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Comprehensive Stormwater Management Plan (CSMP)

Prepared for the Redevelopment of the Rice Creek Commons (formerly Twin Cities Army Ammunition Plant) Project.

Prepared for:

Ramsey County Public Works

1425 Paul Kirkwold Drive
Arden Hills, MN 55112-3933

Kimley»Horn
Expect More. Experience Better.

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Kimley-Horn
2550 University Avenue West
Saint Paul, MN 55114
Phone: 651.645.4197

Prepared by:

Wenck Associates, Inc.
1800 Pioneer Creek Center
Maple Plain, MN 55359
Phone: 763.479.4200

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INTRODUCTION

Ramsey County (County) and the City of Arden Hills (City) working together, under a Joint Powers Agreement, to provide this Comprehensive Stormwater Management Plan (CSMP) to Rice Creek Watershed District (RCWD) for the Rice Creek Commons (formerly Twin Cities Army Ammunition Plant) redevelopment Project (**Figure 2-2**).

Report Purpose: The goal of this CSMP is to communicate how the development, recently renamed Rice Creek Commons, will meet RCWD Rule C requirements using a regional stormwater approach. This CSMP presents the approach for meeting the Water Quality Treatment and Peak Stormwater Runoff Control requirements. The RCWD Rules adopted at the time of printing were effective on December 1, 2014.

Existing conditions were modeled, per requirements in Rule C, and compared against the proposed conditions at outfalls. **Figure 6-2** displays tributary areas by outfall in 2012. The proposed conditions outfall are shown in **Figure 6-3**. The proposed conditions are presented in two stages; completion of the public infrastructure improvements, and the fully developed conditions using landuse assumptions in the Master Plan (**Figure 3-1**) and construction of a regional stormwater system (**Figure 4-5**). The pollutant removal efficiency of the proposed regional ponding system was evaluated at outfalls for the proposed conditions plus an interim condition considered to be the worst case scenario.

Rule C.6: Some outlot purchase agreements will include the requirement of designing and constructing an infiltration device or a stormwater pond that is consistent with this CSMP (Table E-1), specifically Outlots A, J, and K. The remaining outlots in Areas 1 and 2 in **Figure 5-2** will be exempt from RCWD Rule C.6(d)(2) due to MPCA concerns relative to shallow (Unit 1) groundwater is impacted by solvent releases.

The proposed ponding system will reduce pollutant loads from stormwater before discharging to the Resource of Concern (ROC) from the proposed site conditions by more than 50%, meeting RCWD standards. Each outfall under proposed conditions was evaluated for each Resource of Concern (**Figure 6-3**) and tabulated in water quality technical memorandum (P8) provided in Appendix A. Bulleted below are the total TP % reductions summarized by scenario by ROC.

- Rice Creek TP reduced by %
  - public infrastructure improvements (interim scenario 1): 65% total
  - worst case (interim scenario 2): 55% total
  - fully developed conditions (scenario 3): 64% total

- Round Lake TP reduced by %
  - public infrastructure improvements (interim scenario 1): 53% total
  - fully developed conditions (scenario 3): 60% total

This CSMP assumes that before stormwater discharges from the land being developed to the regional system, some method of pre-treatment or grit removal must be installed and maintained by the developer (e.g., flow through device, vegetated swale, vegetated filter strip, SAFL Baffle, off-line deep sump catch basins, The Preserver™, etc.).

Rule C.7: Stormwater pond design details are included in the Stormwater Pond Data Summary Tables included in the Appendix of the HydroCAD Technical Memorandum.

The Site, under proposed fully developed conditions, has discharge rate control measures proposed to meet RCWD's peak stormwater runoff control requirements through a combination of onsite infiltration and wet detention ponds.

Rule C.8: As permits are prepared to construct stormwater ponds and outlet designs are finalized, bounce and inudatiaon periods will be documented by applicants.

Rule C.9: Likewise, as permits are prepared, the design criteria will be followed by applicants.

Rule C.10: It is anticipated that the Site will be developed on an outlot by outlot basis. Preliminary outlots have been identified on the concept preliminary plat (**Figure 5-2**). The regional stormwater system will be preserved through easements or public ownership. Outlot C, the Natural Resources Corridor, will remain in Ramsey County ownership initially and be covered by easements for drainage/utilities, and and covenants for the wetland mitigation. Eventually the stormwater system within the Natural Resources Corridor, will be owned by the City as they will be responsible for ongoing maintenance.

A drainage and utility easement will also cover an approximate 80-ft wide area along the west edge of Outlots I, J, and K to fully meet stormwater water quality requirements.

Table E-1: Stormwater Requirements for Future Development Outlots

Outlot	Subbasin(s) (per Figure 6-1)	Rate Control (per Rule C.7)	Infiltration Required (per Rule C.6)
Spine Road	24, 25, 26	* Per CSMP (interim conditions)	
Outlot C	3, 8, 10, 11, 12, 13, 14, 16, 17		
Outlot H	4, 5, 6, 7		
Rice Creek Commons Old Hwy 8 Extension Road	27	*	✓ per table 5-1 of CSMP
Outlot A	22	*	✓ per table 5-1 of CSMP
Outlot B	16, 17, 19	* Pond P-14, per CSMP	
Outlot D	15	*	
Outlot E	1, 3, 8, 9	*	
Outlot F	1, 3	* Pond P-1, per CSMP	
Outlot G	2, 7	* Pond P-3, per CSMP	
Outlot I	18, 5	*	
Outlot J	18	*	✓ per table 5-1 of CSMP
Outlot K	18	*	✓ per table 5-1 of CSMP
Outlot L	20	*	
County Road H/I-35W Interchange	27, 28, 29, 31	✓+	✓+

✓ Development plans submitted in the future are required to meet Rice Creek Watershed District Rules for this stormwater parameter.

* CSMP submitted compares peak flow rates (existing compared to fully developed conditions) entering the Rice Creek Commons ROC (Rice Creek/Long Lake and Round Lake) in aggregate. The modeling completed sums flows from multiple subwatersheds which drain to the same location (e.g. Rice Creek).

+ The CSMP is based on 30% design, and these proposed ponds did not provide sufficient water quality treatment volume to meet RCWD rules, nor were infiltration BMPs incorporated in the stormwater management design, as required per this CSMP.

This CSMP will provide developers with technical details to complete site design to comply with RCWD Rule C using the regional system to be constructed by Ramsey County and maintained by the City of Arden Hills. Developers that choose to exceed the impervious limits designed to for that outlot, as summarized in Table E-2 and **Figure ES-1**, will be required to address any additional stormwater requirements within that outlot at the developers expense. Any such stormwater management facilities will also be maintained by the owner of the outlot.

Table E-2: Maximum Impervious Surface by Outlot

Outlot ID	Total Outlot Area (acres)	Maximum Impervious Area (acres)	Additional breakdowns
Outlot A	40.1	34.0	
Old Highway 8 extension Road	4.8	4.8	
Spine Road	24.0	24.0	
Outlot B (Creek)	45.9	18.1	15.2 acres in residential
Trail Dedication	1.1	0.7	0.4 acres residential, remaining in trails
Outlot C (NRC)	47.6	5.2	2.1 acres in civic, remaining in recreational and trails, realigned Creek
Outlot D (Town)	58.8	28.6	16.9 acres in residential, 9.7 acres in mixed use, 1.2 acres in commercial, remaining in recreational
Outlot E (Hill)	73.3	27.0	23.9 acres in residential
Outlot F (Flex Business East)	28.7	23.5	
Outlot G (Flex Business South)	31.7	21.6	
Outlot H (NRC)	3.5	0.4	0.4 acres in trails
Outlot I (Flex Business North)	18.2	15.4	
Outlot J (Corporate)	20.0	17.0	
Outlot K (Retail)	20.0	16.5	16.4 acres in retail, remaining in recreational
Outlot L (Creek Meander)	2.7	0.2	0.2 acres in trails, realigned creek

1.0 CSMP Goals and Intended Use

1.1 GOALS

As allowed for under RCWD Rule C.5 (f), this CSMP has been prepared as an alternative means to meet the requirements of Rule C.6 (Water Quality Treatment) and Rule C.7 (Peak Stormwater Runoff Control) for redevelopment of the Site, which will be done in various stages. Upon RCWD Board approval of this CSMP, it is agreed that the water quality treatment volumes and peak runoff rate controls standards for the 427 acre Rice Creek Commons site and the 7.1 acres of MnDOT right-of-way adjacent to the site (subwatersheds 28 & 29) will be met in aggregate for each ROC drainage area given the conditions documented herein.

The development of this CSMP is intended to streamline regulatory permit approvals saving the RCWD and developer time and money as development is proposed. This alone should make the land more attractive and valuable. The County and the City have made a considerable investment in the Site by undertaking cleanup of the site, preparing development planning documents, providing public notice and gathering public input, building public utilities (sewer, water, storm, etc.), constructing ponds and mitigation wetlands. The Site has a Master Plan so that the Site is developed in a responsible way that creates open green space, centralized stormwater management features that creates community around protection of our natural resources and provides a forum for continued education of water management and sustainable development.

By planning for development of Rice Creek Commons using a "campus" approach, the regulatory requirements can be "leveled" so that future applicants within different geographic regions of the project area aren't faced with more challenges in meeting the requirments. Regional treatment also allows for more efficient treatment and maintenance, and helps ensure that the entire site meets RCWD requirements, from first to last development.

The JDA will use this plan to review development plans for conformance with the proposed impervious surface areas by outlot, assumptions documented in this CSMP and various land uses identified in the Master Plan. Permits will still be required from the RCWD for individual development projects to confirm compliance with this CSMP and to meet other applicable RCWD rules. More information on responsiblites are provided in Section 6.0.

1.2 DESIGN PRIORITIES

Given the overlap and complexity of these various requirements, design priorities were established to meet as many of these requirements within the Natural Resources Corridor as possible, with the following priorities in this order:

1. Accommodate all wetland replacement for public infrastructure impacts (Spine/Old Highway 8 extension Roads and utilities, stormwater ponds, associated site grading, maintenance access, County Road I/Old Highway 8 extension Road access)
2. Accommodate all required stormwater rate control and infiltration for Spine/Old Highway 8 extension Roads
3. Accommodate stormwater rate control for Rice Creek Commons development

4. Provide maintenance access to stormwater features in form of a recreational, multi-use trail
5. Provide wetland mitigation for site development to the extent feasible
6. Provide infiltration for site development (residential, retail, and commercial parcels) to the extent feasible
7. Accommodate other passive recreation opportunities where feasible

1.3 RICE CREEK WATERSHED PERMIT PHASING PLAN

Some phases of redevelopment are County projects with more predictable schedules, while other phases are dependent on developer interest on an unknown schedule. All the projects have regulatory requirements to meet.

1.3.1 RCWD Permits Issued in 2013

The redevelopment site work activities commenced after issuance of the RCWD permit 13-0023 (April 30, 2013) to Bolander for demolition and remediation activities. Activities that will be completed under RCWD permit 13-0023, include:

- the removal of railroad track, fencing, bituminous pavement, concrete sidewalk, underground storm sewer, underground sanitary sewer, underground steam, underground condensate, underground watermain, and buildings is over 95% complete. It will be completed by October 15, 2015.
- Soil remediation and cleanup activities to bring the site to within MPCA residential SRV's is approximately 75% complete. It will be completed by October 15, 2015.
- Stabilization to meet the NPDES construction stormwater permit requirements is ongoing, and is addressed as certain areas are completed. It will be 100% complete by October 15, 2015.

This work is considered a Public Infrastructure Improvement.

1.3.2 RCWD Permit Applications Planned for 2015-2016

Nearby highway and bridge improvements are needed whether Rice Creek Commons is redeveloped or not. Various periphery highway and bridge improvement projects are outlined in the Ramsey County Public Works Department Transportation Improvement Plan (such as Interstate I-35W, Highway 10, CSAH 96, County Road H and County Road I.) Ramsey County plans to apply for separate permit applications and approvals for the following public infrastructure projects. The timing is subject to change due to funding, coordination, securing permits and approvals for projects:

- Summer 2015
  - Comprehensive Stormwater Management Plan (CSMP)
  - Creek Meander Permit (Rules D, E, F, G)
  - CSAH 96/I-35W interchange (Ramsey County/SEH)
- Fall 2015
  - Rice Creek Commons Spine Road (CSAH 96 to County Road H), regional stormwater/wetland, and generalsite Grading for portion south of Rice Creek (Rules C, D, E, F, G)
- Spring 2016
  - County Road H/I-35W Interchange (Rules C, D, E, F)

- Undetermined
  - County Road I/I-35W roundabout (including Old Highway 8 extension Road between County Road I and northern most edge of the parcel north of Rice Creek)
  - Rice Creek Commons Old Highway 8 extension Road (within the portion north of Rice Creek parcel). The timing is dependent on when the parcels are sold/developed north of Rice Creek.

1.3.3 RCWD Permit Applications Planned for 2015 and Beyond

Dependent on developer interest, there may be permit applications for portions of the 427-acre site. The location, size and type of development applications (mixed residential, commercial, and light industrial) are unknown, but all development will be consistent with the Master Plan (**Figure 3-1**). Developers will need to prepare the necessary documents to document deviations from this CSMP as well as additional document required to obtain a RCWD permit (e.g., an erosion and sediment control plan may be required to be developed given Rule D requirements). Some development applications may request an extended stormwater management permit for phased development in accordance with Rule C.13. This CSMP will be available to developers as they prepare the necessary applications. Developers will be required to comply with RCWD Board Approved CSMP for each respective project proposed.

1.4 DEVELOPER SUBMITTAL SEQUENCING

Future developers will be responsible to first submit a proposal to the JDA. The submittal would document which outlot (or portion of an outlot) will be developed. The application must document that the land use proposed is consistent with the Master Plan used in developing this CSMP (**Figure 3-1**). If the Land Use is different, the developer must demonstrate how the proposed use will meet the impervious assumptions for that outlot in the CSMP.

If development is within CSMP requirements, the developer application must include:

- Name the outlot(s) or portion of an outlot requested (per **Figure 5-2**)
- Document the total area requested broken down by roof area, pervious and impervious areas,
- Preliminarily communicate the method of proposed grit removal (e.g., flow through device, vegetated swale, vegetated filter strip, SAFL Baffle, off-line deep sump catch basins, The Preserver™, etc.) before stormwater discharges from the land being developed to the regional system,
- Explicitly name the stormwater pond(s) the site is tributary (P-X per **Figure 4-5**), and,
- The applicant must submit existing and proposed topography and describe the infrastructure proposed to convey stormwater.

