generation personal wireless service mobile network technology in use today is LTE. While users still have access to the legacy 3rd generation technology, most network traffic and all newer devices operate on the 4G / LTE services. When engaging in a VoLTE call, the user device will connect to the public switched telephone network (PSTN) through a gateway in order to complete a call to a non-LTE device. For example, a person making an emergency E911 call from a mobile device to a public safety operator on a landline, such emergency call will be routed through the PSTN.

3 DESIGN OBJECTIVES

The design objective for each wireless communications carrier is to provide seamless, ubiquitous, and reliable wireless service to their users, in accordance with the Wireless Communications and Public Safety Act of 1999. T-Mobile's design objectives are consistent with these goals. T-Mobile achieves this design objective by designing its network to supply signal levels sufficient enough to support reliable in-vehicle and in-building communications. Today's wireless systems, like T-Mobile's, provide enhanced communications beyond the initial expectations for voice communication along roadways. The demand to provide in-building communications, voice and data communications, and enhanced E-911 access is a paramount requirement in today's wireless systems.

Designing a wireless telecommunications network involves balancing the need for coverage and capacity. Coverage is the ability to provide reliable signal to the network of expected users. Capacity is the ability to support simultaneous user traffic and high data throughput. This design balance is accomplished through an analysis of demographics, terrain, and long term planning. Initially, system design focuses on providing wide-area coverage, particularly targeting the major highways and roads in an area. As the wireless communications system matures, the carrier's focus changes to increasing their ability to support anticipated volume of user traffic and data throughput, as well as providing coverage to additional locations in the area, such as business and residential districts.

The objective for the proposed site in this report is to provide additional capacity to the area surrounding the proposed site. The surrounding sites have exceeded the amount of usage which they can handle. The proposed site would alleviate the wireless traffic demands on the existing sites by providing additional capacity for users to access the T-Mobile network.

4 RADIO FREQUENCY ENGINEERING ACTIVITIES PERFORMED

In the course of the analysis described in this report, PierCon engineers performed the following tasks:

- Reviewed the conditional use ordinances of the Town of Harrison related to Cellular/Wireless Communications Towers
- Reviewed USGS Topographical Maps of the Town of Harrison and surrounding areas.
- Aerial analysis
- Performed an engineering site analysis and potential alternate locations.
- Reviewed the location and design of adjacent wireless communications facilities
- Reviewed the RF design and objective within and surrounding the Town of Harrison.

5 RADIO FREQUENCY DESIGN

Documentary evidence regarding the need for the proposed telecommunications facility at the proposed location was obtained by PierCon Solutions from T-Mobile's Traffic Performance tool (OneData) in the form of 4G LTE capacity data. The capacity data was used to produce capacity charts which show the amount of usage on surrounding sites. T-Mobile deploys 4G LTE data channels on all of its frequency bands. The 2100 MHz frequency band has the largest channel at 20 MHz wide, meaning that most of the data which is used on the T-Mobile network occurs within the 2100 MHz LTE channel.

Capacity exhaustion occurs when a sector of a wireless facility can no longer handle the data/voice demands of consumers. An analysis was performed in the vicinity of the proposed site which determined that 3 surrounding wireless facilities, NJ05313C, NJ05826A, and NJ05509A, that are providing signal to the area, have reached their capacity limits. Please see attached Exhibit A, Detailed Site Map which demonstrates the following:

- The proposed facility location identified by the Pink dot
- Existing facility locations near the proposed location where red outlined sectors represent T-Mobile LTE Sectors
- T-Mobile LTE Sectors which will benefit greatly from the proposed installation are highlighted in yellow and outlined in red. These sectors are currently exhausted

As depicted by Exhibit A, these sectors currently provide coverage in the direction of and are located within 1 mile of the proposed facility.

Please find attached Exhibit B "LTE Capacity Charts" showing the LTE capacity in the 2100 MHz frequency band for three existing T-Mobile facilities in the area, namely the NJ05313C Beta Sector, NJ05826A Alpha and Delta sectors, and NJ05509A Beta sector. In addition to the 2100 MHz frequency band, the 1900 and 700 MHz frequency bands for NJ05826A Delta sector are shown. Each of the capacity charts in Exhibit B has several components;

- The capacity of the site, depicted by the red line, represents the 70% utilization[1] threshold of the sector.
- The actual utilization of the site, depicted by the orange line, represents the data usage of the site since September 2018.
- As depicted by the charts from September 14th 2018 to April 2nd 2019, each of the surrounding sectors has exceeded the 70% threshold and is at or near 100% utilization.

