MEMORANDUM REPORT NO. 166

SECTORAL CELLULAR WIRELESS NETWORK PLAN TOWNS OF ADDISON AND WAYNE

WASHINGTON COUNTY WISCONSIN

SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

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Special acknowledgement is due Mr. Jason W. Zehrung, Senior Telecommunications Planner, for their contributions to this report.

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SECTORAL CELLULAR WIRELESS NETWORK PLAN TOWNS OF ADDISON AND WAYNE WASHINGTON COUNTY, WISCONSIN

Prepared by the

Southeastern Wisconsin Regional Planning Commission

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INTRODUCTION

The Southeastern Wisconsin Regional Planning Commission is charged by law with the function and duty of "making and adopting a master plan for the physical development of the Region." The permissible scope and content of this plan, as outlined in the enabling legislation, extend to all phases of regional development, implicitly emphasizing, however, the preparation of spatial designs for the use of land and for supporting transportation and other utility facilities, including telecommunications facilities.

Because regional telecommunications planning comprises an integral part of a broader regional planning program, the Commission is developing a region-wide telecommunications plan. One major component of this plan is a regional wireless telecommunications plan. This plan will define a two-level hierarchical network comprised of a set of lower level community WiFi (IEEE 802.11g) networks and an upper level WiFiA (802.11a) regional backhaul network. The WiFiA backhaul network services multiple WiFi networks throughout the region providing high volume, low-cost Internet connections at special backhaul stations called gateways. This regional WiFiA backhaul network is to be described in SEWRPC Planning Report No. 51, *A Wireless Antenna Siting and Related Infrastructure Plan for Southeastern Wisconsin*, which is scheduled to be published in July of 2006.

Planning Report No. 51 envisions the preparation of plans for and the development of local wireless telecommunication plans by local communities or groups of communities. This report will describe a community level wireless telecommunication plan for the Towns of Addison and Wayne in Washington County, Wisconsin. This plan has been prepared in response to letters requesting the Commission to prepare a broadband wireless telecommunication plan for the Towns of Addison and Wayne. The former letter request was dated March 31, 2006; and the latter was dated April 19, 2006.