If the development exceeds the CSMP maximum impervious, the developer application must demonstrate how the additional runoff will be treated to meet RCWD rules. Developers that choose to exceed the impervious limits designed to for that outlot, as summarized in Table E-2, will be required to address any additional stormwater requirements within that outlot at the developers expense. Any such stormwater management facilities will also be maintained by the owner/developer of the outlot.

1.5 JOINT DEVELOPMENT AUTHORITY

Ramsey County (County) and the City of Arden Hills (City) formed a partnership to redevelop the 427 acres. The Joint Powers Agreement (JPA) defines what portions of the redevelopment project are the responsibility of the County, the City, jointly the County and the City, and the developer responsibilities. The JPA calls for the establishment of a Joint Development Authority (JDA) or "governing body." The JDA Board consists of two members from the Ramsey County Board of Commissioners, two members from the City Council, and one appointed resident from Arden Hills who serves a two-year appointment as the JDA Chair. The main duties of the JDA Board are to implement the Rice Creek Commons Master Plan and oversee Rice Creek Commons redevelopment process and activities.

1.5.1 JDA Use of the CSMP

After the RCWD Board approves this CSMP, the JDA Board may need to adjust the requirements for a Development Site. During the Rice Creek Commons redevelopment process, the JDA Board may need to adjust the requirements for a Development Site. The JDA Board will follow the amendment process defined in the JPA. JDA approved requirements related to meeting RCWD's Water Quality Treatment (Rule C.6) and Peak Stormwater Runoff Control (Rule C.7) will be incorporated into the development agreements for each Development Site.

The County and JDA Board will make the CSMP available to interested Developers to promote conformance with RCWD Board Approved CSMP for each respective project.

1.5.2 JDA Responsibilites Administering the CSMP

Three outlots (A, J, K) include the requirement of designing and constructing an infiltration device or a stormwater pond that is consistent with this CSMP (Table 1-1).

Stormwater pond design details are included in the Stormwater Pond Data Summary Tables 6-1 through 6-5, included as part of Appendix A: HydroCAD Technical Memorandum. These tables summarize for each pond, the:

- Tributary subwatershed area,
- Outlet elevation (normal stormwater pond elevation),
- Emergency overflow elevation,
- Dead pool storage (the volume that remains in the ponds "dead storage" for settling until the next storm arrives)
- HydroCAD model predicted high water level (HWL), live storage volume, and peak discharge rate for the following design rainfall events (NOAA Atlas 14)
    - 100-year 24-hour
    - 10-year 24-hour
    - 2-year 24-hour
- Stormwater control structures (e.g., orifice, weir, culvert)
- Stormwater conveyance details (e.g., overland flow channel, pipe details)

The JDA will provide developers with technical details to complete their respective site designs to comply with the assumption used to develop this CSMP.

Table 1-1: Stormwater Requirements for Future Developerment Outlots

Outlot	Subbasin(s) (per Figure 6-1)	Rate Control (per Rule C.7)	Infiltration Required (per Rule C.6)
Spine Road	24, 25, 26	* Per CSMP (interim conditions)	
Outlot C	3, 8, 10, 11, 12, 13, 14, 16, 17		
Outlot H	4, 5, 6, 7		
Rice Creek Commons Old Hwy 8 Extension Road	27	*	✓ per table 5-1 of CSMP
Outlot A	22	*	✓ per table 5-1 of CSMP
Outlot B	16, 17, 19	* P-14, per CSMP	
Outlot D	15	*	
Outlot E	1, 3, 8, 9	*	
Outlot F	1, 3	* P-1, per CSMP	
Outlot G	2, 7	* P-3, per CSMP	
Outlot I	18, 5	*	
Outlot J	18	*	✓ per table 5-1 of CSMP
Outlot K	18	*	✓ per table 5-1 of CSMP
Outlot L	20	*	
County Road H/I-35W Interchange	27, 28, 29, 31	✓+	✓+

✓ Development plans submitted in the future are required to meet Rice Creek Watershed District Rules for this stormwater parameter.

* CSMP submitted compares peak flow rates (existing compared to fully developed conditions) entering the Rice Creek Commons ROC (Rice Creek/Long Lake and Round Lake) in aggregate. The modeling completed sums flows from multiple subwatersheds which drain to the same location (e.g. Rice Creek).

+ The CSMP is based on 30% design, and these proposed ponds did not provide sufficient water quality treatment volume to meet RCWD rules, nor were infiltration BMPs incorporated in the stormwater management design, as required per this CSMP.

The HydroCAD model will be maintained by the County's consultant once per a five-year cycle until fully developed conditions is achiveved to reflect the as-built conditions at Rice Creek Commons.

1.6 DEVELOPER DEVIATIONS FROM CSMP

Future developers may want to deviate from the CSMP. The responsibility is on the developer to prepare an application that documents what is different from the CSMP (e.g., X more square feet of impervious surface than documented in Table 6-2) and how that difference will be mitigated (e.g., stormwater cistern used to water landscaped areas).

Developers that choose to exceed the impervious limits designed to for that outlot, as summarized in Table E-2, will be required to address any additional stormwater requirements within that outlot at the developers expense. Any such stormwater management facilities will also be maintained by the owner/developer of the outlot.

2.0 Site Location

2.1 PROJECT LOCATION

The project site is located in Ramsey County, Minnesota predominately within the limits of the City of Arden Hills. The site is located within portions of Sections 9 and 16, Township 30 North, Range 23 West of the 5th Principal Meridian, (the Site). The Site is bounded by U.S. Interstate Highway 35W on the west, Minnesota State Aid Highway (CSAH) 96 to the south and U.S. Highway 10 to the southwest (**Figure 2-1**). The Arden Hills Army Training Site (AHATS) bounds the Site to the east. The redevelopment Site is comprised of approximately 427 acres of the western portion of the former TCAAP facility.

2.2 DRAINAGE AREAS AND RESOURCES OF CONCERN

Rice Creek divides the Site into two sections. The portion south of Rice Creek, and the portion north of Rice Creek (**Figure 2-2**). This project is located within Lower Rice Creek subwatershed area. Some of the Site drains to Rice Creek, and the remainder of the Site drains south to Round Lake.

3.0 Background Information

Portions of the Site will be developed by Ramsey County, the City of Arden Hills, and yet to be determined developers. Ramsey County hired the Port Authority to consult and help broker commercial developer interest in the Site. The following sections help put into context the behind-the-scenes planning accomplished leading up to this submittal by giving a brief overview of the Joint Development Authority (JDA), a brief status update on various planning steps underway, and the role of the Energy Resilience Advisory Board in Rice Creek Commons redevelopment. This section will also give a brief overview of the contamination and remediation activites on the Site at the time of printing. As well as the federal, state and local water resource regulations that need to be met on the Rice Creek Commons.

3.1 OTHER CONTROLLING DOCUMENTS AND GUIDELINES

A number of documents and guidelines have been or will be in place to guide the JPA decision making, including this CSMP.

3.1.1 Rice Creek Commons Master Plan & Alternative Urban Areawide Review

The City of Arden Hills prepared the Master Plan and the Alternative Urban Areawide Review (AUAR). The Arden Hills City Council approved the Master Plan Land Use Map on June 30, 2014 (**Figure 3-1**), after several months of development, work session meetings and public comments. Changes to the Master Plan over time can be expected, based on market demands and adjustments as development occurs.

The Master Plan Land Use Map (**Figure 3-1**) shows the Natural Resources Corridor. The site also has a number of delineated wetlands (**Figure 3-2**). It is a goal of the Master Plan to meet the majority of the wetland mitigation and stormwater management requirements within the Natural Resources Corridor.

An AUAR is a form of environmental documentation through Minnesota State Rules that evaluates one or more development scenarios for an entire geographical area rather than a specific project. Development scenarios are established based upon the comprehensive plan, zoning ordinances, developers' plans, and other relevant information. The City of Arden Hills approved the Final AUAR and Mitigation Plan for the Rice Creek Commons on July 28, 2014 (https://mn-ardenhills.civicplus.com/DocumentCenter/View/971).

3.1.2 Regulations and Policies

The Arden Hills City Council is working on the Regulations and Policies for the Rice Creek Commons. The City of Arden Hills maintains a website with background and additional information (http://www.cityofardenhills.org/)

3.1.3 Energy Resilience Advisory Board

An appointed five member Energy Resilience Advisory Board (ERAB) is working with consultants to develop the Rice Creek Commons Energy Integration and Resiliency Framework ("EIRF"), which will become a companion document to the Master Plan and policy actions that the JDA, the County, and the City can consider to support that energy

future. The visioning and development of guiding principles for Rice Creek Commons is underway at the time of this printing.

3.2 SITE HISTORY OVERVIEW

The Site was used for the production and storage of small arms ammunition from the 1940s to the mid-1990s. Prior to development in the 1940s, the Site was used for agricultural purposes. Many investigation and cleanup activities have been focused on the Site in the past. There are a number of maps available of the surficial geology and hydrogeology at Rice Creek Commons (**Figures 3-3, 3-4, 3-5** and **3-6**).

There were several redevelopment attempts between 2002 and 2011. One attempt, by Ryan Companies, completed a number of soil borings on the Site (**Figure 3-7**).

Ramsey County is cleaning up the surface of the Site to residential soil reference value (SRV) to allow unrestricted land use however, future property use is anticipated to be mixed residential, retail, non-retail commercial (i.e., office, light industrial) and park (i.e., recreational) (per the Master Plan.) Within the redevelopment Site (427 acres), the Army will continue to own, operate and monitor groundwater remediation systems in the surficial groundwater (Unit 1, shown in **Figure 3-8**) and in the deep groundwater (Unit 3, shown in **Figure 3-9**). Ramsey County maintains a website with background and additional information (http://ricecreekcommons.com/)

3.3 RAMSEY COUNTY PURCHASE AND CLEAN UP OVERVIEW

The redevelopment Site is comprised of approximately 427 acres of the western portion of the former TCAAP facility. Ramsey County has closed on the initial purchase and transfer of title for 397 acres of previously remediated property. The remaining 30 acres of property, which has residual soil contamination, is being leased from the federal government while Ramsey County remediates the soil. Ramsey County entered into a demolition and remediation contract with Carl Bolander and Sons in April 2013 to clean up the State's largest Superfund site. Once the cleanup is complete, the County will close on the final 30 acres and take title of the leased property. Ramsey County is completing additional subsurface investigations throughout the Site and implementing MPCA-approved response actions as necessary.

3.4 ARMY GROUNDWATER REMEDIATION SYSTEM OVERVIEW

The federal government retains responsibility for certain environmental liabilities under the Offer to Purchase, and federal environmental laws require the U.S. government to promise, for certain contaminated property it sells, that "any additional remedial action found to be necessary after the date of such transfer shall be conducted by the United States." Under advisement by the MPCA, redevelopment of the Site must proceed in a manner such that infiltration does not alter the groundwater flow regime in areas that are known to be affected by historical solvent releases. The following sections 3.4.1 and 3.4.2 define the remaining known areas.

3.4.1 TCAAP Hillside Sand Groundwater Plume

The TCAAP Groundwater Recovery System (TGRS) will continue to treat contaminated groundwater from Unit 3 (the Quaternary aged Hillside Sand Formation, which is one of the hydrogeologic units beneath Rice Creek Commons). The TGRS treats groundwater, from

Unit 3 (**Figures 3-5** and **3-6**), through a system of deep pumping stations and an on-site treatment facility that air strips the contaminants from the water, and then recharges the treated groundwater back into the Unit 3 groundwater table (**Figure 3-9**). This system will remain in place with oversight from the Minnesota Pollution Control Agency (MPCA) and the U.S. Environmental Protection Agency (EPA) for approximately the next 50 years. In the area of the Rice Creek Commons redevelopment project, Unit 2 is an aquitard which is located above Unit 3 and hydraulicly separates the surficial groundwater (Unit 1) from deep groundwater (Unit 3).

3.4.2 Rice Creek Commons Surficial Groundwater Plumes

The Site has surficial (Unit 1) contaminated groundwater associated with the Installation Repair Program (IRP) Sites I and K and Building 102. The Site K and Building 102 plumes are located in the north end of the portion south of Rice Creek, while the Site I plume is located north of CSAH 96 in the southeast portion of the portion south of Rice Creek (**Figure 3-8**). This figure shows a snapshot of the Unit 1 groundwater plumes supported by monitoring data presented in the Fiscal Year 2012 Annual Performance Report (FY 2012 APR). There are variaitons in the size, shape and orientation of the plumes, as documented in subsequent APRs. The Unit 1 layer is comprised of generally heterogenous and discontiguous materials. In the location of the Site K plume, Unit 1 geology can be described as having discontinuous stratigraphy (both vertically and horizontally). This makes predicting the groundwater flows using a model difficult because of heterogenousity. The Unit 1 layer is at the ground surface, extends south of Rice Creek (**Figure 3-4**) and tapers out until the Unit 2 (aquitard) is exposed at the surface. To the best of our knowledge a groundwater model does not exist for Unit 1.

3.4.2.1 Site I Surficial Groundwater Plume

According to the FY 2013 APR, the Site I has a shallow groundwater plume and has not achieved the ROD clean up levels to close the site. There are three selected remedies in the Record of Decision (ROD Amendment #2, 2009): groundwater monitoring, additional characterization, and land use controls. The annual sampling, from monitoring well 01U667, is required into the future until the cleanup goals are met. According to Conestoga-Rovers & Assoiciates (CRA) report dated May 1994 (available on Ramsey Co ftp), Unit 1 is the uppermost unit at Site I comprised of discontinuous layers of fine graned sand, silt and clay (generally fill material from previous construction activities) with pockets and layers of organic deposits (peat). Unit 1 is less than 40 feet thick at Site I. Surficial groundwater is perched within Unit 1, which is underlain with Unit 2 (an aquitard, separating Unit 1 from the deeper aquifer).

3.4.2.2 Site K Surficial Groundwater Plume

According to the FY 2103 APR, the Site K shallow groundwater plume has not achieved the ROD clean up levels to close the site. Eight remedy components are being implemented at Site K. The plume is being treated using a groundwater extraction trench and air stripper, and monitored using monitoring wells, piezometers and sentinel wells. When the system operates as designed the treated water discharges to the storm sewer that, in turn, discharges to Rice Creek. This system will remain in place with oversight from the MPCA and the EPA into the future. According to CRA report dated May 1994, Unit 1 (the Fridley Formation) is the uppermost unit at Site K comprised of fine to medium graned sand with minor constituents of silt. Unit 1 is less than 2.2 to 46.8 feet thick at Site K. Surficial groundwater is perched within Unit 1, which is underlain with Unit 2 (an aquitard,

separating Unit 1 from the deeper aquifer). Groundwater at Site K flows west-northwest toward Rice Creek.