The proposed facility will provide data capacity relief to T-Mobile's LTE network, specifically those existing facilities as provided in Exhibit A. The proposed site is intended to provide offload in the area bounded by Woodland Ave, Sheridan Ave, Patterson St, and Cross St (this area is known as the Target Area). Currently, each facility that is exhausted is at or near 100% utilization and needs relief. Adding a new installation will allow data traffic in the area to be offloaded onto the proposed facility.

6 RADIO FREQUENCY ENGINEERING RESPONSES TO THE ORDINANCE

The following section of the report addresses the RF Engineering responses to Section 17-82.10-Conditional Uses of the Town of Harrison's ordinance. Each section of the checklist is provided and the RF Engineering responses immediately follow.

B. Requirements for specific uses.

5. Cellular/Wireless Communication Towers, Antennas and Associated Facilities and Devices. Cellular/wireless communication towers, antennas and associated facilities and devices (hereinafter collectively referred to as "cellular antennas" shall be permitted in the CC and I zones, provided that no cellular antennas shall be sited within two hundred fifty (250) feet of an SF-1, SF-2. SF-3, 2F-1, 2F-2, 3F, A, or SH zone, and further subject to compliance with the following requirements:

Regarding the permitted CC and I zones; the closest CC zone is approximately 2600 feet to the south and the closest I zones are approximately 3000 feet to the southeast. Due to this distance these zones would not be able to provide sufficient coverage to the Target Area and offload the existing sites. Therefore neither of these zones could be utilized.

[1] The capacity of a sector is shown to be 70% for the following reasons. Data usage across all wireless telecommunications networks is rapidly increasing. Ideally, a new site should be built before an existing sector reaches 90-100% utilization (Poor user experiences occur at these higher utilization amounts). The process of identifying a feasible structure/location, having a willing landlord, and going through the process of planning/zoning takes many months to complete. In order to avoid poor user experiences the new site process needs to be started when a sector has reach 70% utilization.

c) Comprehensive Plan. In order to provide proper evidence that any proposed location of cellular antennas (and any supporting tower and/or ancillary building enclosing related electronic equipment) has been planned to result in the fewest number of towers within the Town of Harrison, the applicant shall submit a "Comprehensive Plan." Said Comprehensive Plan shall indicate how the applicant proposes to provide full service throughout the Town of Harrison from its proposed location. To the greatest extent possible, said Comprehensive Plan shall also indicate how the applicant's plan is coordinated with the needs of all other providers of cellular communication services within the Town of Harrison.

This report is the comprehensive plan required in the ordinance. The proposed facility is not a new tower, and therefore is not increasing the number of cellular towers within the Town of Harrison. As stated previously in this report, the proposed facility will increase the capacity of the Town of Harrison allowing for the increased ability to access the T-Mobile network. While T-Mobile cannot comment on whether other wireless providers intend to utilize this existing building as a wireless facility, T-Mobile is not in opposition to such a colocation. Several surrounding existing T-Mobile wireless facilities are colocations with other wireless carriers, and it would seem reasonable for other wireless carriers to also need an additional facility in this area. This engineer did not collect any capacity or coverage data for wireless carriers other than T-Mobile.

e) Maximum height. The applicant shall demonstrate that total requested height for location of the cellular antenna is minimum height necessary to achieve the purposes of the cellular antenna.

The antennas are proposed to be located 8' 9" higher than the parapet wall. In order to achieve significant coverage the antennas must have good line of sight over the surrounding existing structures. Having the antennas any lower can seriously hinder T-Mobile's ability to provide reliable coverage.

f) Design details.

2) Microwave antennas shall be prohibited for transmission of signals where ground lines are reasonably available.

Temporary microwave antennas are proposed in order to allow the site to function as quickly as possible. Fiber will be ordered to the site upon approval. Once fiber has been run to the facility the microwave dish is no longer required.

7 CONCLUSION

PierCon Solutions' analysis of T-Mobile's existing network indicates that a significant gap in wireless service exists (due to capacity) within the Town of Harrison. The application by T-Mobile proposes to construct a new wireless telecommunications facility at 600 Frank E. Rodgers Blvd. N., Harrison, NJ 07029. The proposed installation, consisting of 12 antennas, will alleviate capacity deficiencies and provide reliable service as described above.