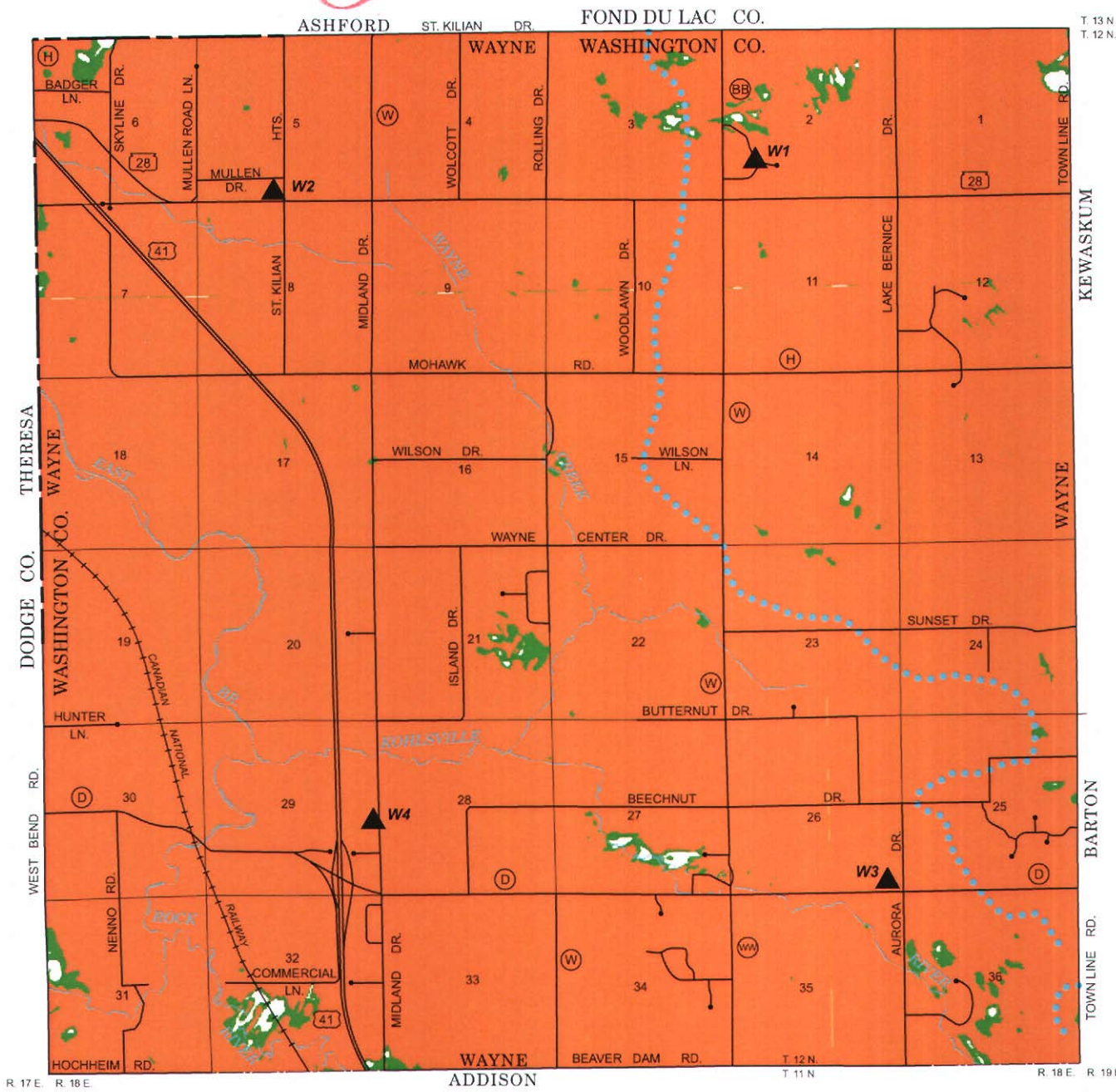
SECTORAL CELLULAR WIRELESS NETWORK PLANS – TOWNS OF ADDISON AND WAYNE

The wireless telecommunication plan for the Towns of Addison and Wayne is shown in Maps 1, 2, 3, and 4. On Map 1, the proposed four access points for the Town of Wayne are shown at their preferred locations. Each access point is assumed to be mounted on a utility pole at a height of twenty feet or higher. Each access point is to serve three 120 degree sectors creating a cellular structure that provides geographic coverage throughout the Town. The orange colored areas provide a fixed user with a potential data transmission rate exceeding 24 megabits per second. The green areas represent lower signal level coverage and reduced data throughput, but still with rates above 6 megabits per second. The few white areas represent areas of reduced signal levels, that must be investigated through a field test study to verify the signal level coverage in those areas. Although most of these white areas are believed to represent uninhabited low lying areas, any inhabited area will be brought up to standards by access point adjustments in the design of a final plan.

Map 2 represents the backhaul network to the point of presence (POP) gateway along USH 41. At this gateway, there would be an interconnection to a fiber-based Internet channel. The proposed access points for the Town of Addison are shown on Map 3. Four access points also provide complete high data rate coverage for this Town. Map 4 shows the backhaul linkages for the Town of Addison. Since the two towns are directly adjacent, the potential savings from a joint plan were investigated. The savings proved to be substantial. The number of access points in a

Map 1

POTENTIAL LOCATIONS OF WiFi ACCESS POINTS AND ATTENDANT PERFORMANCE OFACCESS NETWORK FOR FIXED USERS IN THE 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