3.4.2.3 Building 102 Surficial Groundwater Plume

According to the FY 2103 APR, the Building 102 shallow groundwater plume has not achieved the ROD clean up levels to close the site. The plume is being treated using Natural Attenuation (abiotic degradation), and monitored to evaluate attainment and to verify that groundwater reaching Rice Creek does not exceed state surface water standards. This system will remain in place with oversight from the MPCA and the EPA into the future. Building 102 is close to building 103, which is a considered a part of Site K.

3.5 NO ASSOCIATION DETERMINATION

Due to the potential concern relative to surficial (Unit 1) contaminated groundwater, Ramsey County is seeking explicit MPCA approval relative to implementation of stormwater best management practices (BMPs) to ensure infiltration does not alter the groundwater flow regime in areas affected by historical solvent releases. Ramsey County is seeking protection of a No Association Determination under the Minnesota Enviornmental Response and Liability Act (MERLA) for the proposed actions related to plans for stormwater infiltration, as well as concurrence from the U.S. EPA and the U.S. Army with those plans.

Ramsey County submitted a Proposed Actions Letter/Request for No Association Determination request for activites under the demolition and remediation contract, described in Section 3.3, and was granted a No Association Determination on April 13, 2013. At the time of this printing, the MPCA is considering Ramsey County's additional Proposed Actions Letter/Request for No Association Determination requests for the following proposed actions:

- Redevelopment of the Site through mass grading and installation of municipal utility infrastructure, including all proposed public roadways, underground utilities (i.e., water mains, sewers, electric power, communications lines), as well as stormwater best management BMP systems, mitigated wetlands, Rice Creek channel modifications, and other infrastructure improvements.
- The proposed stormwater system will include surface water retention and surface water conveyances, though infiltration will be the preferred method for managing stormwater on-Site. Areas of the Site where increases in stormwater infiltration (above what was considered existing conditions) are not considered appropriate are defined on **Figure 5-2**. **Figure 3-8** shows areas of the Site where shallow (i.e., Unit 1) groundwater is currently impacted by solvent releases.
- Ramsey County met with MPCA on March 18, 2015 at Ramsey County Public Works. The MPCA requested Ramsey County document the predicted infiltration contributing to the surficial (Unit 1) aquifers in the vicinity of the Installation Repair Program (IRP) Site K before the start of the redevelopment project (circa 2012) and at the end of the redevelopment project (circa, TBD). During this meeting, MPCA discussed Ramsey County's written request made on September 16, 2014 for the MPCA to issue an assurance letter called a No Association Determination to fully develop the Site. A No Association Determination would give Ramsey County assurances that the Site could be developed, as presented in the CSMP, and Ramsey County would not be associated with known contamination for Superfund liability purposes. Ramsey County is preparing a technical document thatoutlines the measures prescribed in the comprehensive stormwater management planning process to limit impacts on the

remaining impacted surficial groundwater after the current demolition and remediation efforts are completed.

- Site sampling, excavation, segregation, grading, movement, stockpiling, permitting and means necessary for appropriate disposal of soils and media to accommodate the above-referenced improvements.
- Dewatering, sampling, permitting and means necessary for appropriate disposal of waters to accommodate the above-referenced improvements.

3.6 REGULATORY REQUIREMENT OVERVIEW

There are a number of federal, state and local water resource regulations that need to be met on the Rice Creek Commons. Given the complexity and potential conflicts between these regulations, we have been meeting with the respective agencies to confirm requirements. The four key agencies and their respective approvals required are listed below:

MnDOT has jurisdiction over wetland and drainage within MnDOT right-of-way, including the interchange areas of County Road H and County Road I. Wetland and drainage permits will be required from MnDOT for modifications to these interchanges that impact wetlands and surface water runoff.

MN DNR has jurisdiction over Rice Creek (within the top of banks of the Rice Creek channel) including any changes to the creek alignment, new crossings and floodplain impacts. A public waters permit and floodplain review will be required for the creek realignment, crossing and floodplain impacts adjacent to Rice Creek.

US Army Corps of Engineers (USACE) has jurisdiction over waters of the US which includes certain wetlands and streams. A Clean Water Act Section 404 permit will be required for wetland and creek impacts.

Rice Creek Watershed District (RCWD) has jurisdiction over Rice Creek Commons storm water runoff, erosion control, floodplains, wetlands, and creek crossings. RCWD approval is required in each of these areas by way of a Comprehensive Stormwater Management Plan (CSMP) and issuance of RCWD Permits. As allowed for under RCWD Rule C.5 (f), this CSMP has been prepared as an alternative means to meet the requirements of Rule C.6 (Water Quality Treatment) and Rule C.7 (Peak Stormwater Runoff Control) for redevelopment of the Site, which will be done in various stages.

4.0 Rice Creek Commons Redevelopment

4.1 PREDEVELOPMENT CONDITIONS

The predevelopment conditions for the site are agreed to be 2012, before redevelopment activities, such as demolition, commenced. The Site had open space, buildings, roads, utilities, no engineered infiltration devices, and groundwater remediation systems operating. Using LiDAR data and information available on the soils, land use, and storm sewers, the predevelopment conditions subwatersheds were delineated (**Figures 4-1** and **4-2**). The southern portion of the Site drains to Round Lake, while the remainder drains to Rice Creek. **Appendix A** includes a technical memorandum summarizing the modeling completed for the Site under predevelopment conditions. Wenck evaluated the Site stormwater runoff for 2-, 10-, and 100-year 24 hour design rainfall events (2.82, 4.22, and 7.31 inches, respectively). Precipitation depths were obtained from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 and distributed with a nested curve.

Due to the remediation at Rice Creek Commons, there is a considerable amount of data available on the groundwater levels in Unit 1. **Figure 4-3** is a historical map showing the surficial (Unit 1) groundwater levels in 1987. There are no groundwater level lines shown on the map in areas where the surficial (Unit 1) groundwater wasn't observed. Hydrogeologic factors such as heterogeneity of Unit 1, The historical map doesn't have depth to groundwater labeled. **Figure 4-4** shows the groundwater piezometric contours using 2012 groundwater conditions. The groundwater levels were evaluated using available surficial (Unit 1) groundwater monitoring wells (20 wells), and based on the water level data available between 1987 and 2013, 2012 was determined to represent the seasonably high groundwater condition.

There are 14.4 acres of wetland on the site (**Figure 3-2**). The RCWD, United States Army Corps of Engineers (USACE), and Minnesota Department of Transportation (MnDOT) have different jurisdiction and mitigation requirements for the wetlands impacted. Mitigation is needed on site to satisfy RCWD and Corps requirements for the Site infrastructure impact to wetlands (construction of the Spine and Old Highway 8 extension Roads, Natural Resources Corridor grading), as shown in **Figure 4-5**. This amount does not include the creek realignment, however that work is expected to be self-mitigating. Wetland sequencing will be defined in the County's permit applications submitted to RCWD.

4.2 CONCEPT GRADING PLAN

The current plan shows the site grading for Rice Creek Commons public infrastructure improvements and the layout of the Natural Resources Corridor (**Figure 4-5**), a blend of stormwater ponds and mitigation wetlands. **Figure 4-6** is a flow diagram showing the connections between tributary subwatersheds, stormwater ponds and wetlands. The proposed grading plan accomplishes the following priorities for fully developed conditions:

1. Provide all wetland replacement for the public infrastructure impacts
2. Accommodate all required stormwater rate control and infiltration for Spine/Old Highway 8 extension Roads
3. Accommodate stormwater rate control for all Rice Creek Commons development

4. Provide maintenance access to stormwater features in form of a recreational, multi-use trail
5. *
6. *
7. Provide some space for passive recreation opportunities along the easterly portion of the site

* Depending on further coordination with the USACE and RCWD, there is room in the Natural Resources Corridor to accommodate most of priority #5 and priority #6 (Section 1.2 of this CSMP). If a permit from the USACE cannot be obtained for wetland impacts of future development, the proposed grading plan would not provide wetland replacement (priority #5) for future site development within the Natural Resources Corridor, requiring individual developments that impact wetlands to address mitigation needs separately as a part of their planning and design activities. In that case, additional infiltration best management practices (BMPs) may be incorporated into the Natural Resources Corridor (priority #6) rather than additional wetland mitigation.

4.3 PROPOSED CONDITIONS

The proposed conditions are presented in two stages; completion of the public infrastructure improvements (interim conditions), and the fully developed conditions using landuse assumptions in the Master Plan. **Appendix A** includes technical memorandums summarizing the modeling completed for the Site.

4.3.1 Interim Conditions (Public Infrastructure Improvements) (Interim Scenario 1)

The first phase of site development includes the construction of public infrastructure improvements including Spine Road, I-35W improvements, alterations to County Road H and realignment of Rice Creek (**Figure 4-5**). During this interim construction phase, a contractor, selected by Ramsey County will construct all wetlands and ponds except P-1, P-3, and P-14. The interim conditions reflect the first stage of site development which includes the construction of public infrastructure improvements. **Appendix A** includes technical memorandums summarizing the modeling completed for the Site under interim conditions (Interim Scenario 1). The same rainfall and snowmelt events were evaluated for interim conditions, as were evaluated for existing conditions.

4.3.2 Worst Case Interim Conditions (Interim Scenario 2)

The pollutant removal efficiency of the proposed regional ponding system was evaluated for the worst case scenario. This Interium Scenario 2 assumes the public infrastructure improvements are completed, stormwater pond (P-14) is built, Rice Creek Commons develops east of Spine Road (landuse per **Figure 3-1**) and there is no development or infiltration device in subwatershed SB-18 (**Figure 4-7**). **Appendix A** includes a water quality technical memorandum summarizing the modeling completed for the Site under interim conditions (Interim Scenario 2). The same rainfall and snowmelt events were evaluated for interim conditions, as were evaluated for existing conditions.

4.3.3 Proposed Conditions (Fully Developed)

Using the grading plan and assumption that existing topography will remain relatively unchanged and information available on the soils, fully developed conditions land use, and storm sewers, the fully developed conditions subwatersheds were delineated (**Figures 3-1 and 4-7**). The comparison between existing and fully developed site drainage divide is shown on **Figure 5-1**. **Appendix A** includes technical memorandums summarizing the modeling completed for the Site under proposed conditions (fully developed). The same rainfall and snowmelt events were evaluated for fully developed conditions, as were evaluated for existing conditions.

5.0 CSMP Meets RCWD Rule C Requirements

5.1 RCWD RULE C OVERVIEW

The Rice Creek Commons to be redeveloped is located within two Resource of Concern (ROC) Drainage Areas (see **Figure 2-2**). The northern part of the site (278 acres) drains to Rice Creek which flows into Long Lake located approximately 1.3 miles downstream. The southern part of the site (208 acres) drains directly into Round Lake. General drainage patterns will be maintained under the proposed, fully developed conditions and stormwater runoff within each ROC drainage area will be managed to meet RCWD's Rule C requirements as described below (as adopted at the time of printing).

As allowed for under RCWD Rule C.5 (f), this Comprehensive Stormwater Management Plan (CSMP) has been prepared as an alternative means to meet the requirements of Rule C.6 (Water Quality Treatment) and Rule C.7 (Peak Stormwater Runoff Control) for redevelopment of the Site, which will be done in various stages. The water quality treatment volume and peak runoff rate controls standards will be met in aggregate for each ROC drainage area. As agreed to with RCWD staff, existing impervious surface area is based on 2012 conditions prior to the start of site demolition and remediation activities. Proposed impervious surface areas are based on the proposed infrastructure improvements and various land uses identified in the Master Plan.

Best management practices (BMPs) used to meet the standards will be constructed and functional prior to, or concurrent with the construction of impervious surfaces associated with each development project. Once approved by RCWD, this CSMP will apply to future development of the site. Permits will be required for individual development projects to confirm compliance with this CSMP and to meet other applicable RCWD rules.

Initial stages of redevelopment include site demolition and remediation activities that commenced in April of 2013. The next phase is construction of public infrastructure improvements including the main access road serving the development, utilities, rough site grading, regional stormwater ponds, and mitigation wetlands. The majority of the stormwater ponds and wetland mitigation areas are located within the Natural Resources Corridor that runs through the center portion of the site.

Upon completion of the public infrastructure improvement work, private development will take place over time and in various stages which will include construction of additional stormwater management facilities. Individual stormwater management plans must conform to this CSMP as well as any ordinances that may apply within the redevelopment area.

In accordance with RCWD stormwater management policy, better site design techniques shall be considered to reduce impervious surfaces and maximize water quality and flood control benefits. Two such techniques, preserving/dedicating natural areas and using a treatment train approach for runoff management, have been incorporated into this CSMP. Developers will be required to evaluate and apply better site design techniques, wherever possible, as part of the design process for future development of the site. A better site design guidance document and checklist is available on the RCWD website.

5.2 WATER QUALITY TREATMENT – RULE C.6

RCWD's water quality treatment requirements will be met through a combination of onsite infiltration and wet detention ponds, as described below. Due to soil constraints (Type C and D soils with low permeability), ongoing groundwater treatment activities (described in Section 3.4), MPCA's advisement to not alter the groundwater flow regime in areas that are known to be affected by historical solvent releases, and other factors such as subsurface vapor treatment and shallow Unit 1 groundwater; the use of onsite infiltration is limited and determined to not be feasible over the majority of the site. **Figure 5-1** shows locations of potential infiltration practices based on review of existing soil borings. Copies of the soil boring logs for the project site are provided in **Appendix B**. Infiltration is deemed feasible and required in the area north of Rice Creek and an area on the west side of the Spine Road alignment as shown in **Figure 5-1**. Both of these areas drain to Rice Creek. In all other areas, including areas draining south to Round Lake, water quality treatment will be provided through wet detention ponds.