PierCon performed a thorough review of the wireless code and has addressed each section to which a response from a radiofrequency engineering perspective was applicable. The operation of this facility will enable T-Mobile to provide reliable wireless service to the Town of Harrison and to remedy the identified service gaps. After performing the independent radiofrequency analysis, PierCon Solutions concludes that this facility is essential to T-Mobile's network design for the Town of Harrison.

Report Prepared by:

Benjmain Blankstein
Associate RF Engineer
04/09/2019
PierCon Solutions, LLC

Report Reviewed by:

Frances Boschulte
RF Manager
04/09/2019
PierCon Solutions, LLC

8 APPENDIX - EXHIBITS

- *Exhibit A – Detailed Site Map*
- *Exhibit B – LTE Capacity Charts*

NJ06856D

Detailed Site Map
Existing & Proposed Sites

600 Frank E. Rodgers Blvd. N.
Harrison, NJ

- Proposed T-Mobile Facility
- T-Mobile Sites
- T-Mobile LTE Sectors
- T-Mobile LTE Exhausted Sectors

PierCon Solutions LLC
Specialists in Wireless Systems

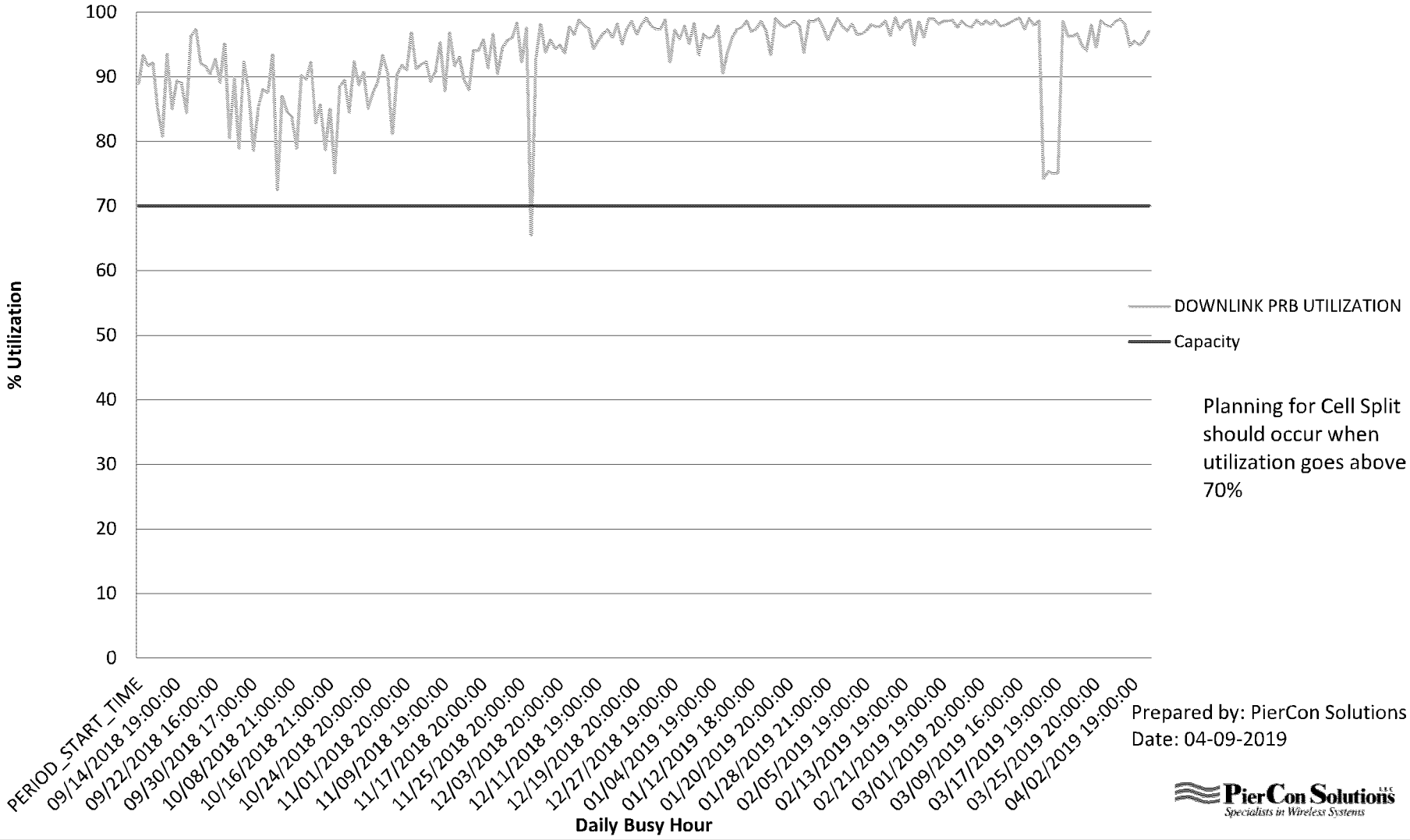
T-Mobile

Prepared By: Piercon Solutions LLC
Date: 04/08/19

Exhibit B - LTE 2100 Capacity Chart for NJ05313C (Beta)

T · ·Mobile·

Application:
NJ06856D
600 Frank E Rodgers Blvd, Harrison, NJ 07029



Prepared by: PierCon Solutions
Date: 04-09-2019

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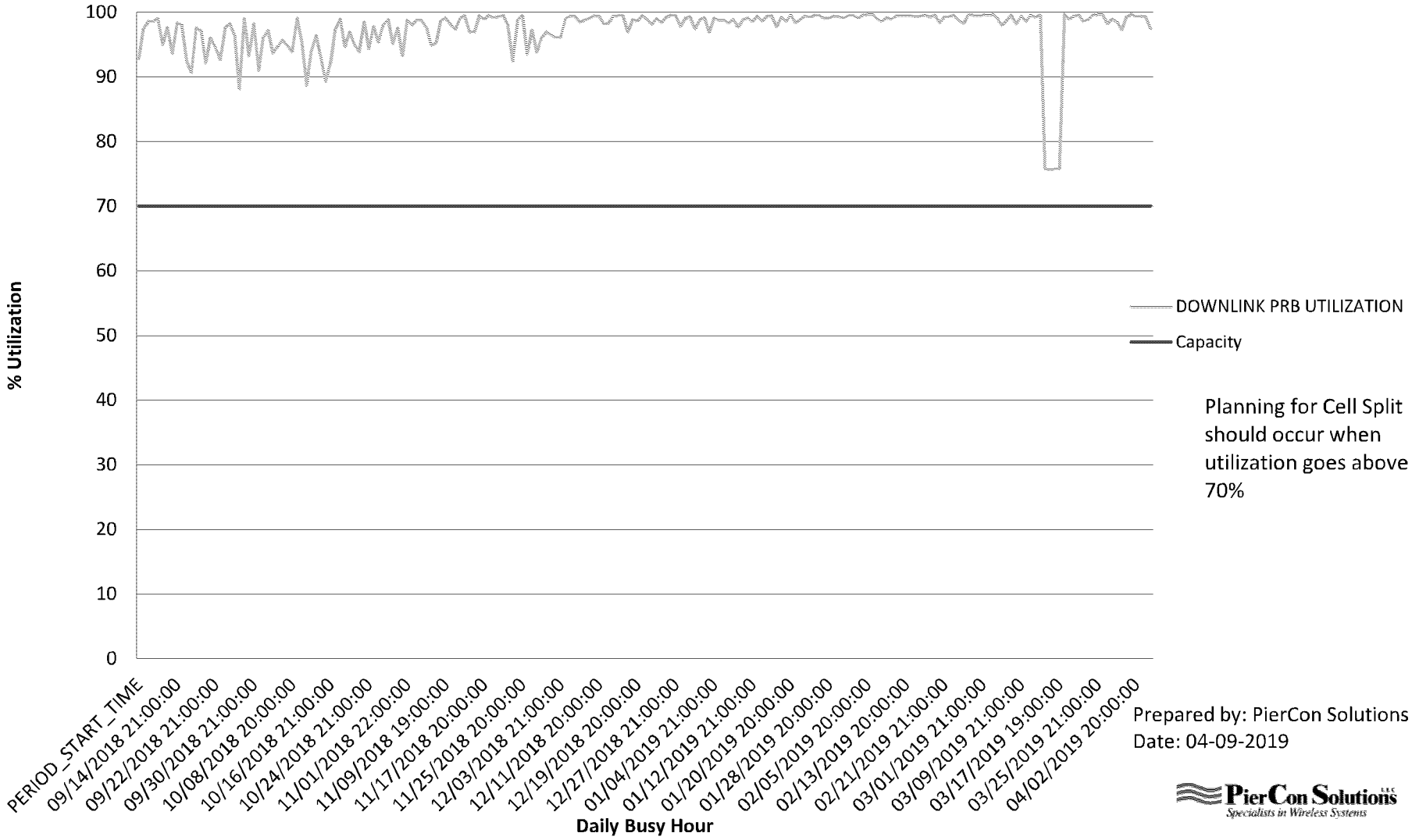
Exhibit B - LTE 2100 Capacity Chart for NJ05826A (Alpha)