GRAPHIC SCALE

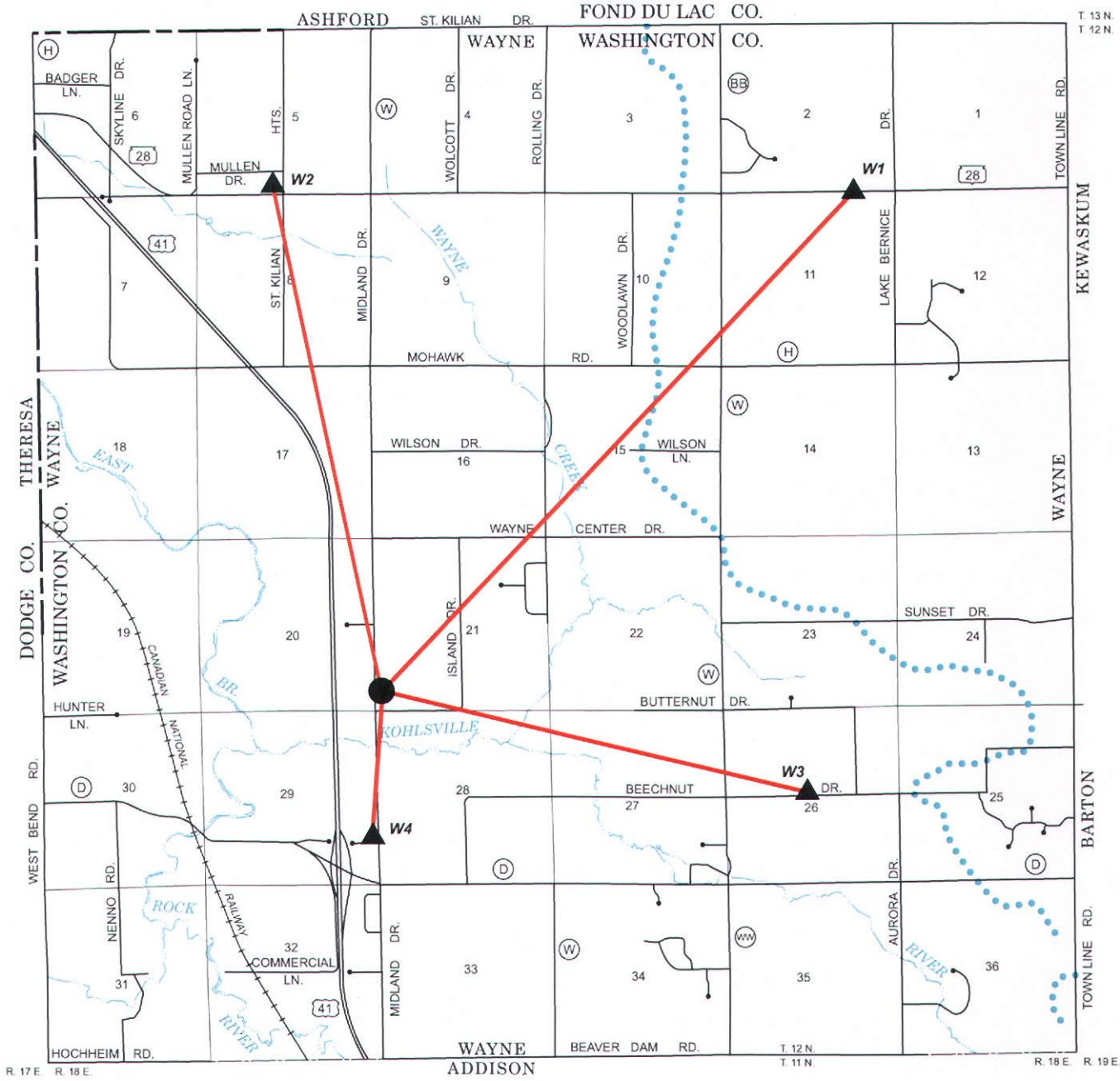
0 1/2 1 MILE

0 2,000 4,000 6,000 FEET

Source: SEWRPC.

