SUMMARY OF PROPOSED COMPREHENSIVE BROADBAND TELECOMMUNICATIONS PLAN FOR SOUTHEASTERN WISCONSIN

A regional wireless plan that provides universal geographic coverage in all parts of the Region at fourth generation (4G) performance levels has been selected as the primary broadband telecommunications plan for Southeastern Wisconsin. This regionally-focused plan was the only one of the four alternative plans evaluated that provided both full geographic coverage throughout the Region and broadband throughput performance to fourth generation (4G) standards. The regional wireless plan also integrates the broadband communications needs of public safety and other governmental functions with the private commercial needs of economic development. The plan is set forth in SEWRPC Planning Report No. 53, *A Regional Broadband Telecommunications Plan for Southeastern Wisconsin.*

The regional wireless plan is shown on Map 1. The network infrastructure consists of 141 antenna base stations installed at existing tower sites on a co-location basis. An Internet fiber optic link gateway is provided at each tower site as part of a fiber optic backhaul network. Each antenna site supports a four sector configuration, 90 degrees each. The technology employed is IEEE Standard 802.11a, also known as WiFiA, the higher frequency version of WiFi, with a public safety band of 4.9 GHz and a commercial band at 5.3 GHz. The antenna site density as shown on Map 1 varies with higher densities in urban areas and lower densities in rural areas. This variation is required, in part, because of the higher building "clutter" in urban areas and in part to serve the heavier traffic volumes that may be expected in areas with higher population density. While originally designed to serve fixed users, the regional wireless network would also provide broadband services for nomadic (laptop computer) users. While such users do not typically have the same transmit power or receiver sensitivity as fixed users, service to such users will be augmented using fixed users as repeater sites for nomadic users. With this approach, service to nomadic users will improve and approach that of fixed users as the number of fixed users rises. Furthermore, with advancing antenna and electronic technology in laptop computers, the need for repeaters may be expected to decline over time as fixed and nomadic transceivers become more similar in performance characteristics.

Although the regional wireless plan was selected as the preferred telecommunications plan for the Region because of its combined contributions to high speed throughput performance, region-wide geographic coverage, and public safety, the regional telecommunications planning process recognizes the existence of and plans for two other broadband telecommunications systems:

1. Community-based wireless communications systems

2. Fiber-to-the-Node (FTTN) wireline communications systems

The community-based wireless plan provides guidance to local units of government interested in deploying broadband wireless networks in their communities. An example of such a plan is shown for the Town of Wayne in Washington County (see Maps 2 and 3). Map 2 illustrates the local wireless area network and Map 3 the wireless backhaul network. This network has been partially deployed on an experimental basis in recent weeks (October 2007). Four 20-foot access point sectoral transceivers are required to provide full geographic coverage in the Town. The system presently is providing throughput performance at 10 to 15 megabits per second to the initial users both in the upstream and the downstream direction. This Internet performance far exceeds that available to users with telephone-based DSL or cable service broadband which typically average only 1 to 3 megabits per second. The regional plan recommended 4G performance standard is 20 megabits per second in both directions.

An example of a more urban community wireless plan, that for the Village of Grafton and the City of Cedarburg, is illustrated on Map 4. Full geographic coverage of the two communities would be provided by 41 access points. Wireless backhaul to a gateway provides connection to the Internet. Performance levels of the Cedarburg-Grafton network plan would be expected to be similar to those in the rural Town of Wayne. The extent of community-based wireless networks in the Region will depend on initiatives of individual communities. Neither Grafton nor Cedarburg have pursued the joint community plan shown on Map 4.

AT&T is currently deploying its Fiber-to-the-Node (FTTN) wireline network in many parts of the Region. This FTTN network provides downstream throughput as high as 25 megabits per second, but is presently operated to provide only about 1 megabit per second in the upstream direction. Most of the downstream bandwidth is to be allocated to television broadcasting, with about 7 megabits per second made available for Internet data services. Although providing a greatly improved level of service over existing facilities, it is unlikely that the FTTN network will provide universal geographic coverage in the Region. Its coverage likely will not extend beyond the urban service areas of the Region which cover only about 36 percent of the geographic area of the Region (see Map 5).