T-Mobile

Application:
NJ06856D
600 Frank E Rodgers Blvd, Harrison, NJ 07029



Planning for Cell Split should occur when utilization goes above 70%

Prepared by: PierCon Solutions
Date: 04-09-2019

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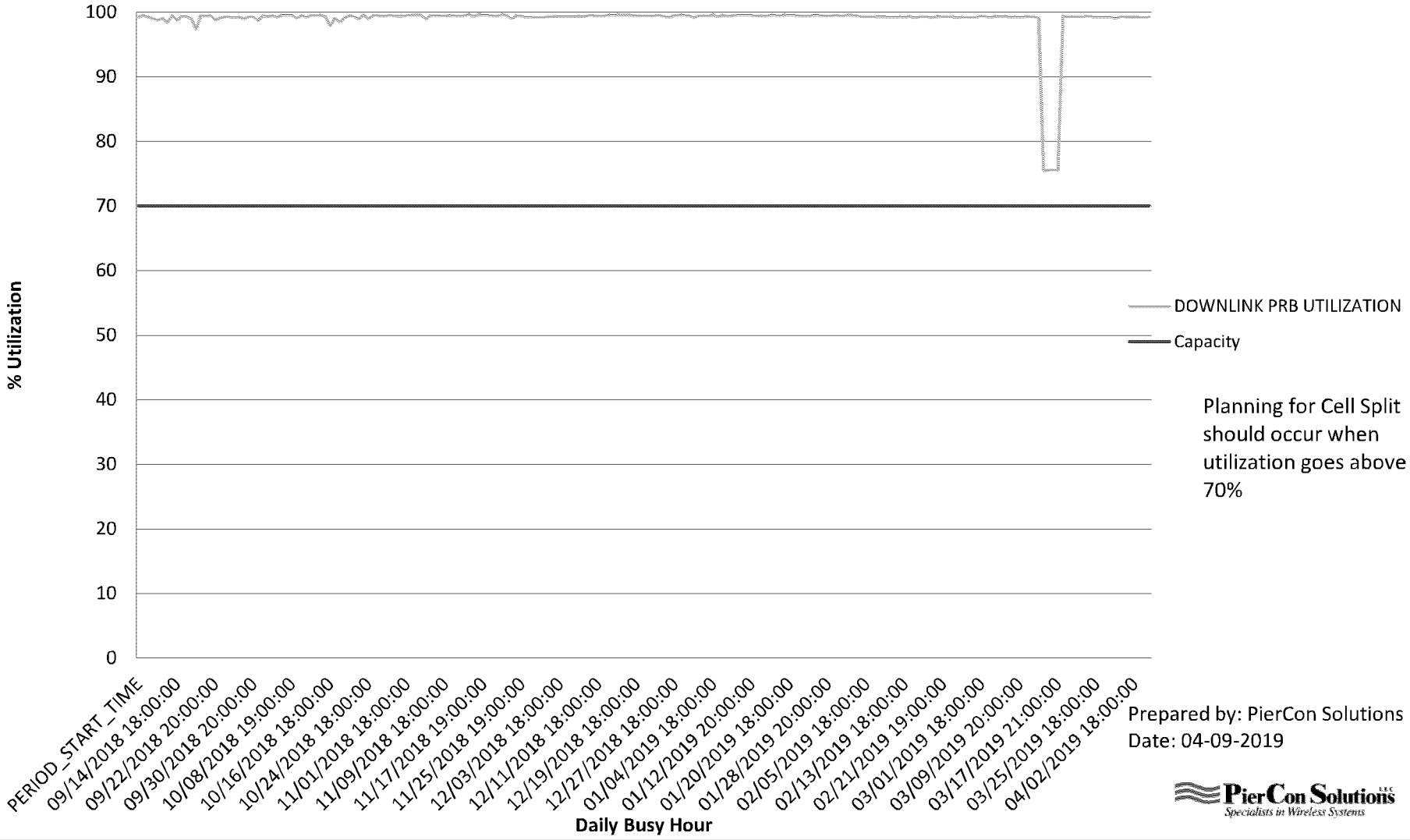
Exhibit B - LTE 2100 Capacity Chart for NJ05826A (Delta)