Map 2

POTENTIAL LOCATIONS OF ACCESS POINTS AND ACCESS NETWORK GATEWAY FOR BACKHAUL IN THE TOWN OF WAYNE



LEGEND

- BASE STATION GATEWAY
- ACCESS POINT LOCATIONS
- *W3* IDENTIFICATION NUMBER

GRAPHIC SCALE

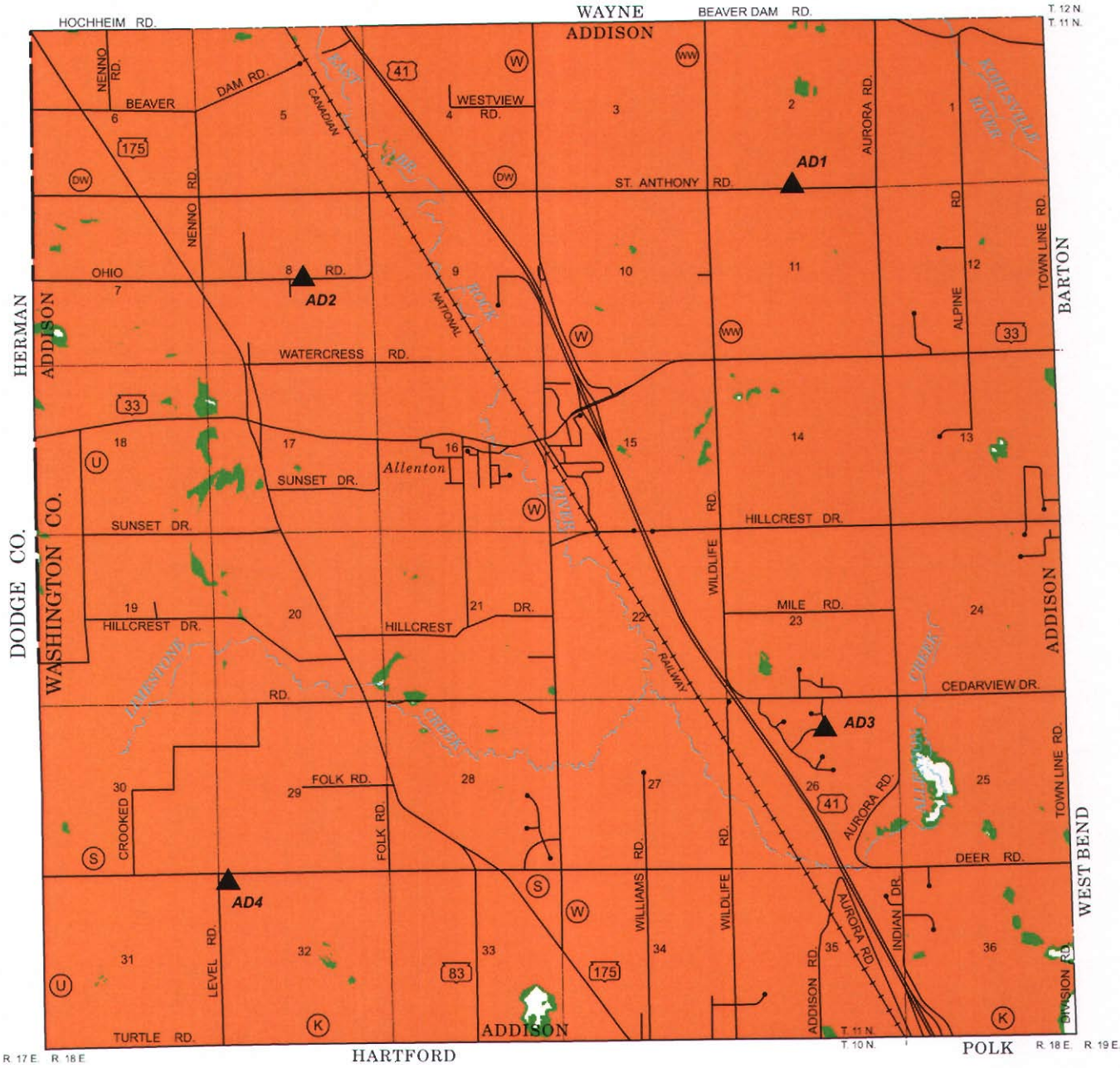
0 1/2 1 MILE

0 2,000 4,000 6,000 FEET

Source: SEWRPC.

Map 3

POTENTIAL LOCATIONS OF WiFi ACCESS POINTS AND ATTENDANT PERFORMANCE OF ACCESS NETWORK FOR FIXED USERS IN THE TOWN OF ADDISON



LEGEND

- ▲ ACCESS POINT LOCATIONS
- *A3* 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