Available soil borings (circa 2007) were reviewed along the Spine Road cooridor, the best soils for infiltration practices are located in areas affected by historical solvent releases, thus infiltration is deemed infeasible and not required. The **Appendix A** HydroCAD Technical Memorandum Section 3.3 and Figure 3 display the conclusions of the infiltration potential analysis based on the 2007 borings. The runoff from Spine Road is collected by stormsewer and directed to stormwater ponds (P-2, P-6 and P-13). Additional soil borings were drilled to obtain geotechnical recommendations to advance the Spine Road corridor design during summer 2015. The preliminary soil borings logs available at the time of printing were reviewed and the best soils for infiltration practices were located in areas where infiltration BMPs were infeasible. **Figure 5-3** display the conclusions of the infiltration potential analysis based on the 2015 preliminary borings. Many of the borings show clay soils, which are not favorable for infiltration BMPs. The borings with feasible soils were located in the headwaters portions of the delineations where there isn't a large enough subwatershed tributary to feed an infiltration BMP (SR-211), in areas of high groundwater (SR-214, SR-215, SR-216, SR-217) and in areas where stormwater reintroduction is not allowed due to historical solvent releases. These additional soil borings, when finalized, will be submitted with the public infrastructure improvements permit application to RCWD.

5.2.1 Stormwater BMP Strategy to meet Rules

5.2.1.1 Infiltration

Rule C.6 requires that where feasible, infiltration be provided for stormwater runoff from new and/or reconstructed impervious surfaces. Proposed impervious surface area is based on the proposed public infrastructure improvements and various land uses identified in the Master Plan.

Water quality treatment volume required for phosphorus removal is calculated as follows:

$$\text{Required Water Quality Treatment Volume (ac-ft)} = \text{Area of New or Reconstructed Impervious Surface (acres)} \times 1.1\text{ (in)} \div \text{Total Phosphorus Removal Factor} \div 12\text{ (in/ft)}$$

Where the Total Phosphorus Removal Factor = 1.0 for Infiltration BMPs

As noted above, onsite infiltration was deemed feasible and is required in the area north of Rice Creek and the northwest corner of the portion south of Rice Creek, as shown in **Figure 5-1**. The proposed new/reconstructed impervious surface area and the required water quality treatment volumes (infiltration volume) based on the above equation are provided in **Table 5-1** below:

Table 5-1: Infiltration Requirements

	Area North of Rice Creek (Figure 5-1: Area 4)	Area West of Spine Road (Figure 5-1: Area 3)
Impervious Surface (acre)	40.9	36.3
Infiltration Volume (acre-ft)	3.7	3.3

One large regional infiltration facility could be constructed in each drainage area to meet the above volume requirements. In lieu of providing large regional facilities, smaller infiltration systems could be constructed as individual parcels develop. In this case, a rate of 4,000 cubic feet of infiltration volume per acre of impervious surface area created would be used to determine infiltration requirements on a parcel-by-parcel basis.

Infiltration systems that capture, store and infiltrate stormwater runoff into the underlying permeable soils include both ground surface depressions such as infiltration basins and underground facilities such as an infiltration trench. Typical construction details for each of these practices are provided in the Minnesota Stormwater Manual (excerpts included in **Appendix C**). Drawdown must be within 48 hours after the storm event for surface systems and 72 hours for subsurface systems. A minimum of three feet of separation must be provided from the bottom of the infiltration system to the seasonally high groundwater table or bedrock. The infiltration systems will be equipped with a bypass or overflow device to redirect stormwater runoff from larger rainfall events (greater than 1.1 inches) to the downstream conveyance systems. The bypass or overflow for the infiltration device in the northwest corner of the portion south of Rice Creek will be directed to the wet detention Pond (P-13), where additional water quality benefits will be provided along with rate control.

Total suspended solids (TSS) will be removed to the maximum extent practicable from stormwater runoff from new and reconstructed impervious surfaces and from stormwater draining to infiltration areas. This will be accomplished through the use of sump catch basins and manholes, grit chambers, sand filters, or similar BMPs.

The proposed wet detention ponds described below will provide additional volume reduction and water quality benefits through infiltration, evaporation, and plant uptake between storm events creating additional storage volume in the pond as water levels drop below the outlet elevation.

5.2.1.2 Wet Detention Ponds

Stormwater ponds used for water quality treatment in meeting Rule C.6 need to be properly sized consistent with Nationwide Urban Runoff Program (NURP) criteria. This includes providing a permanent wet pool with dead storage at least equal to the runoff volume from a 2.5-inch rainfall over the pond tributary area under full development. The permanent pool volume is the most important design parameter influencing pollutant removal efficiency. It

provides storage and treatment of runoff during and between storm events. The amount of dead storage calculated for each pond is shown in the Pond Data Summary Tables provided in HydroCAD Technical Memorandum (**Appendix A**).

The proposed fully developed dead storage volume provided for each ponding system is summarized in **Table 5-2**.

Table 5-2: Dead Storage

Pond/Ponding System	Dead Storage Provided (ac-ft)
P-1, P-2, P-3, P-5, P-6	14.4
P-7, P-8, P-9, P-10, P-11, P-12, P-13	15.6
P-4	0.6
P-14	4.5
Total	35.1

Individual ponds P-4 and P-14 meet RCWD's dead storage requirements. Although some of the individual ponds may not meet the dead storage requirements, the ponding system with multiple ponds in series provides a treatment train approach that enhances overall pollutant removal capabilities.

5.2.1.3 P8 Water Quality Modeling

To ensure that the average annual total phosphorus removal efficiency for the ponding systems in series is at least 50% (TP Removal Factor), the P8 Water Quality Model was utilized to estimate the overall phosphorus removal efficiency under fully developed conditions. For fully developed conditions, each outfall is numbered as shown in **Figure 6-3**. The tributary areas to each outfall are shaded in a similar color. A description of the modeling effort is summarized in a Technical Memorandum provided in **Appendix A**. Based on the P8 modeling results, the total phosphorus removal efficiencies for the two proposed ponding systems are as follows:

Table 5-3: TP Load Reductions to Rice Creek (Scenario 3: Fully Developed Conditions

Discharge Point	Watershed Inflow Load (lbs./year)	Total Outflow (lbs./year)	% Reduction
Outfall #5	279	99.9	64%
Outfall #10	18.8	7.1	62%
CRH-1**	7.1	3.8	46%
CRH-3**	5.4	4.2	22%
Thumb Infiltration	13.6	0.4	97%
Total	323.9	115.4	64%

*The total TP inflow load for each discharge point was calculated by summing the TP loads from each contributing watershed (i.e. total TP inflow load for CRH-3 = TP load from CRH-2 + TP load from CRH-3).
** Ponds CRH-1 and CHR-3 are 30% designed, see text above.

Table 5-4: TP Load Reductions to Round Lake (Scenario 2: Fully Developed Conditions)

Discharge Point	Total TP Inflow Load* (lbs./year)	Total Outflow Load (lbs./year)	% Reduction
Outfall #2	168.8	66.3	61%
Outfall #1	12.4	6.1	51%
Total	181.2	72.4	60%

*The total TP inflow load for each discharge point was calculated by summing the TP loads from each contributing watershed (i.e. total TP inflow load for Outfall #1 = TP load from Pond 4 + TP load from Wetland 1)

The 2012 outfalls are numbered as shown in **Figure 6-2**. TP loads were evaluated for interim development conditions. The results from these models are presented in **Appendix A**.

The P8 modeling confirms that the wet detention ponding networks provide water quality treatment of site stormwater runoff sufficient to meet RCWD rules. Improved wet pond designs have been observed to achieve higher pollutant removal efficiencies by adding in features such as wetland benches, flow barriers that divide the pond into two or more segments, forebays, and floating wetlands and / or aerators. The BMPs modeled in P8 are simple ponds and infiltration devices without explicitly modeling the additional pollutant removals associated with these enhanced designs. The least effective BMP provides over 50% TP removal. Each ponds, shown on **Figure 4-5**, will be installed with an aquatic bench. Future private designers should not be expected to install BMPs that are more effective than required in the CSMP, unless impervious surfaces proposed are greater than assumed in this CSMP.

Pond outlets will be designed to provide skimming/retention of oils and floatable debris for at least the 1-year 24-hour design rainfall event (2.45 inches). Velocities through each skimming device will be limited to 0.5 feet per second.

The ponds will also be designed with an aquatic bench extending below the normal water level a minimum width of 10 feet and one foot deep for safety purposes, provide suitable habitat for rooted aquatic plants, and improve access for maintenance.

5.2.2 Additional BMPs for Consideration of Future Development

Additional onsite volume abstraction/reduction will be encouraged as part of future development. The following may be considered, if feasible::

- Capture and reuse of stormwater for irrigation - Operating plans for stormwater reuse including calculations and documentation will be provided by developers and submitted with individual permit applications.
- Planting of new trees - Tree planting plans will be provided by developers and submitted with individual permit applications. Tree canopy areas provide variable rainfall interception that can be estimated using a variety of methods.
- Soil amendments - Project specifications that incorporate soil amendments or conditioners, where applicable, to restore soil function and increase infiltration capacity will be consistent with RCWD Soil Amendment Guidelines.

- Native plants - Use native plants wherever possible to enhance stormwater abstraction and uptake capabilities.
- Wetland buffers - Maintain vegetative buffers along edges of wetlands to slow runoff and filter out nutrients and suspended solids.
- Grass channels - Use grass channels and swales wherever possible to convey stormwater runoff.

5.3 PEAK STORMWATER RUNOFF CONTROL – RULE C.7

With the exception of small direct tributary areas to Rice Creek and infiltration volumes described above, all stormwater runoff from developed areas of the site will be routed through stormwater ponds where both water quality and rate control will be provided.

The HydroCAD computer model was used to model existing and proposed conditions to determine peak discharges and water levels for the 2-year, 10-year, and 100-year, 24-hour design rainfall events using NOAA Atlas 14 precipitation values. Analysis of the 10-day snowmelt event was not required as all stormwater ponds have a defined outlet at an elevation below the 100-year high water level. A description of the modeling effort, calculations, technical analysis, and supporting information is summarized in a Technical Memorandum provided in **Appendix A**.

5.3.1 Allowable Peak Discharge Rates

Since the project site is located within the Flood Management Zone of the lower Rice Creek Watershed, proposed discharge rates will be limited to 80% of existing peak discharge rates. Based on modeling of existing conditions, the allowable peak rates for the proposed redevelopment (80% of existing/Flood Management Zone) is as follows:

Table 5-5: Allowable Peak Rates

Drainage Area	2-Year	10-Year	100-Year
Rice Creek (cfs)	252	483	975
Round Lake (cfs)	127	254	525

5.3.2 Proposed Peak Discharge Rates

Stormwater runoff from redeveloped areas within both drainage areas will be routed through onsite regional ponds to meet the above peak stormwater runoff control requirements for the 2-year, 10-year and 100-year 24-hour design rainfall events (80% of existing).

Based on modeling of proposed conditions, the following peak rates have been determined:

Table 5-6: Proposed Peak Rates

	2-Year	10-Year	100-Year
Interim Rice Creek (cfs)	104	232	607
fully developed conditions Rice Creek (cfs)	237	414	853
Interim Round Lake (cfs)	51	124	349
fully developed conditions Round Lake (cfs)	54	117	326

Overall, peak rates will be reduced and there should be no adverse downstream impacts. Peak discharge rates, water elevations, and storage volumes for each of the proposed ponding areas are summarized in the Pond Data Summary Table provided in HydroCAD Technical Memorandum (**Appendix A**).

Wet detention ponds that are not constructed initially as part of the public infrastructure improvement construction phase (Ponds P-1, P-3 and P-14) will be constructed later as part of future development phases. These ponding areas will be dedicated and space reserved for future use by way of outlots and/or easements and located in the general area shown on the site plan. Ponds will be constructed to provide the dead storage volume and flood storage consistent with what was modeled and included as part of the overall stormwater analysis presented in this CSMP.

5.3.3 Outlet Control Structures

Each pond will be designed with a multi-stage outlet control structure to manage stormwater discharges for each of the design events. The outlet structure will also be designed to provide skimming/retention of oils and floatable debris for at least the 1-year 24-hour design rainfall event (2.45 inches).

Each pond will be equipped with a stabilized emergency overflow spillway to convey flows greater than the 100-year 24-hour design rainfall event (7.31 inches). Emergency overflow routes shall also be provided for added protection against flooding and local erosion.

Stormwater conveyance systems such as storm sewers and drainage channels will be designed and constructed by commercial developers to route stormwater runoff to various ponding areas serving the development.

5.3.4 Low Floor and Low Entry Freeboard Requirements

The storage volumes and discharge rates established for each pond must be maintained to prevent flooding of property and meet peak flows. The lowest floor elevation of future buildings and structures adjacent to ponds and connecting drainage channels must be at or above the 100-year high water level and the lowest opening elevation must be at least two feet above the 100-year high water level. These building elevations should be indicated on site grading plans to ensure adequate freeboard is provided. Pond emergency overflow elevations must be at least one foot below the lowest opening elevation.

6.0 Stormwater BMPs

6.1 CONSTRUCTION OF PONDS

The stormwater ponds (P-2, P-4, P-5, P-6, P-7, P-8, P-9, P-10, P-11, P-12, P-13, CRH-1, CRH-2, and CRH-3) will be constructed by the contractor(s) selected by the County (**Figure 4-5**). The County's contractor will construct storm sewer conveyance from P-5 to P-3, along with a temporary connection to the outfall to provide conveyance until P-3 is constructed. Stormwater ponds P-1, P-3 and P-14 will be constructed by respective developers. The engineering design for stormwater ponds located in MnDOT right-of-way (CRH-1, CRH-2, and CRH-3) was preliminary (30%). The proposed ponds submitted did not provide sufficient water quality treatment volume to meet RCWD rules, nor were infiltration BMPs incorporated in the stormwater management design, as required per this CSMP.

The planned phasing is that all but stormwater ponds (P-1, P-3 and P-14) will be constructed as part of the public infrastructure improvements (Interim Scenario 1) staged outlets and general site grading to create wetland hydrology.

6.2 VOLUME REDUCTION PRACTICES

The volume reduction BMPs (e.g., infiltration practices) on the portion area and the northwest corner of the portion south of Rice Creek will be designed and constructed by the respective developer following the Minnesota Stormwater Manual guidance (**Appendix C**) and the RCWD Permit requirements. In Areas 3 and 4 (**Figure 5-1**) soil infiltration rates will be evaluated to determine if the native soils at the bottom of the proposed infiltration device infiltrate more than 8.3 inches per hour. The soils shall be amended to slow the infiltration rate below 8.3 inches per hour or as allowed by a local unit of government with a current MS4 permit. The respective developer will be the entity responsible for long-term operations and maintenance of volume reduction practices. Respective developers shall submit an infiltration management plan as part of the RCWD permit applicaiton.