T · ·Mobile·

Application:
NJ06856D
600 Frank E Rodgers Blvd, Harrison, NJ 07029



Planning for Cell Split should occur when utilization goes above 70%

Prepared by: PierCon Solutions
Date: 04-09-2019

PierCon Solutions LLC
Specialists in Wireless Systems

Exhibit B - LTE 1900 Capacity Chart for NJ05826A (Delta)

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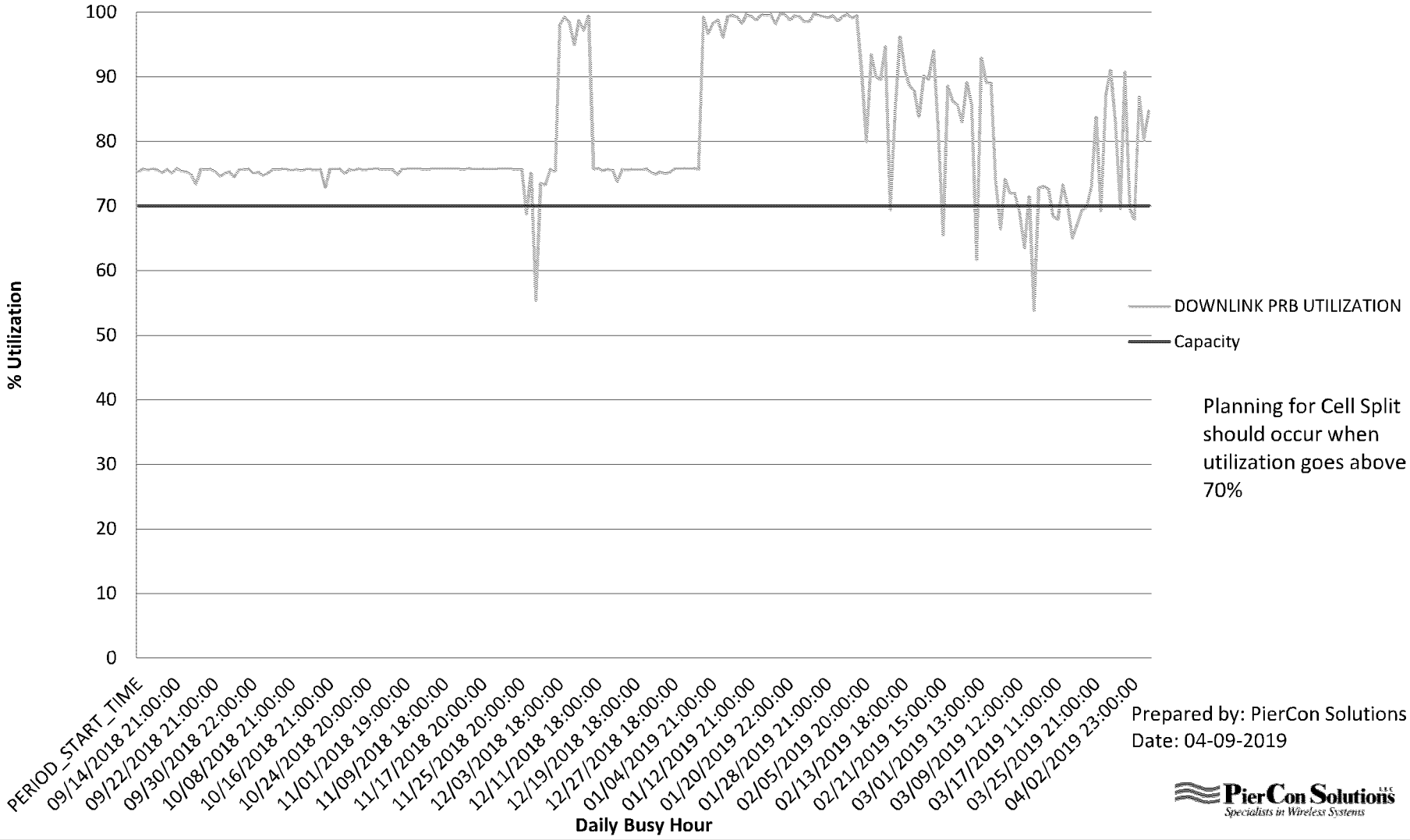
Application:
NJ06856D
600 Frank E Rodgers Blvd, Harrison, NJ 07029