GRAPHIC SCALE

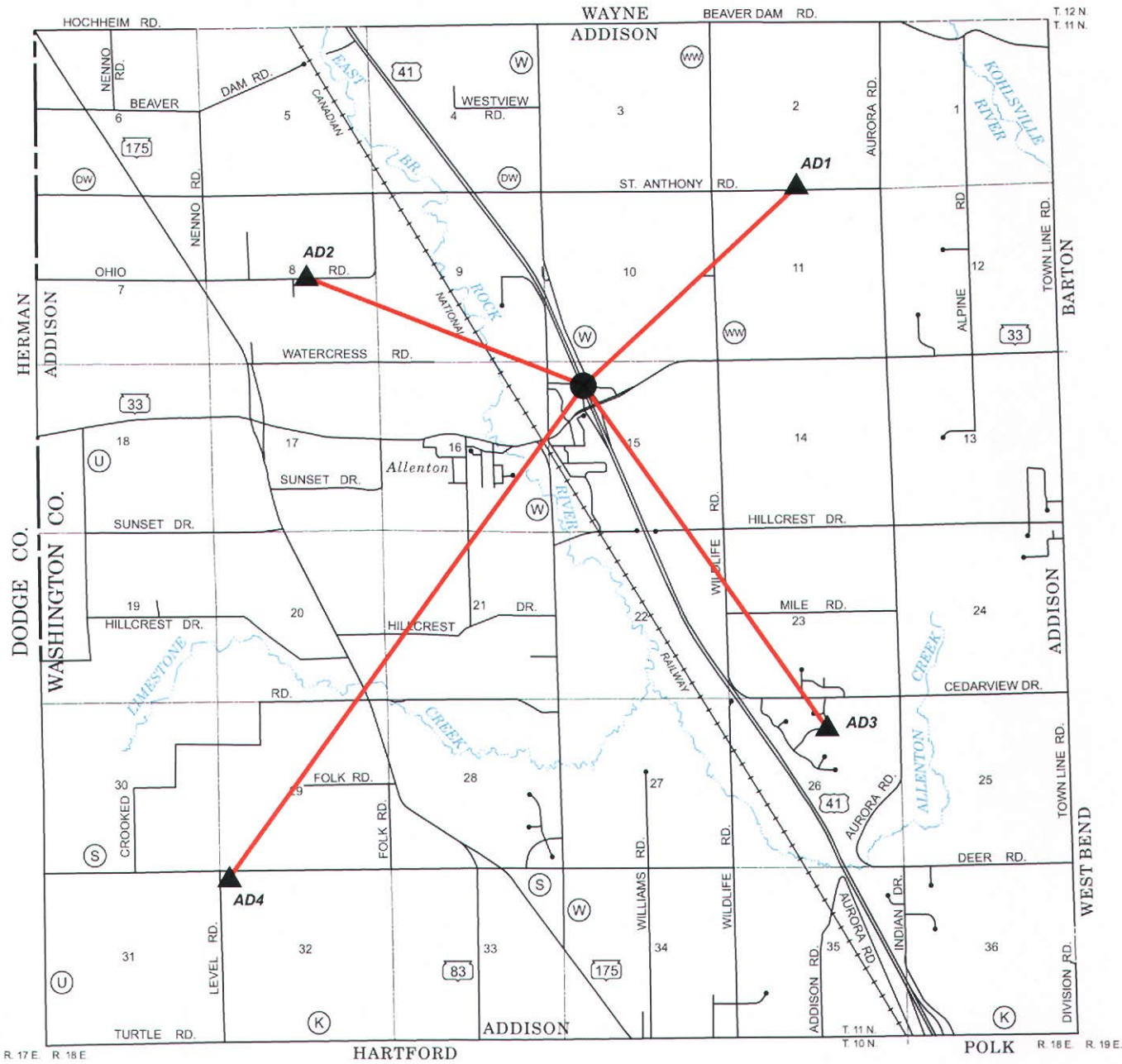
0 1/2 1 MILE

0 2,000 4,000 6,000 FEET

Source: SEWRPC.

Map 4

POTENTIAL LOCATIONS OF ACCESS POINTS AND ACCESS NETWORK GATEWAY FOR BACKHAUL IN THE TOWN OF ADDISON



LEGEND

- BASE STATION GATEWAY
- ACCESS POINT LOCATIONS
- *A3* IDENTIFICATION NUMBER

GRAPHIC SCALE

0 1/2 1 MILE

0 2,000 4,000 6,000 FEET

Source: SEWRPC.

joint plan are reduced from eight to six and a single POP gateway is able to serve both towns. The access and backhaul networks for the joint system are displayed in Maps 5 and 6, respectively. Savings were found in both the initial infrastructure deployment and in continuing operating costs. The estimated infrastructure costs for the town plans separate and joint are tabulated below:

Separate Wireless Infrastructure Costs -
Town of Wayne or Addison

1.	Access Point Base Stations 4 at $5,250 each =	$21,000
2.	Gateway POP Fiber Internet Connection 1 at $17,300 =	$17,300
3.	Project Management and Engineering =	$30,000
	Total	$68,300

It should be noted that the estimated infrastructure costs do not include any charges for use of existing utility or light poles or co-location on gateway antenna towers. Each town network would incur these same infrastructure deployment costs.

Joint Wireless Infrastructure Costs
Towns of Wayne and Addison

1.	Access Point Base Stations 6 at $5,250 each =	$31,500
2.	Gateway POP Fiber Internet Connection 1 at $17,300 =	$17,300
3.	Project Management and Engineering =	$45,000
	Total	$93,800

It should be noted that development of a joint network would reduce the costs to each Town from $68,300 to $46,900. The latter cost represents a per household cost of $80.50 in the Town of Wayne, and $40.82 in the Town of Addison.