6.3 RESPONSIBLE PARTY FOR STORMWATER MANAGEMENT FEATURES

Ramsey County is the entity responsible for short-term (through 5-year establishment and approval period) operations and maintenance of the wetland mitigation (Wi, W-1, W-2, W-3, W-4, and W-5).

MnDOT is the entity responsible for long-term operations and maintenance of the stormwater management and drainage facilities receiving stormwater from MnDOT right-of-way. Preliminarily these consisit of stormwater ponds; P-15, CRH-1, CRH-2, and CRH-3.

The City of Arden Hills is the entity responsible for long-term operations and maintenance of the stormwater management and drainage facilities receiving stormwater from public and private spaces within the Site. Most of these stormwater ponds are located within the Natural Resources Corridor (P-4, P-5, P-6, P-7, P-8, P-9, P-10, P-11, P-12, and P-13). Regional ponds owned by public entities that are used to meet rate control requirements do not need a maintenance agreement with the RCWD.

Some ponds (P-1, P-3 and P-14) will be constructed by the developer but will be maintained by the city once constructed and stabilized to the City'ss satisfaction. The individual Developers are not known at this time.

The infiltration BMPs in Areas 3 and 4 will be responsibility of the Developer. The Developer will need to record a Stormwater Operation and Maintenance Agreement (see RCWD website for template) with RCWD. Submittals must include an exhibit and/or legal description that identify the BMPs. The Agreement must be submitted to the RCWD for review and approval prior to submitting it to the County Recorder's office.

Table 6.1 summarizes responsible entity for the long-term operations and maintenance of the stormwater management and drainage facilities. Pretreatment features to provide grit removal will be constructed by developers and maintained by developers per each outlot.

Table 6-1: Pond Responsibilites

Feature	Constructed by	Long-Term O&M Responsibility
P-1	Developer	City of Arden Hills
P-2	Ramsey County's Contractor	City of Arden Hills
P-3	Developer	City of Arden Hills
P-4	Ramsey County's Contractor	City of Arden Hills
P-5		
P-6		
P-7		
P-8		
P-9		
P-10		
P-11		
P-12		
P-13		
P-14	Developer	City of Arden Hills
P-15	Ramsey County's Contractor	MnDOT
Infiltration BMP outlot A	Developer	Developer
CRH-1	Ramsey County's Contractor	MnDOT
CRH-2	Ramsey County's Contractor	MnDOT
CRH-3	Ramsey County's Contractor	MnDOT
Infiltration BMP outlot J	Developer	Developer
Infiltration BMP outlot K	Developer	Developer
Pretreatment BMP, grit removal	Developer	Developer

6.4 MAINTENANCE GUIDELINES FOR STORMWATER FEATURES

6.4.1 Ponds

Stormwater management and drainage facilities shall be maintained as necessary to ensure the stormwater system functions as it was originally designed, including:

- Removing accumulated sediment from low areas
- Regularly inspecting pipes, structures, and embankments for structural integrity
- Removing trash, debris, or other obstructions from site
- Clearing tributary areas of invasive or nuisance/undesirable vegetation
- Addressing any erosion issues, including restoring slope protection and riprap

Site access routes shall be well maintained and clear of obstruction. Detailed guidelines for maintenance is provided in the Minnesota Stormwater Manual. Stormwater ponds will not function properly unless a pre-treatment device is properly sized, installed and maintained as necessary to ensure the device functions as it was originally designed.

6.4.2 Infiltration BMPs

The Minnesota Stormwater Manual presents a multitude of options of infiltration BMPs for stormwater runoff. These devices will be selected, designed and installed after the CSMP is adopted. The Minnesota Stormwater Manual presents a variety of design guidelines, as well as operation and maintenance considerations for BMPs. Appendix C contains an example of the information available. Some infiltration BMPs include:

- Bioinfiltraiton/rain garden
- Infiltration basin
- Infiltration trench
- Permeable pavement
- Tree trench/tree box
- Underground infiltration

Some BMPs are easier to maintain than others. Infiltration BMPs will not function properly unless a pre-treatment device is properly sized, installed and maintained as necessary to ensure the device functions as it was originally designed. Infiltration BMPs must be maintained as necessary to ensure the device functions as it was originally designed.

6.4.3 Pre-Treatment (Grit Removal)

The Minnesota Stormwater Manual presents a multitude of options to pre-treat stormwater runoff prior to discharging it into stormwater BMP. Some pre-treatment systems include:

- Flow through device
- Swirl Chambers
- Trench Forebays
- Level Spreaders
- Vegetated filter strips
- Forebays
- Vegetated swales
- SAFL baffle

- off-line deep sump catch basins
- Proprietary Products

Detailed guidelines for maintenance is provided in the Minnesota Stormwater Manual.

6.5 EASEMENTS FOR PONDS

Preliminary outlots have been identified on the concept preliminary plat (**Figure 5-2)**. At this time the drainage and utility easements are not defined, due to the concept nature of the stage the project is in. It is one of the objectives of the plat development process to define the drainage and utility easement corridors. It is anticipated, as the platting documents for submission are produced, these corridors will be addressed and illustrated as well as other outlots or easements that may need to account for ponds, water features, stormwater retention/detention features as well as sites for significant utility structures such as substations, lift stations, etc. that may be dedicated to the public or privately owned based how it will be managed and maintained.

Some of the areas designated for MnDOT right-of-way may be right of way dedications in the plat and may not be considered tracts or outlots in the final version. Right-of-way or easements may also be needed in the portion north of Rice Creek area's westerly road if this is to become public or have public utilities.

The public infrastructure improvement grading shows the location of trails. All ponds located in the Natural Resources Corridor (NRC) are accessable by trails for long-term operations and maintenance. **Table 6.1** summarizes who is responsible for construction and long-term operations and maintenance for each stormwater pond as drainage and utility easement corridors are identified.

If a develpment project submits a RCWD permit application that has an impervious acreage less than or equal to the values by outlot in **Table 6.2**, the requirements of Rule C.6 (Water Quality Treatment) and Rule C.7 (Peak Stormwater Runoff Control) will be considered satisified.

Table 6-2: Impervious Summary by Outlot

Outlot ID	Area (acres)	Impervious Area (acres)	Additional breakdowns
Outlot A	40.1	34.0	
Old Highway 8 extension Road	4.8	4.8	
Spine Road	24.0	24.0	
Outlot B (Creek)	45.9	18.1	15.2 acres in residential
Trail Dedication	1.1	0.7	0.4 acres residential, remaining in trails
Outlot C (NRC)	47.6	5.2	2.1 acres in civic, remaining in recreational and trails, realigned Creek
Outlot D (Town)	58.8	28.6	16.9 acres in residential, 9.7 acres in mixed use, 1.2 acres in commercial, remaining in recreational
Outlot E (Hill)	73.3	27.0	23.9 acres in residential
Outlot F (Flex Business East)	28.7	23.5	
Outlot G (Flex Business South)	31.7	21.6	
Outlot H (NRC)	3.5	0.4	0.4 acres in trails
Outlot I (Flex Business North)	18.2	15.4	
Outlot J (Corporate)	20.0	17.0	
Outlot K (Retail)	20.0	16.5	16.4 acres in retail, remaining in recreational
Outlot L (Creek Meander)	2.7	0.2	0.2 acres in trails, realigned creek

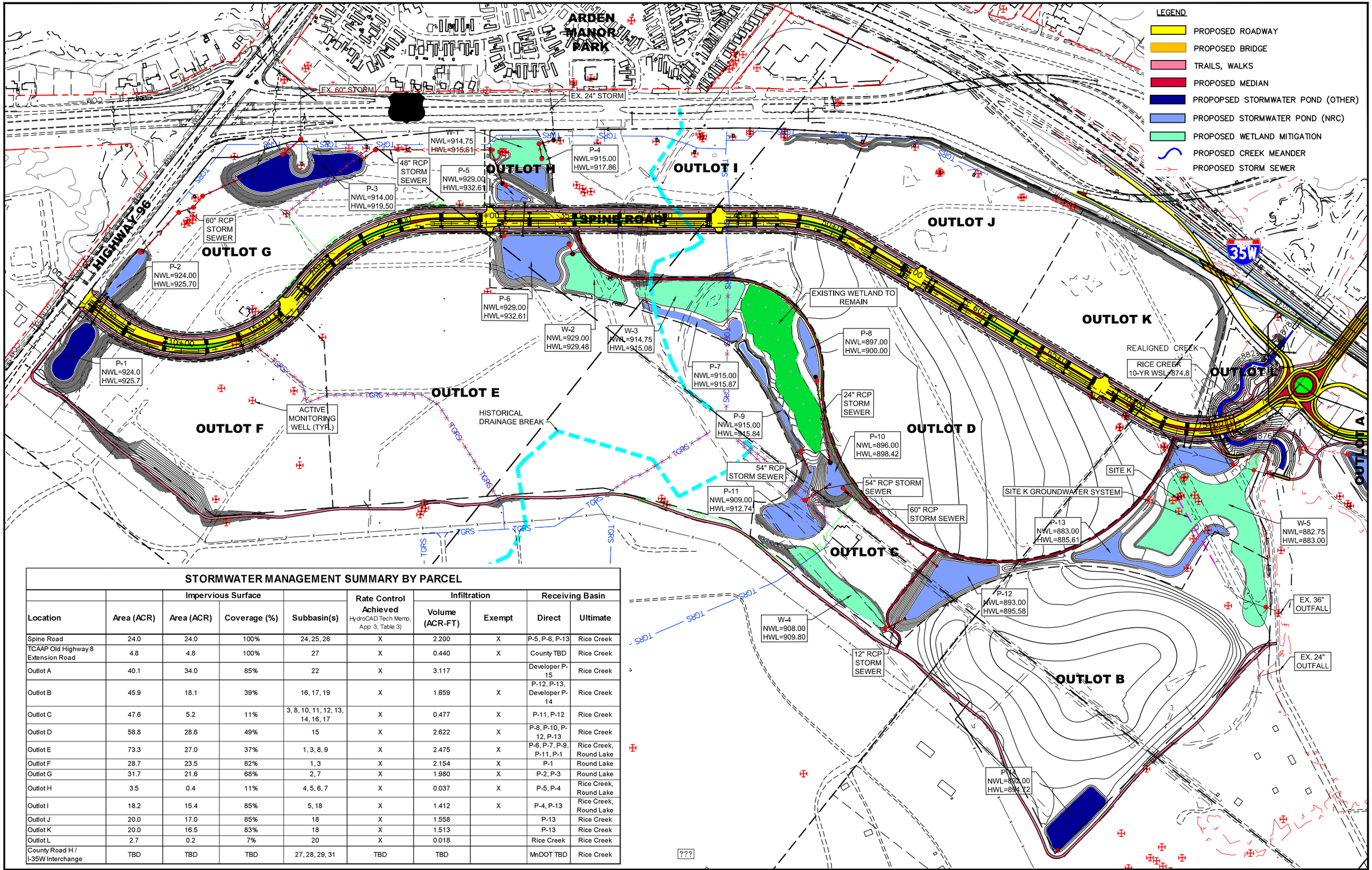
The surface area at normal water elevation for ponds/wetlands is not considered part of the impervious areas by outlot in **Table 6.2**.

6.6 RECORD DRAWINGS FOR PONDS

As required by the City of Arden Hills, upon completion of construction, the responsible party shall retain a duly licensed Professional Engineer in the State of Minnesota to certify that the as-built plans are consistent with design.

The County will require the Contractor to submit as-built drawings of the stormwater ponds, outlet control structures and stormwater system. The as-built drawings are submitted to the City of Arden Hills and the RCWD. At the end of the correction period/warranty period in the construction contract, the County will transfer responsibility of operation and maintenance of the stormwater ponds, outlet control structures and stormwater system to the City of Arden Hills.

Figures



STORMWATER MANAGEMENT SUMMARY BY PARCEL

		Impervious Surface			Rate Control Achieved (HydroCAD Tech Memo, App. 3, Table 3)	Infiltration		Receiving Basin	
Location	Area (ACR)	Area (ACR)	Coverage (%)	Subbasin(s)		Volume (ACR-FT)	Exempt	Direct	Ultimate
Spine Road	24.0	24.0	100%	24, 25, 26	X	2.200	X	P-5, P-6, P-13	Rice Creek
TCAAP Old Highway 8 Extension Road	4.8	4.8	100%	27	X	0.440	X	County TBD	Rice Creek
Outlot A	40.1	34.0	85%	22	X	3.117		Developer P-15	Rice Creek
Outlot B	45.9	18.1	39%	16, 17, 19	X	1.659	X	P-12, P-13, Developer P-14	Rice Creek
Outlot C	47.6	5.2	11%	3, 8, 10, 11, 12, 13, 14, 16, 17	X	0.477	X	P-11, P-12	Rice Creek
Outlot D	58.8	28.6	49%	15	X	2.622	X	P-8, P-10, P-12, P-13	Rice Creek
Outlot E	73.3	27.0	37%	1, 3, 8, 9	X	2.475	X	P-6, P-7, P-9, P-11, P-1	Rice Creek, Round Lake
Outlot F	28.7	23.5	82%	1, 3	X	2.154	X	P-1	Round Lake
Outlot G	31.7	21.6	68%	2, 7	X	1.980	X	P-2, P-3	Round Lake
Outlot H	3.5	0.4	11%	4, 5, 6, 7	X	0.037	X	P-5, P-4	Rice Creek, Round Lake
Outlot I	18.2	15.4	85%	5, 18	X	1.412	X	P-4, P-13	Rice Creek, Round Lake
Outlot J	20.0	17.0	85%	18	X	1.558		P-13	Rice Creek
Outlot K	20.0	16.5	83%	18	X	1.513		P-13	Rice Creek
Outlot L	2.7	0.2	7%	20	X	0.018		Rice Creek	Rice Creek
County Road H / I-35W Interchange	TBD	TBD	TBD	27, 28, 29, 31	TBD	TBD		MnDOT TBD	Rice Creek

Kimley»Horn
2550 UNIVERSITY AVENUE WEST, SUITE 238N
SAINT PAUL, MINNESOTA 55114
Ph: 651-645-4197 www.kimley-horn.com