Selection of the regional wireless plan as the preferred broadband telecommunications plan was based upon an evaluation of four alternative plans against the following objectives:

1. Performance - Achieve 20 megabits per second in both directions.

2. Universal Geographic - Provide Region-wide geographic coverage.

3. Infrastructure Cost - Lower cost networks are favored.

4. Redundancy - Alternative transmission paths provide higher network reliability.

5. Public Safety - Joint public safety/commercial communications are particularly cost effective.

6. Most Demanding Application - Broadcast or interactive video is the most demanding application.
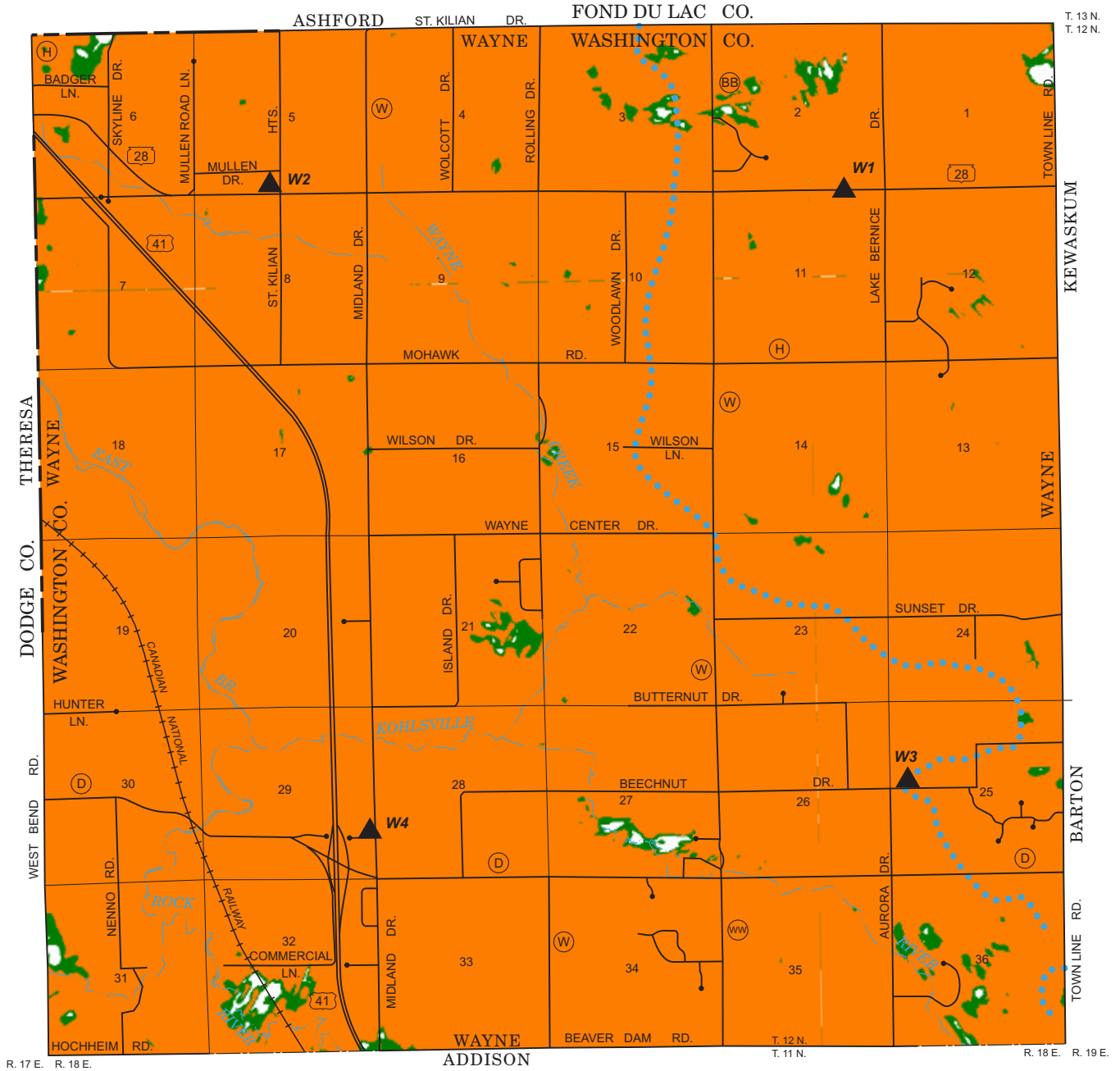
Commentary on each of the alternative plans is set forth in Table 1. The superior nature of the regional wireless plan is evident from the commentary. Its low cost, universal coverage, symmetric 4G-level performance, and strong support of public safety made it the best choice.