The estimated cost of cellular infrastructure deployment for the Wayne-Addison area was based upon equipment cost quotations from a WiFi equipment manufacturer. Total cost of the infrastructure was determined based upon the cost of each access point plus the cost of Internet access – whether the access is provided through the WiFiA backhaul network or through a direct POP connection to an optical fiber network. In this estimate, a direct optical fiber network connection was assumed.

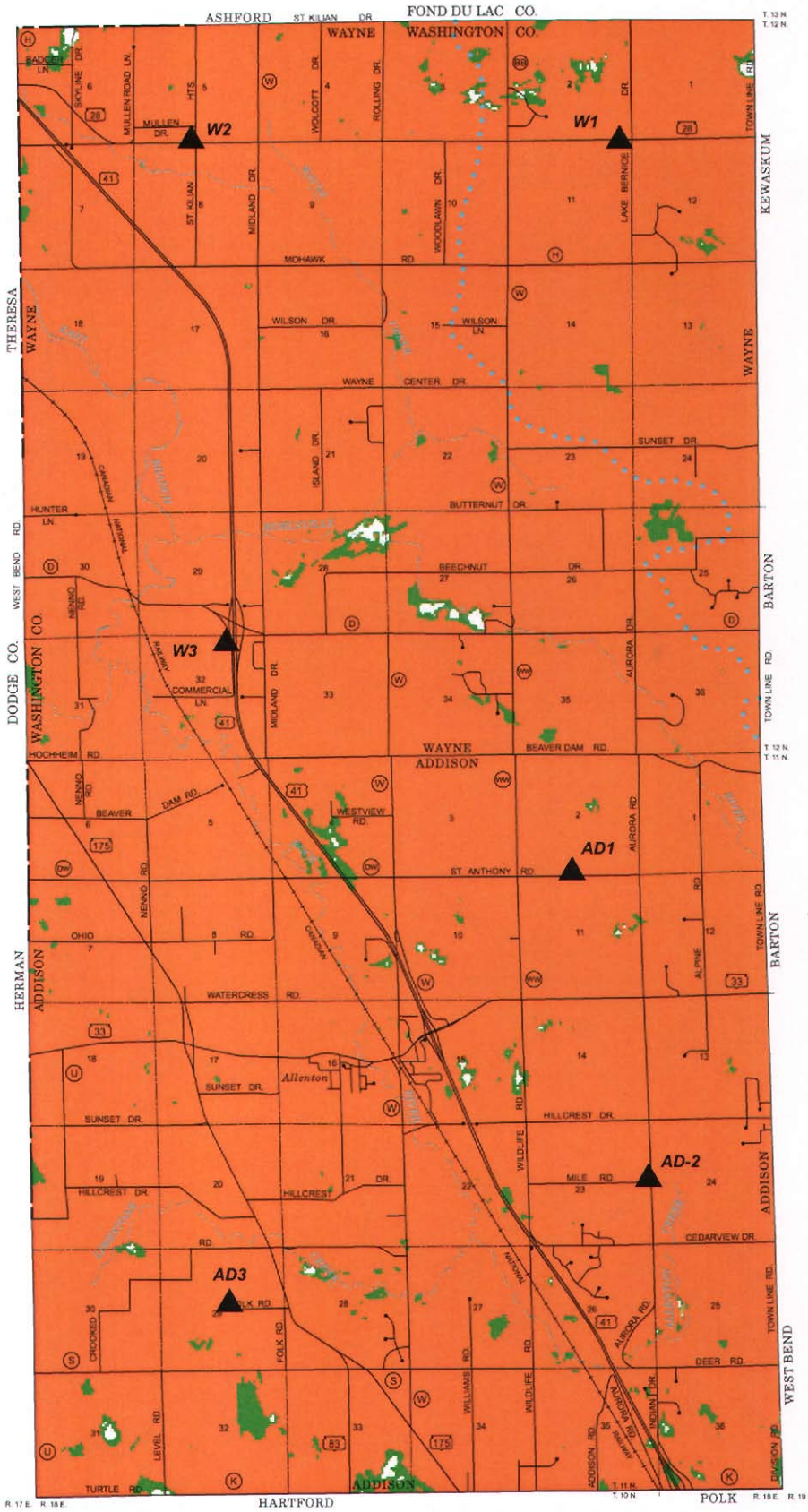
Part of the project engineering cost would support field testing to verify the performance of the plan access point locations in providing specified signal levels throughout their individual coverage areas. The cost estimate encompasses only the network infrastructure and does not include the cost of user equipment which would be purchased or leased by individual users.