RAMSEY COUNTY

ARDEN HILLS

TCAAP Site Redevelopment Infrastructure

0 125 250
SCALE IN FEET

COMPREHENSIVE STORMWATER MANAGEMENT PLAN

MANAGEMENT SUMMAR□ □□ PARCEL
FIGURE ES-□

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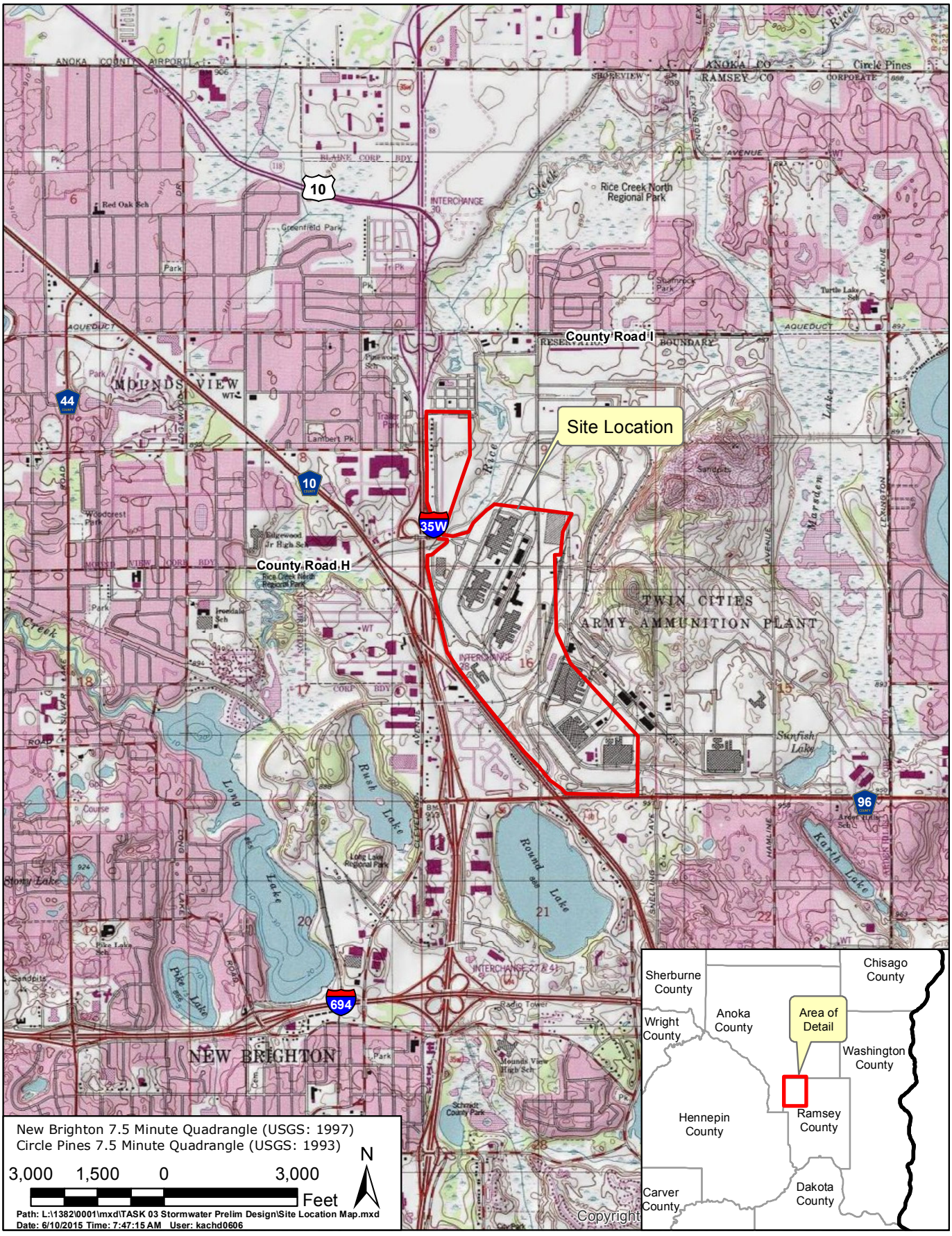


RAMSEY COUNTY

Site Location Map

WENCK ASSOCIATES

Responsive partner. Exceptional outcomes.

JUN 2015

Figure 2-1

RAMSEY COUNTY

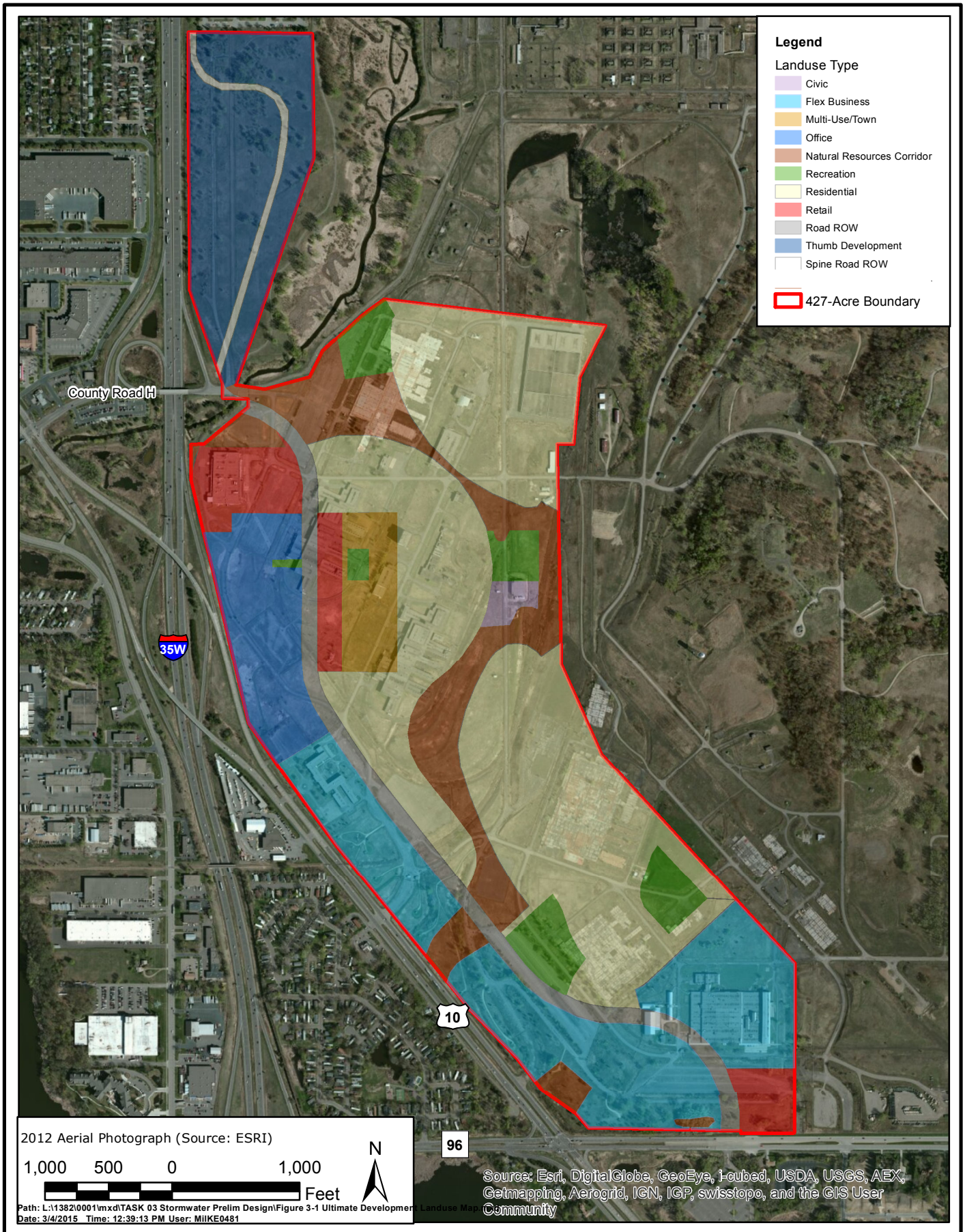
Site Detail Map

WENCK ASSOCIATES

Responsive partner. Exceptional outcomes.

JUNE 2015

Figure 2-2



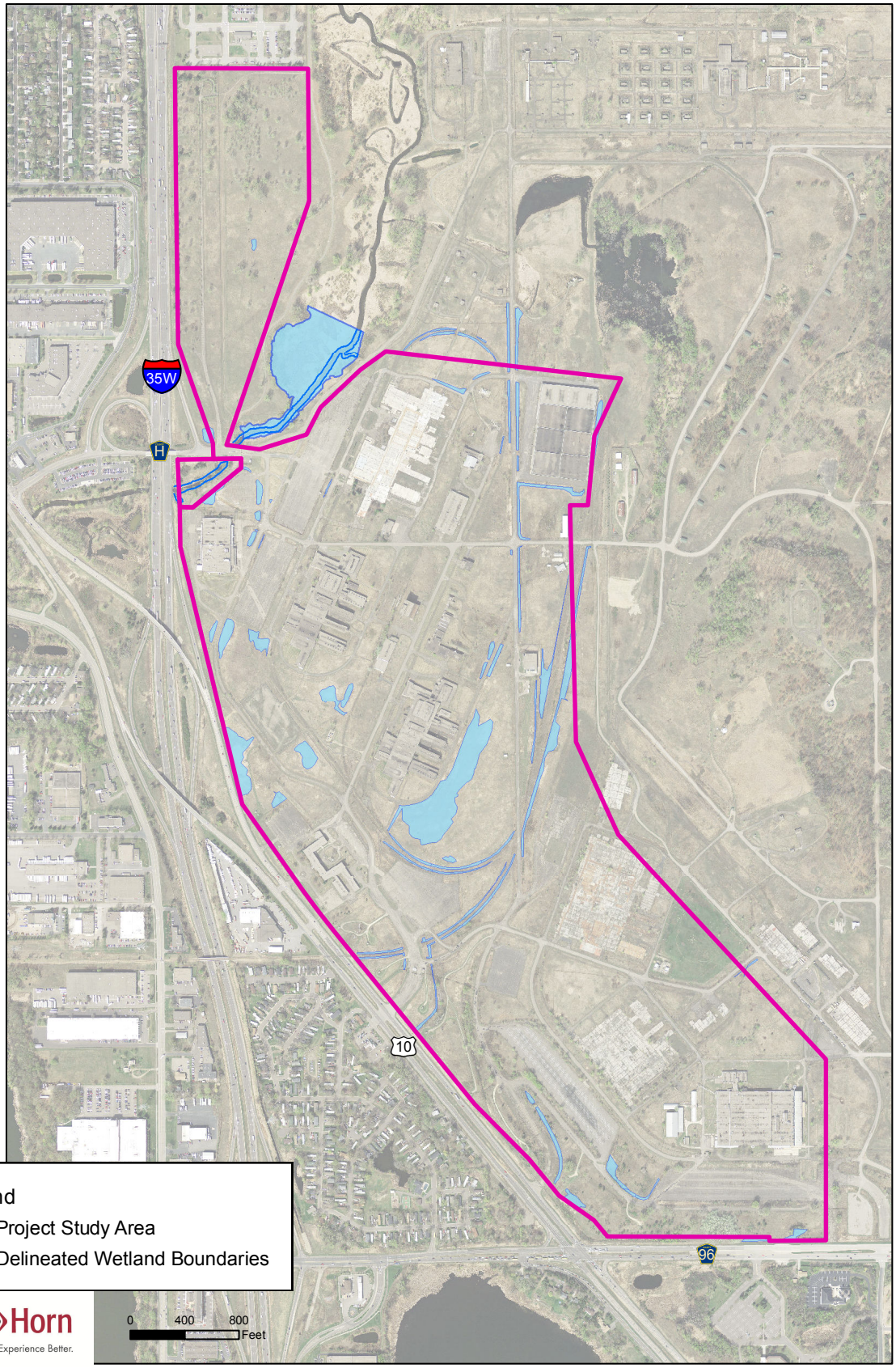
RAMSEY COUNTY

(FINAL AUAR) Fully Developed Conditions: Landuse Map

WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.

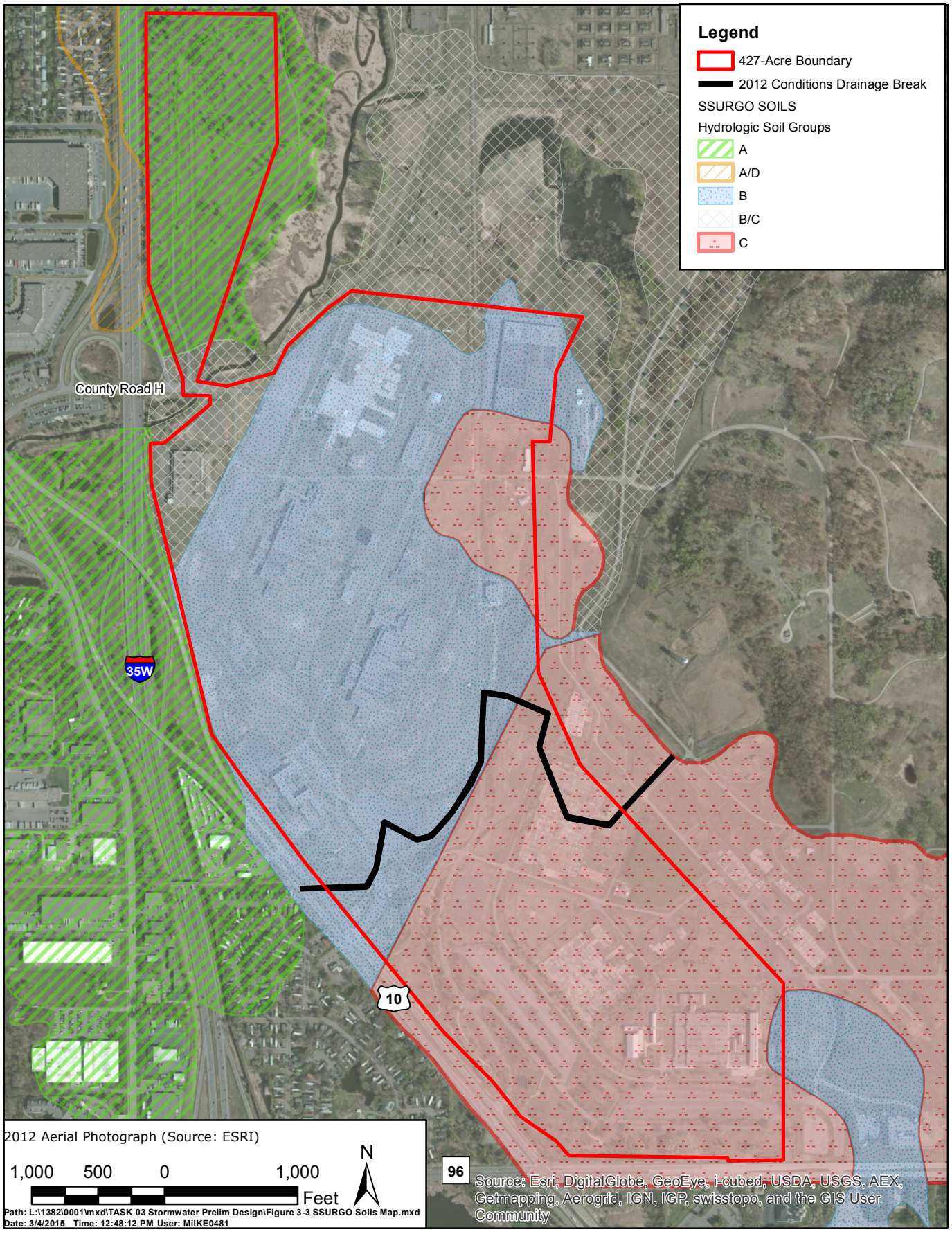
JUNE 2015

Figure 3-1



Map Source: Kimley Horn

RAMSEY COUNTY	WENCK ASSOCIATES Responsive partner. Exceptional outcomes.	JUNE 2015
Pre-Development (2012): Wetlands Map (Kimley-Horn)		Figure 3-2