The primary alternative broadband telecommunications plans are designed to serve primarily fixed users and secondarily nomadic users. These plans do not address the needs of mobile (cell phone) users. Cellular coverage for voice communications is quite adequate in the Region with the exception of some outlying rural areas in Ozaukee, Washington, Waukesha and Walworth Counties. Mobile data communications of 4G (20 megabits per second) or even 3G (2 megabits per second) do not exist in the Region. Two alternative mobile wireless plans were developed for the Region – one based on the new mobile WiMAX technology (IEEE standard 802.16e) and the other based on a mobile version of WiFi (802.11g). WiMAX was selected for evaluation since an existing carrier in the Region (Sprint Nextel) has adopted WiMAX as its next generation of wireless technology. However, Sprint Nextel has made no firm commitment to deploy WiMAX in Southeastern Wisconsin. The WiFi mobile wireless plan is an adjunct plan to either the selected regional wireless plan or any of the community-based wireless network installations.

Commentary on the two mobile wireless plans is also included in Table 1. Based on present specifications obtained from Motorola on 802.16e WiMAX, the technology is not feasible for deployment in Southeastern Wisconsin. Its deployment cost and its need for over 300 new base stations makes its deployment in Southeastern Wisconsin extremely unlikely. The WiFi mobile wireless plan is an adjunct to the regional or community-based wireless plan, is cost effective, and was selected as the adjunct mobile wireless plan for the Region.

Map 1

RECOMMENDED REGIONAL BROADBAND WiFiA WIRELESS SYSTEM PLAN FOR SOUTHEASTERN WISCONSIN

LEGEND

▲ ANTENNA BASE STATION SITE (141)

RECEIVED POWER AT REMOTE: LESS THAN -114.0 dBmW

RECEIVED POWER AT REMOTE: -122.0 dBmW to -114.0 dBmW

AREA OF LOW SIGNAL COVERAGE

GRAPHIC SCALE

0 1 2 3 4 5 6 MILES

0 5 10 15 20 25 30 35 40,000 FEET

Source: SEWRPC.