Planning for Cell Split should occur when utilization goes above 70%

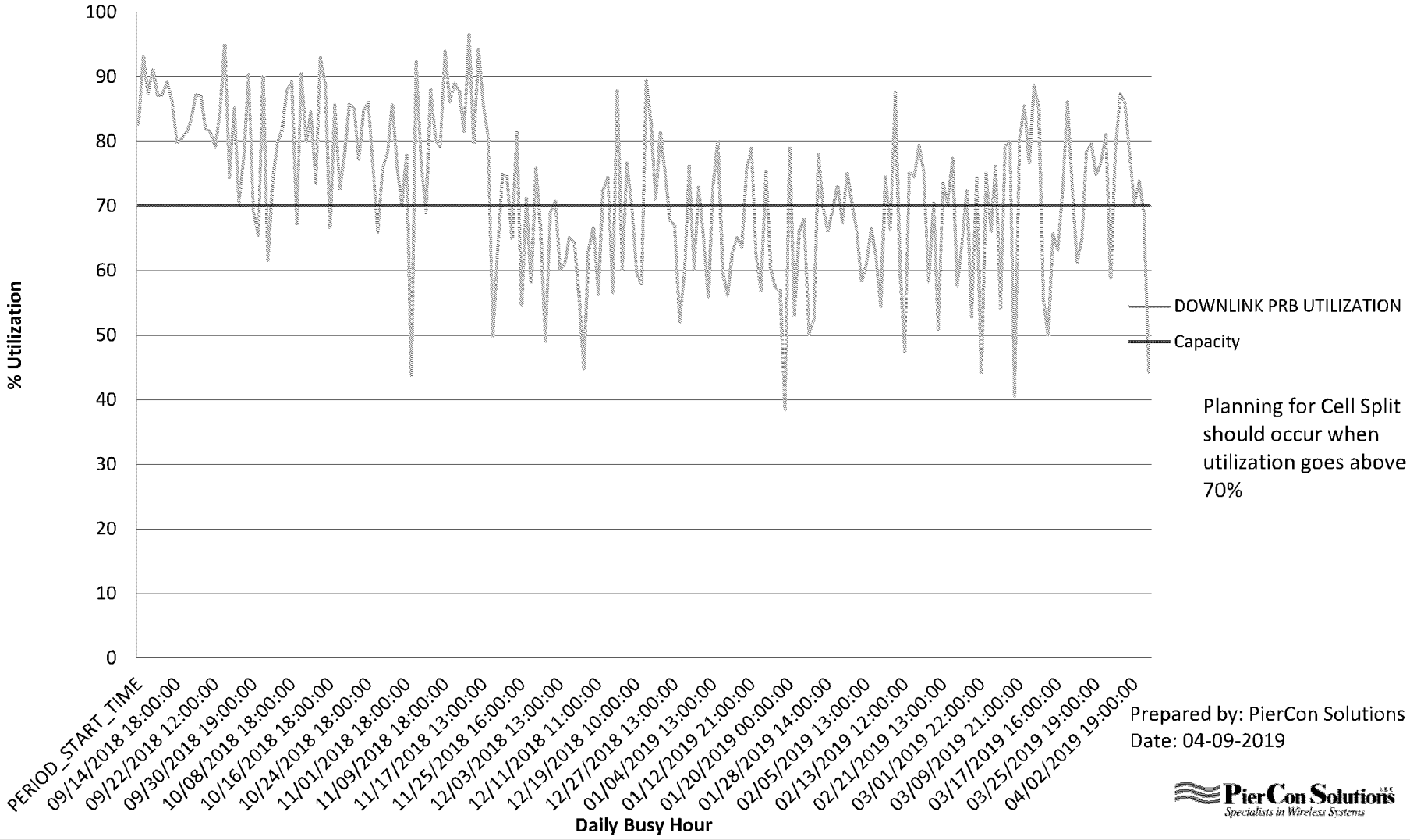
Prepared by: PierCon Solutions
Date: 04-09-2019

PierCon Solutions LLC
Specialists in Wireless Systems

Exhibit B - LTE 700 Capacity Chart for NJ05826A (Delta)