RAMSEY COUNTY

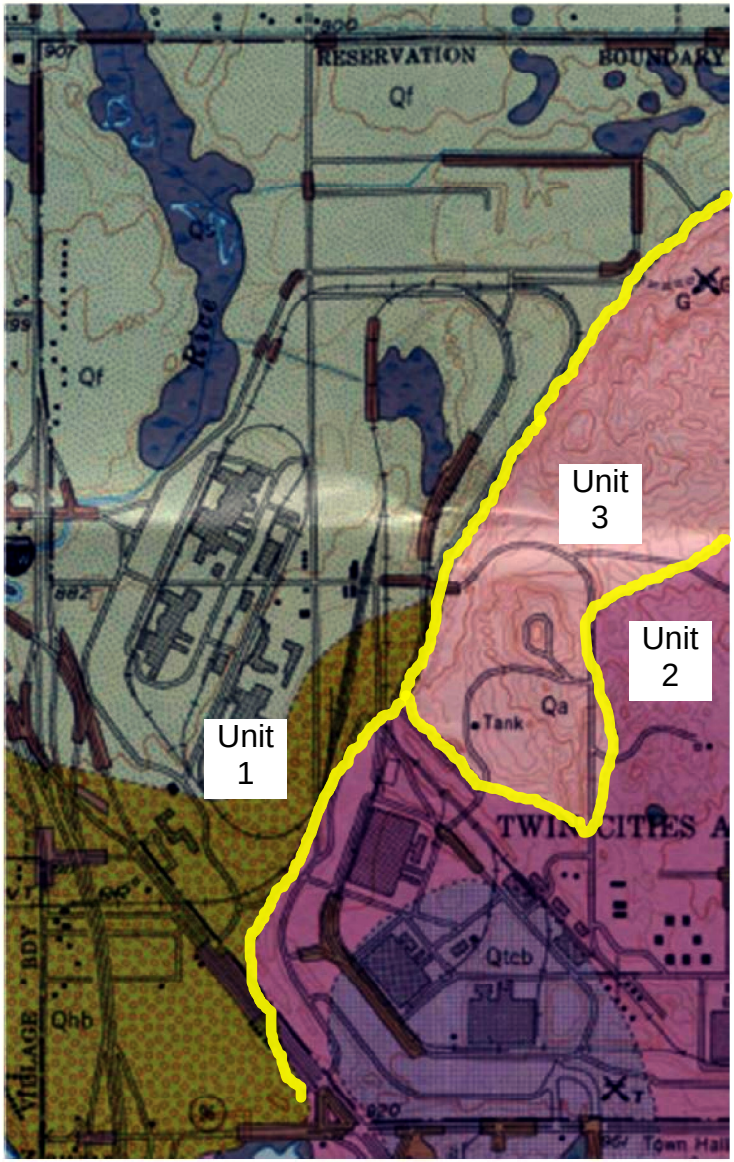
SSURGO Soils Map

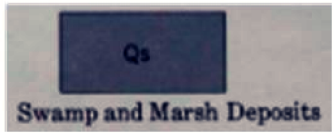
WENCK ASSOCIATES

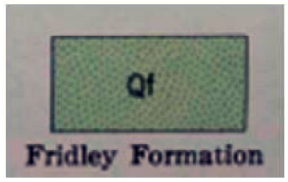
Responsive partner. Exceptional outcomes.

JUNE 2015

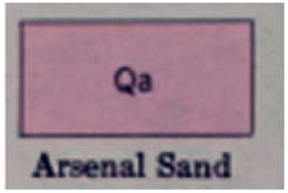
Figure 3-3







Unit 1: Water Bearing
(Low Yield)



Unit 3: Water Bearing
(High Yield)

Unit 1: Water Bearing
(Low Yield)

Unit 2 (Aquitard)

Source: Stone, John E., "Geologic Map Series 2. Surficial Geology of the New Brighton Quadrangle, MN GM-2 (1966.)

RAMSEY COUNTY	WENCK ASSOCIATES Responsive partner. Exceptional outcomes.	JUNE 2015
Surficial Geology Map		Figure 3-4

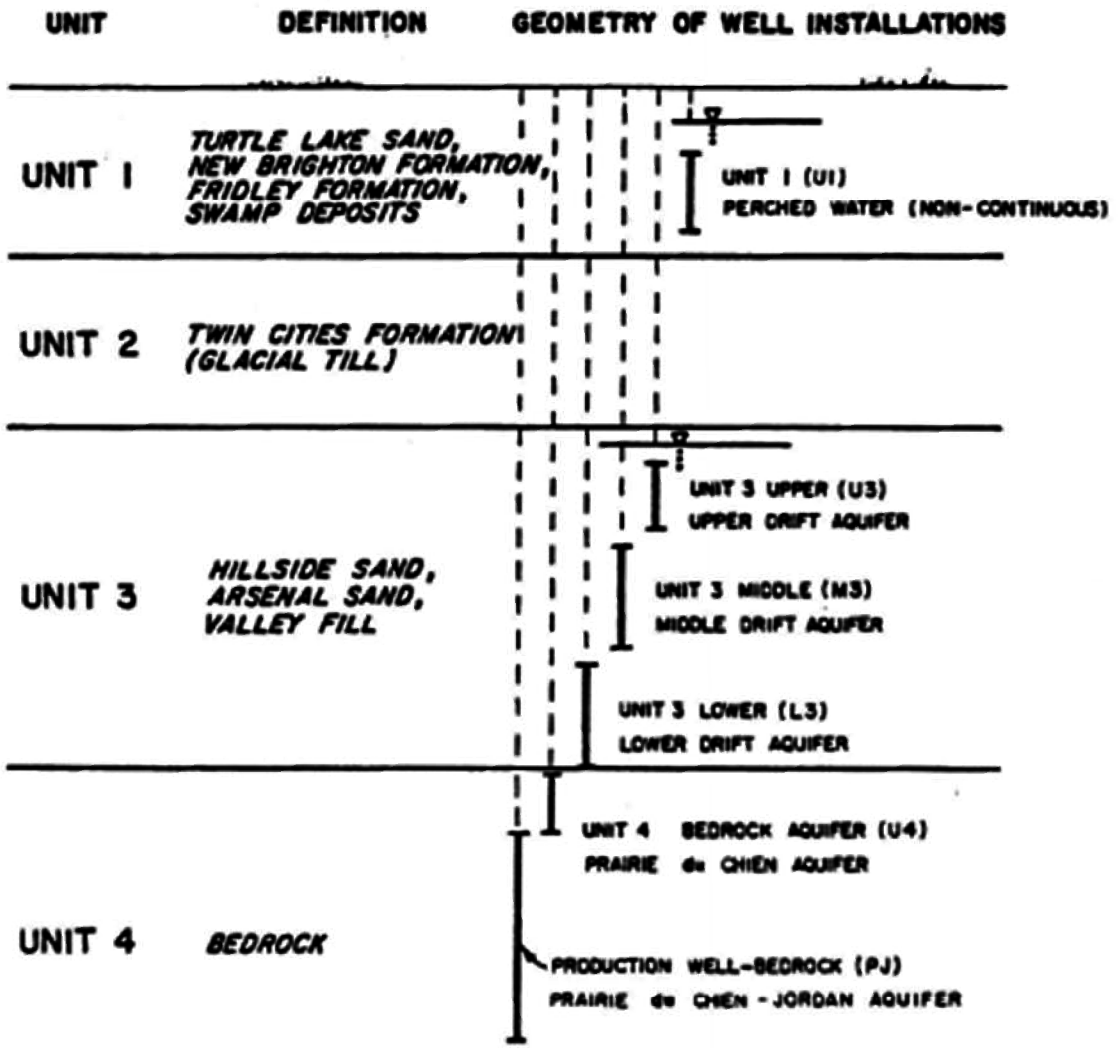
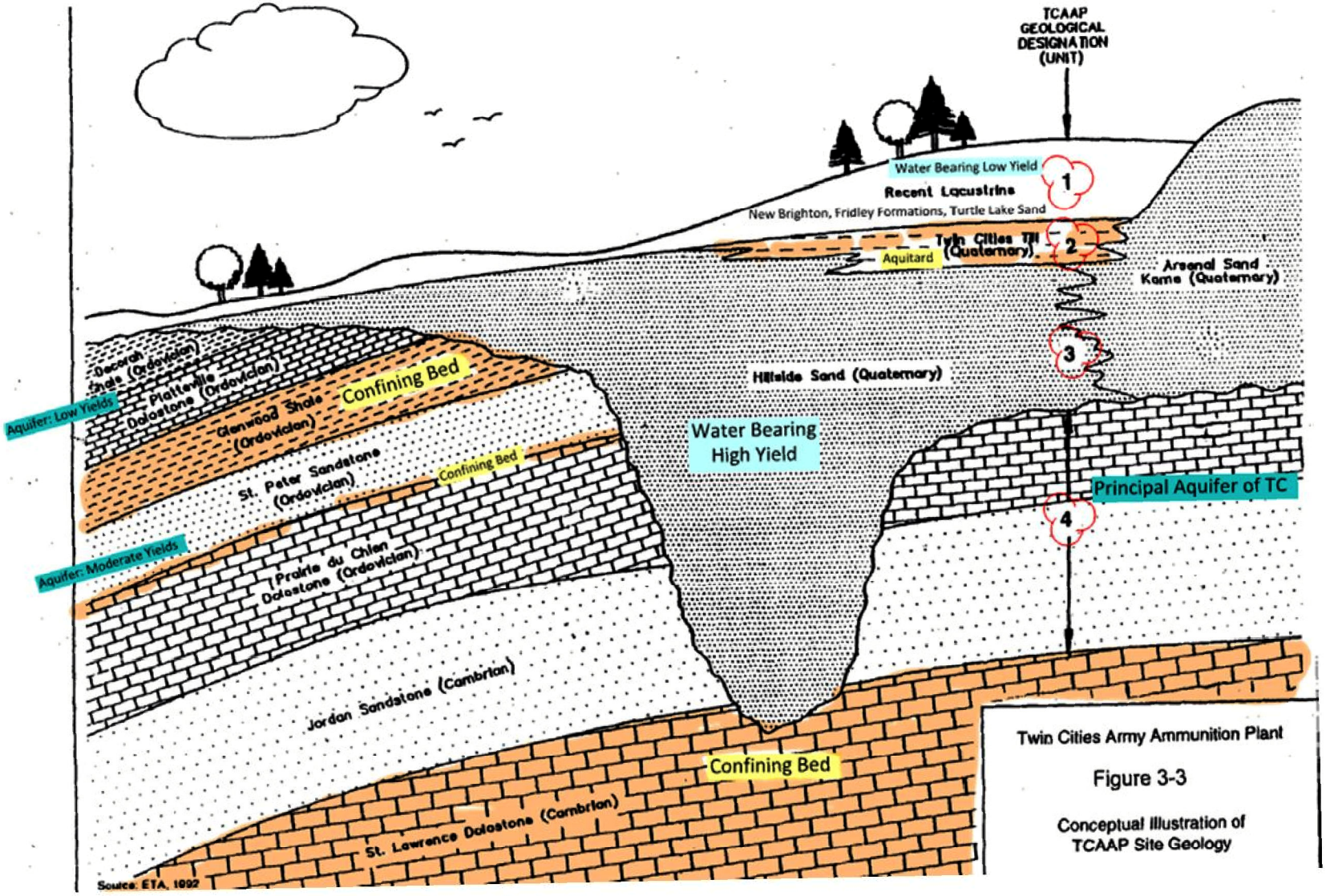


FIGURE 2.15 Illustration Showing Four Hydrologic Units at TCAAP (Source: Ref. 5207)