3

Map 2

COMMUNITY-BASED WIRELESS PLAN—TOWN OF WAYNE

LEGEND

▲ ACCESS POINT LOCATIONS

W3 IDENTIFICATION NUMBER

RECEIVED POWER AT REMOTE:
GREATER THAN -113.0 dBmW,
THROUGHPUT: 24 Mpbs TO 54 Mbps

RECEIVED POWER AT REMOTE:
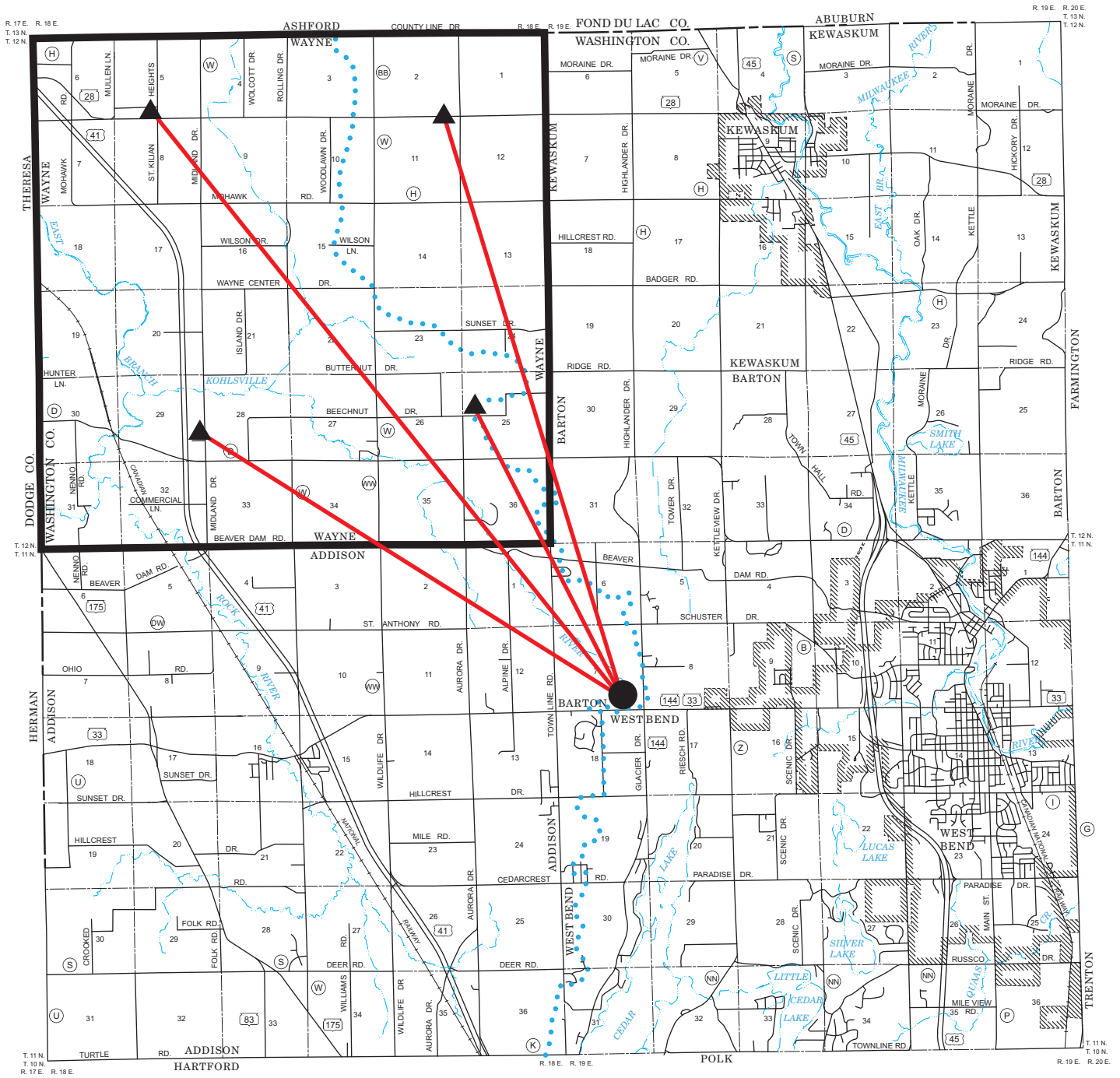-121.0 TO -113.0 dBmW,
THROUGHPUT 6 TO 24 Mbps