T · ·Mobile·

Application:
NJ06856D
600 Frank E Rodgers Blvd, Harrison, NJ 07029



Planning for Cell Split should occur when utilization goes above 70%

Prepared by: PierCon Solutions
Date: 04-09-2019

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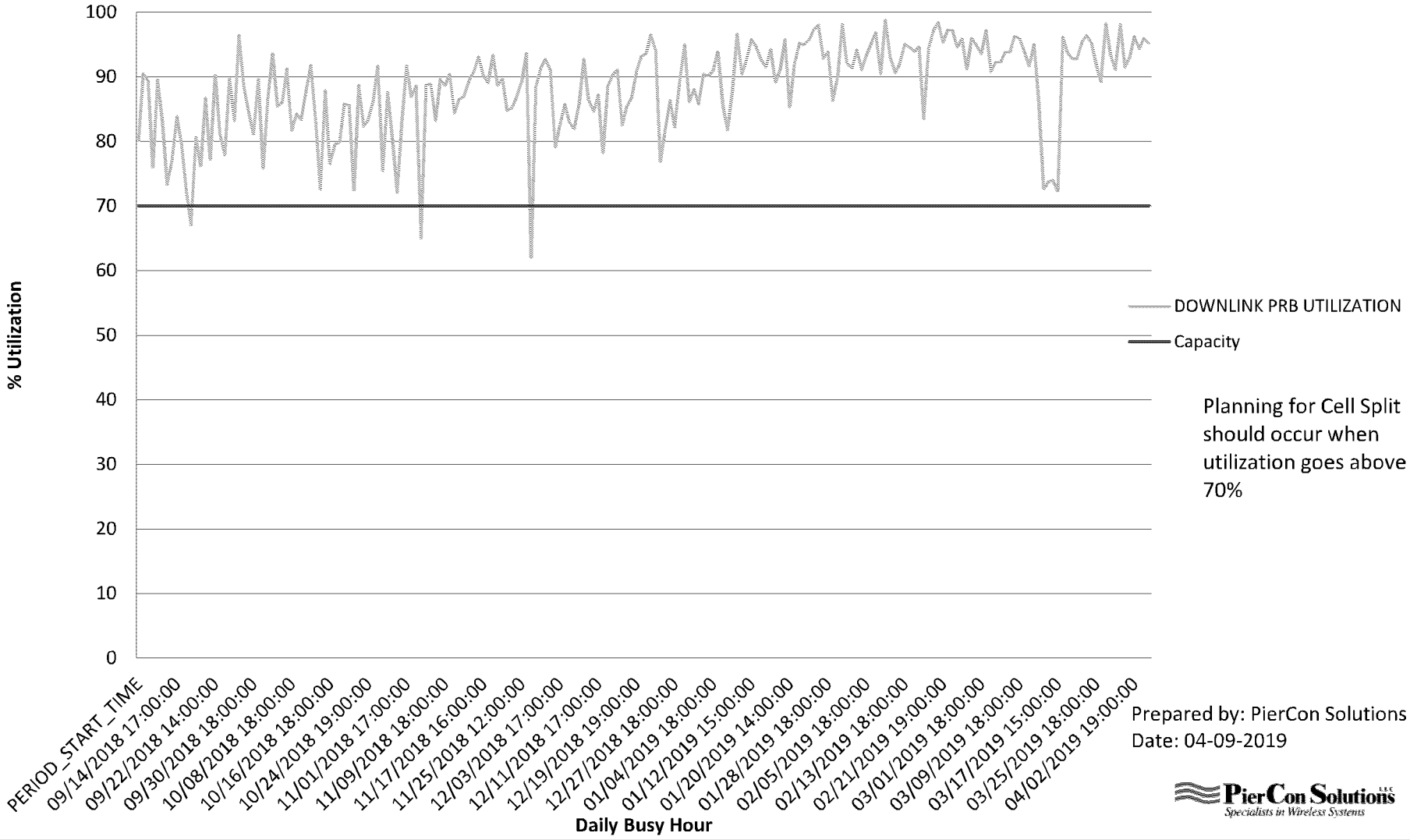
Specialists in Wireless Systems

Exhibit B - LTE 2100 Capacity Chart for NJ05509A (Beta)

T · ·Mobile·

Application:
NJ06856D
600 Frank E Rodgers Blvd, Harrison, NJ 07029



Planning for Cell Split should occur when utilization goes above 70%

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Date: 04-09-2019

PierCon Solutions LLC
Specialists in Wireless Systems