Map 5

POTENTIAL LOCATIONS OF WiFi ACCESS POINTS AND ATTENDANT PERFORMANCE OF ACCESS NETWORK FOR FIXED USERS IN THE COMBINED AREA OF THE TOWNS OF ADDISON AND WAYNE

LEGEND

- ▲ ACCESS POINT LOCATIONS
- *AW3* 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



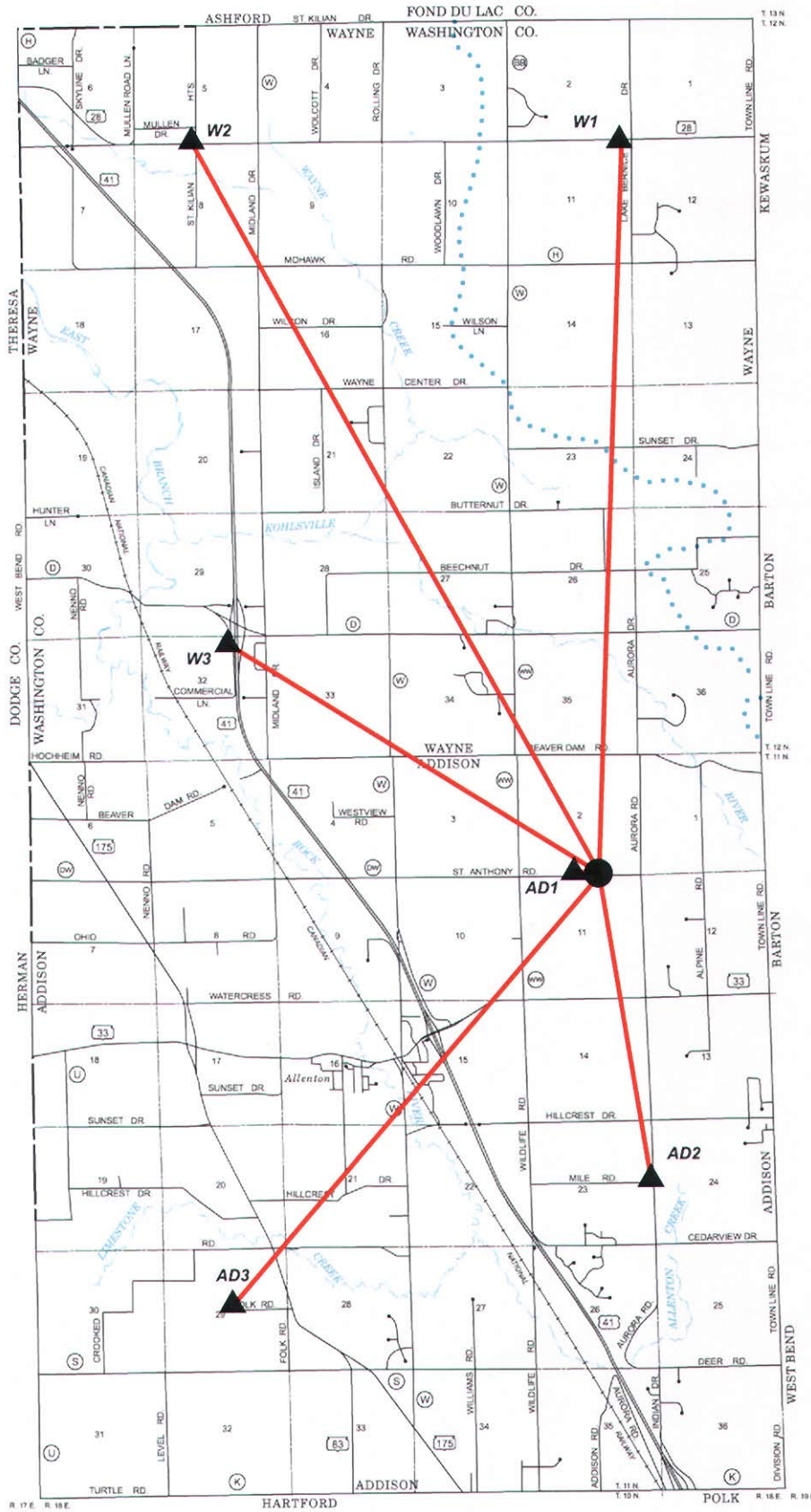
Source: SEWRPC.