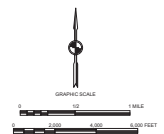AREA NOT WITHIN ACCEPTABLE COVERAGE

Source: SEWRPC.
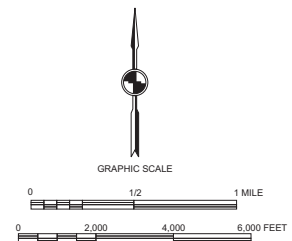
Map 3

WIRELESS BACKHAUL NETWORK SERVING THE TOWN OF WAYNE
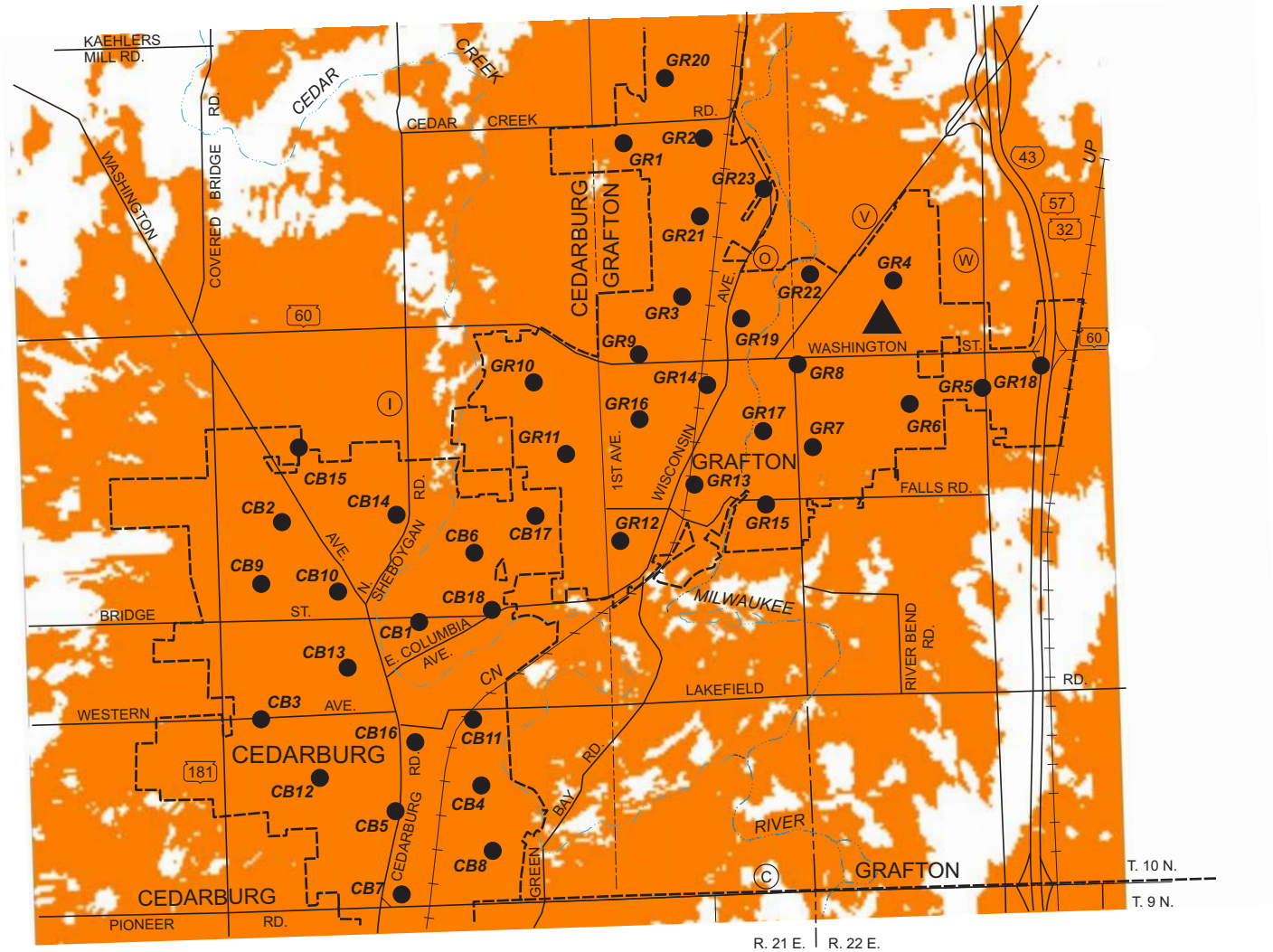

LEGEND

● INTERNET GATEWAY

▲ ACCESS POINT
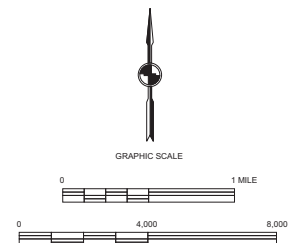
▬ TOWN OF WAYNE

Source: SEWRPC.