Map 6

POTENTIAL LOCATIONS OF ACCESS POINTS AND ACCESS NETWORK GATEWAY FOR BACKHAUL IN THE COMBINED AREA OF THE TOWNS OF ADDISON AND WAYNE

LEGEND

- ● BASE STATION GATEWAY
- ▲ ACCESS POINT LOCATIONS
- *AW3* IDENTIFICATION NUMBER



Source: SEWRPC.

The Wayne-Addison area wireless telecommunications system was designed to serve the residential, business or other fixed location user. Because of the low population densities and extended distances characteristic of rural towns, new user transceiver equipment must be installed to process the reduced wireless signal levels. Such an installation would take the form of an active directional antenna. An active antenna includes electronic circuitry to boost the signal level and to provide a proper impedance match for the cable that connects the antenna to the user's transceiver. To support this enhanced receiving capability, the fixed user will require two equipment items: (1) an active antenna with appropriate cabling connections; and (2) a transceiver/router unit.

The combined cost of the fixed user's equipment, including installation, should approximate $400. Part of the cost can be recovered from the user as part of the initial installation, and the rest could be amortized over the life of a one year or two year subscription contract. Allocation decisions on these startup costs will be influenced by the Internet Service Provider (ISP) who would be engaged to build and/or manage the system.

Two alternative business models are proposed for community consideration. The first would involve an outside investor-operator who would install and operate the system with one or more Internet Service Providers (ISPs). The second would involve local government ownership of the infrastructure with a contracted ISP. Both models bring broadband wireless services to the entire community.

The initial deployment of the network will focus on data communications and Internet access. Voice communications services, however, could be incorporated into the system at an early date. Such voice communications services would utilize the Voice-over-Internet Protocol (VoIP) capabilities of the broadband wireless network. VoIP services may be incorporated into the network in one of three ways:

1. ISP Operator Upgrade

   In this scenario, the ISP would purchase and install the necessary server equipment to provide VoIP services.

2. User Provider Selections

   Here, the user would select his own VoIP service from a national or regional provider independent of the ISP's data services.

3. ISP Contract with Major VoIP service provider

   In this alternative, the ISP would contract with a national VoIP service provider to furnish the service on a wholesale basis.

The third alternative is probably preferable since the best quality of service is obtained with a minimal investment and with competitive service provided to the user.

WIRELESS NETWORK DEVELOPMENT PROCESS

The currently prevailing wireless telecommunication system development process within the United States places the responsibility for system development largely within the private sector. Therefore, the system development process is driven by decisions made within national corporate structures in response to competitive market forces. Public telecommunication service planning efforts, such as that conducted by the Southeastern Wisconsin Regional Planning Commission, are intended not to replace, but to influence this competitive market driven process in the public interest. To be effective, the introduction of public planning requires some changes in the current entirely private development process. The modified wireless telecommunication development system process then consists of the following sequences of steps:

1. Public preparation of a broadband wireless system plan for designated service areas;
2. Preliminary review and approval of system plan by the municipalities comprising each service area concerned;

3. Field studies to verify or modify the preliminary plan as may be found necessary;
4. Final review and approval of the system plan by the municipalities comprising each service area concerned;
5. Issuance of a request for proposals to deploy infrastructure in accordance with approved plan;
6. Selection of infrastructure development vendor;
7. Issuance of a request for proposals to operate system;
8. Selection of vendor to operate system; and
9. System operation

SUMMARY

Broadband WiFi wireless communications system plans are presented in this memorandum report for the Towns of Addison and Wayne in Washington County, Wisconsin. Each town plan requires four access points and a backhaul to a gateway Point of Presence (POP) base station for fiber-based Internet connection. If the two towns choose to develop a joint integrated network to serve both communities, the number of total access points needed is reduced from eight to six. The initial infrastructure costs for individual town networks are estimated at $68,300 including project management, and engineering. The infrastructure cost of a joint network is estimated at $93,800 which lowers the costs to each town to $46,900.

Throughput performance for fixed location users is based upon the employment of an active directional antenna with a supporting high gain, low noise preamplifier at each user location. The initial system development supports only data communications, but voice communications using VoIP technology can be added at a later date.