Map 4

COMMUNITY-BASED WIRELESS PLAN—CEDARBURG-GRAFTON AREA

LEGEND

▲ EXISTING BASE STATION TO BE USED FOR WiMAX APPLICATION

● RECOMMENDED LOCATION OF WiFi ACCESS POINT

GR3 IDENTIFICATION NUMBER

RECEIVED POWER AT REMOTE:
-70dBmW TO -87dBmW,
THROUGHPUT: 24 Mpbs to 54Mbps

AREA NOT WITHIN ACCEPTABLE COVERAGE

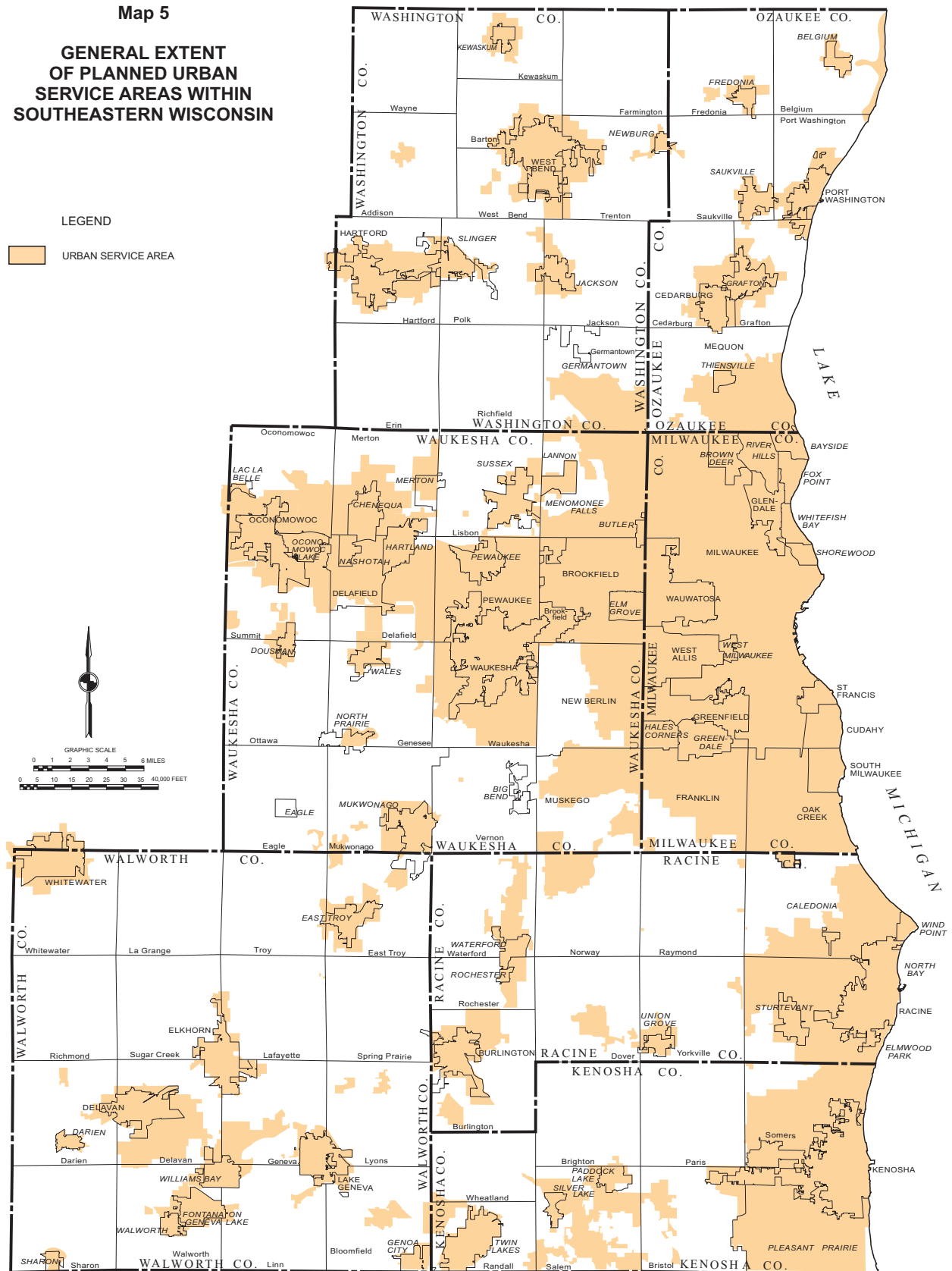GRAPHIC SCALE

Source: SEWRPC.

Map 5

**GENERAL EXTENT
OF PLANNED URBAN
SERVICE AREAS WITHIN
SOUTHEASTERN WISCONSIN**

LEGEND

URBAN SERVICE AREA

GRAPHIC SCALE

0 1 2 3 4 5 6 MILES

0 5 10 15 20 25 30 35 40,000 FEET

Source: SEWRPC.

Table 1

SUMMARY OF SALIENT CHARACTERISTICS OF ALTERNATIVE REGIONAL TELECOMMUNICATIONS PLANS

Plan	Universal Geographic Coverage	Performance	Infrastructure Cost	Redundancy	Public Safety	Most Demanding Application
Community-Based Wireless Plan	Geographic coverage depends on a community-by-community plan implementation	Meets the throughput standard but may have less speed improvement potential than fiber-based systems	Plan is much lower in cost than fiber-based systems $20.3 million	Built-in redundancy is possible using peer-to-peer communications feature to be field tested as part of the regional wireless plan	Joint 4.9 GHz frequency operation for public safety communications is possible as an added feature in a community network	Plan is not designed for broadcast video services but is well suited to video con-ferencing
Regional Wireless Plan	Plan specifies coverage for the entire Region, but implement-ation depends on a county-by-county deployment	Meets the throughput standard but may have less speed improvement potential than fiber-based systems	Plan is the lowest in infrastructure cost by a wide margin $6.4 million	Plan will have inherent redundancy for both alternative transmission paths and for failure of infrastructure base stations	Plan has specific separate network for public safety	Plan is not designed for broadcast video services but is well suited to video conferencing
Fiber-to-the-Node (FTTN) Wireline Plan	Plan will cover only 35 percent of the geographic areas of the Region	Plan will meet throughput standards in the downstream but not the upstream direction	For a third of the geographic coverage, plan is more than 10 times the cost of the Regional Wireless Plan $77.7 million	Plan has no explicit redundant transmission paths	Plan does not specifically provide for public safety communications except for priorities in times of public emergency	Plan emphasizes the video broadcast application. Slow upstream throughput is not compatible with video conferencing
Fiber-to-the-Premises (FTTP) Wireline Plan	Plan, like the FTTN plan, covers only 35 percent of the Region	Plan will have the greatest throughput potential of any plan	It is the most costly of all of the plans $246.0 million	Plan has no explicit redundant transmission paths	Plan does not specifically provide for public safety communications except for priorities in times of public emergency	Plan is well suited to both broadcast video and video con-ferencing
WiMAX Mobile Wireless Plan A	Economic considerations will limit coverage in low density rural area	Plan provides for 4G throughput performance	The cost far exceeds that of the WiFi mobile wireless plan $38.0 million	There is no provision for network redundancy	There are no specific public safety features in this plan	Videoconferencing is supported in this plan
WiFi Mobile Wireless Plan B	Operating with both the regional and community-based wireless networks, this plan provides for full regional coverage	Plan provides for 4G throughput performance	Infrastructure costs are minimal and relate to augmentations of the other two wireless plans $1.0 million	Plan calls for redundancy using peer-to-peer transmission paths	Plan allows for integration with 4.9 GHz public safety wireless network	Video conferencing is supported in this plan

Source: SEWRPC.