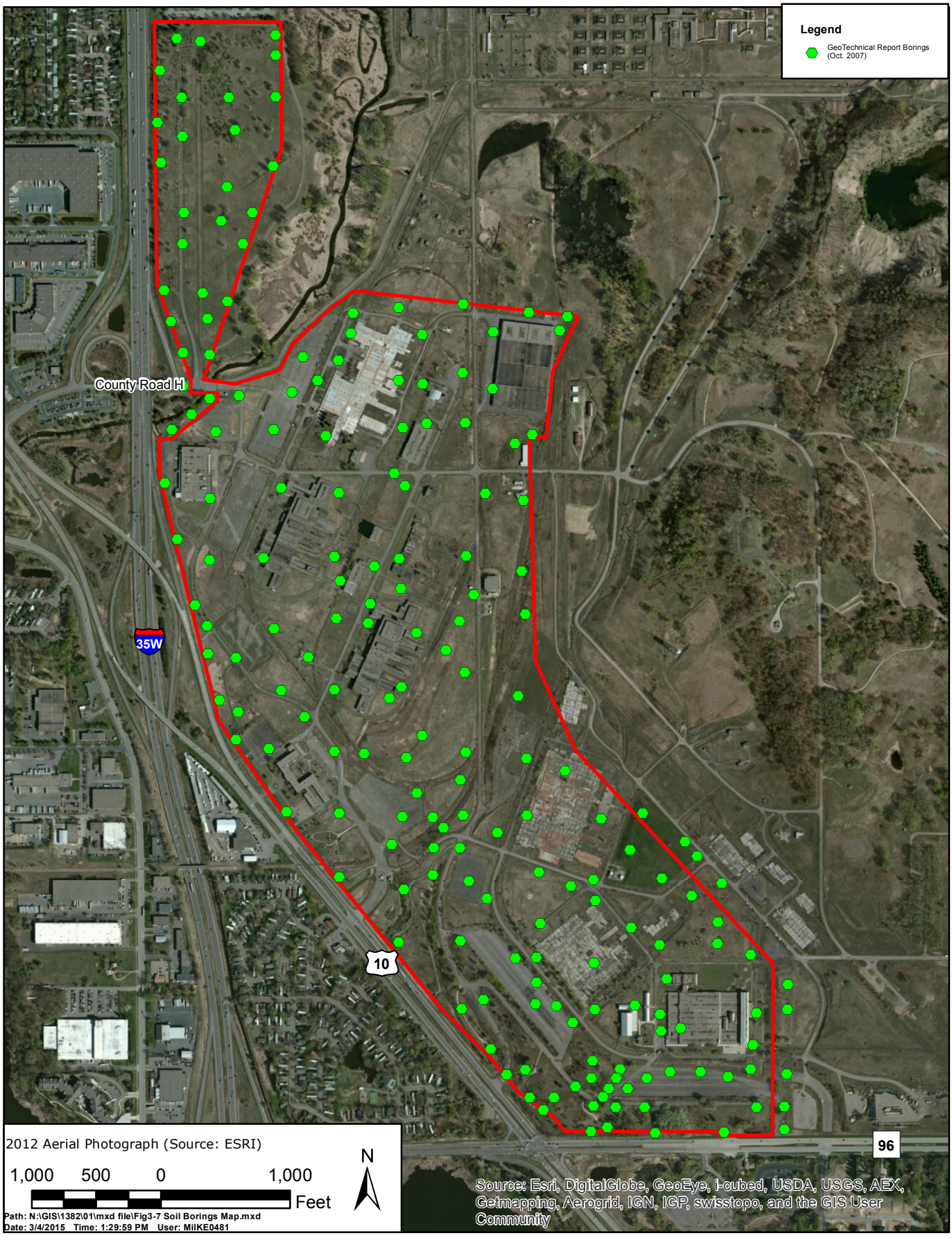
Source: Wenck, "Five-year review report of the final remedy for the New Brighton/Arden Hills Superfund Site" Figure 2-15, August 2009

RAMSEY COUNTY	WENCK ASSOCIATES Responsive partner. Exceptional outcomes.	JUNE 2015
TCAAP Four Hydrologic Units		Figure 3-5



Source: Wenck, "Five-year review report of the final remedy for the New Brighton/Arden Hills Superfund Site" Figure 3-3, August 2009

RAMSEY COUNTY	WENCK ASSOCIATES Responsive partner. Exceptional outcomes.	JUNE 2015
TCAAP Concept Site Geology		Figure 3-6



RAMSEY COUNTY

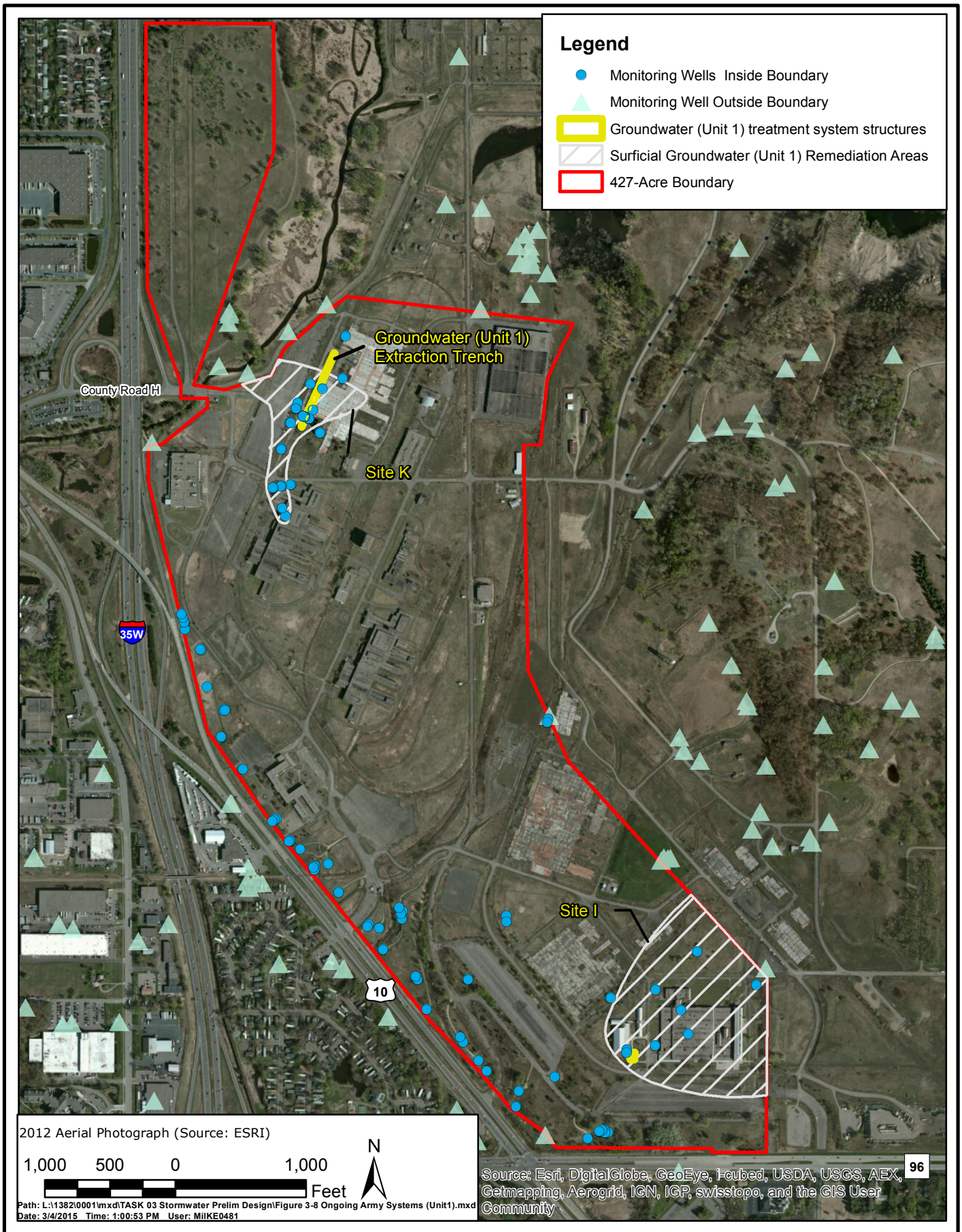
Soil Borings Map (Oct. 3, 2007)

WENCK ASSOCIATES

Responsive partner. Exceptional outcomes.

JUNE 2015

Figure 3-7



RAMSEY COUNTY

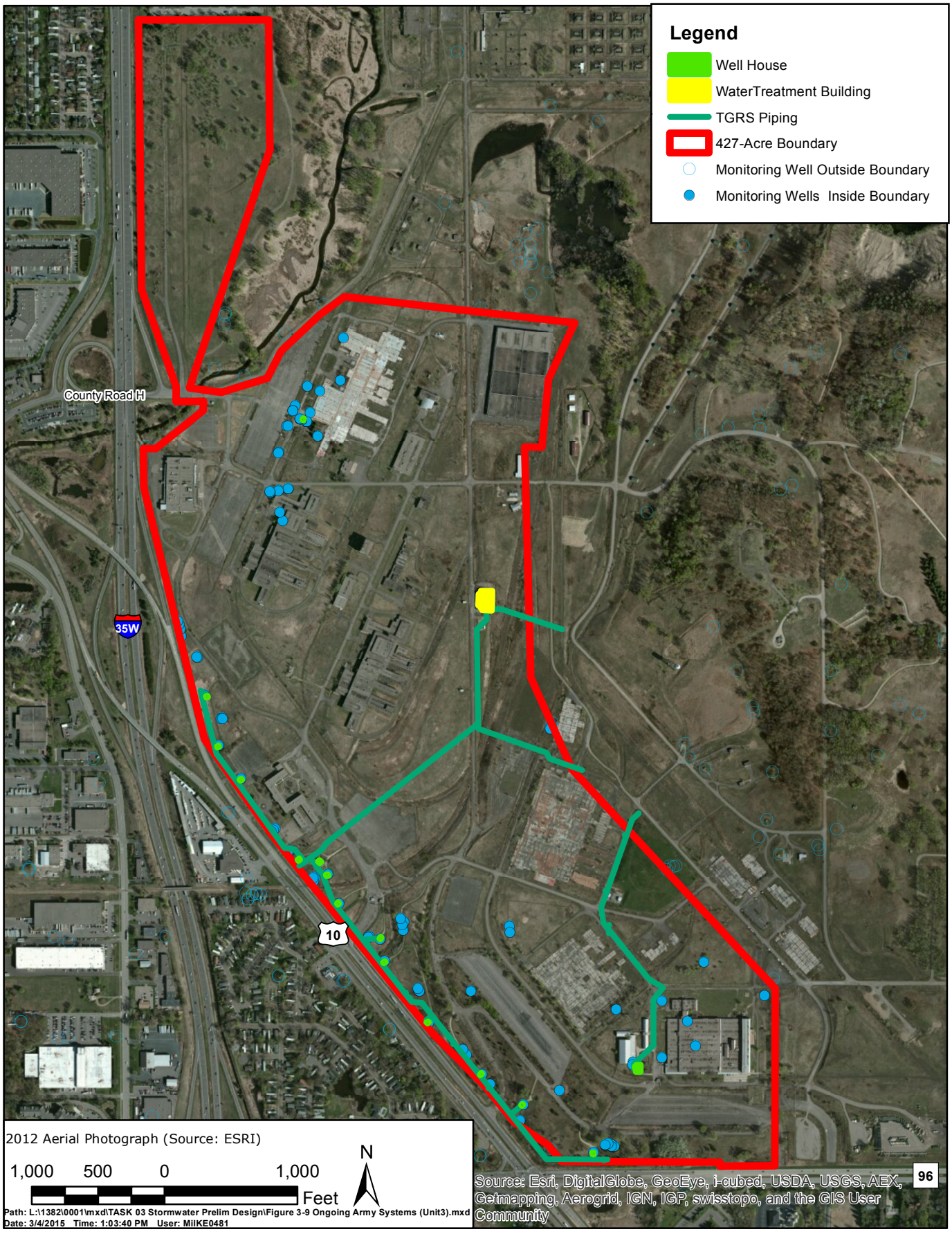
Ongoing Army Systems (Unit 1)

WENCK ASSOCIATES

Responsive partner. Exceptional outcomes.

JUNE 2015

Figure 3-8



RAMSEY COUNTY

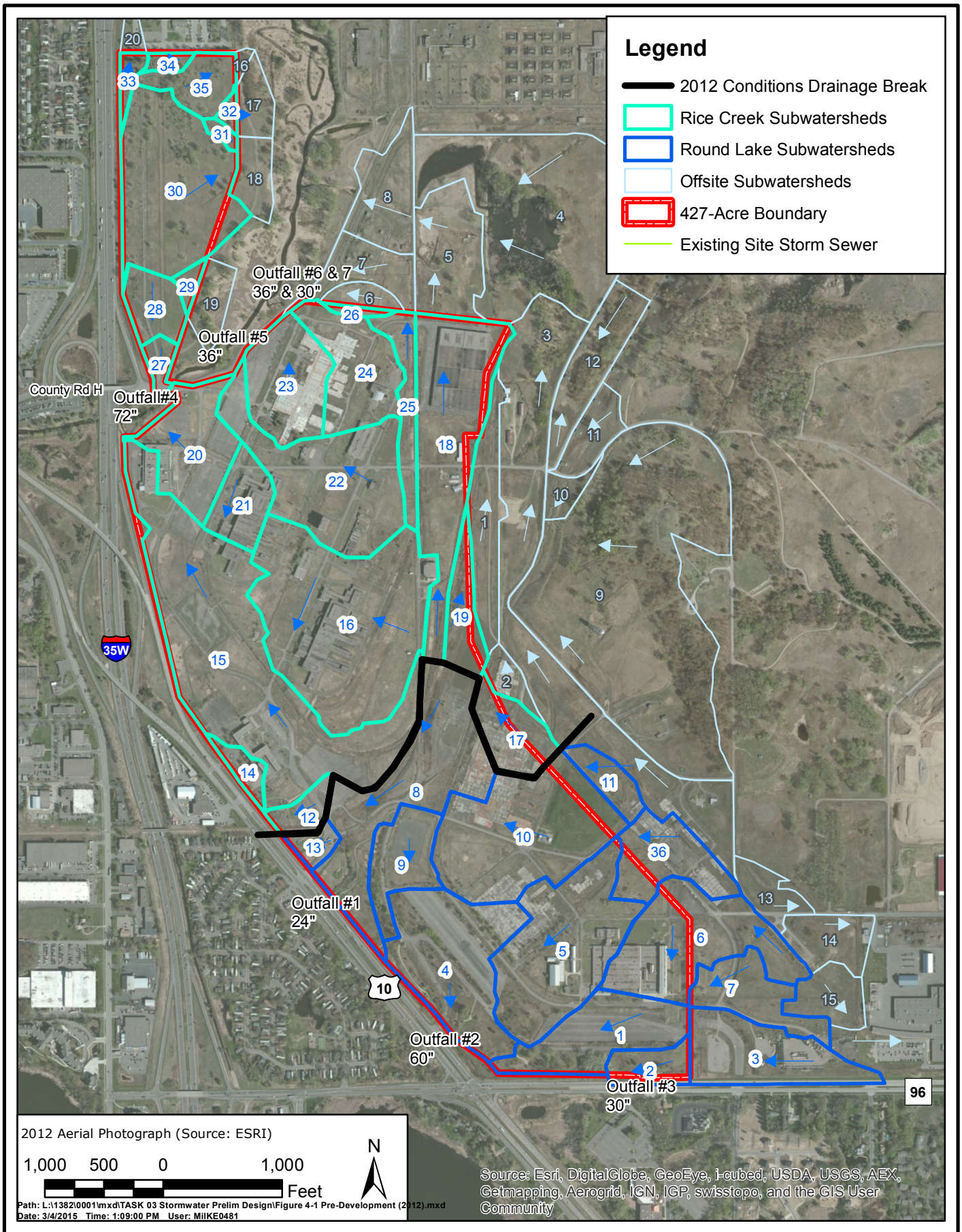
Ongoing Army Systems (Unit 3)

WENCK ASSOCIATES

Responsive partner. Exceptional outcomes.

JUNE 2015

Figure 3-9



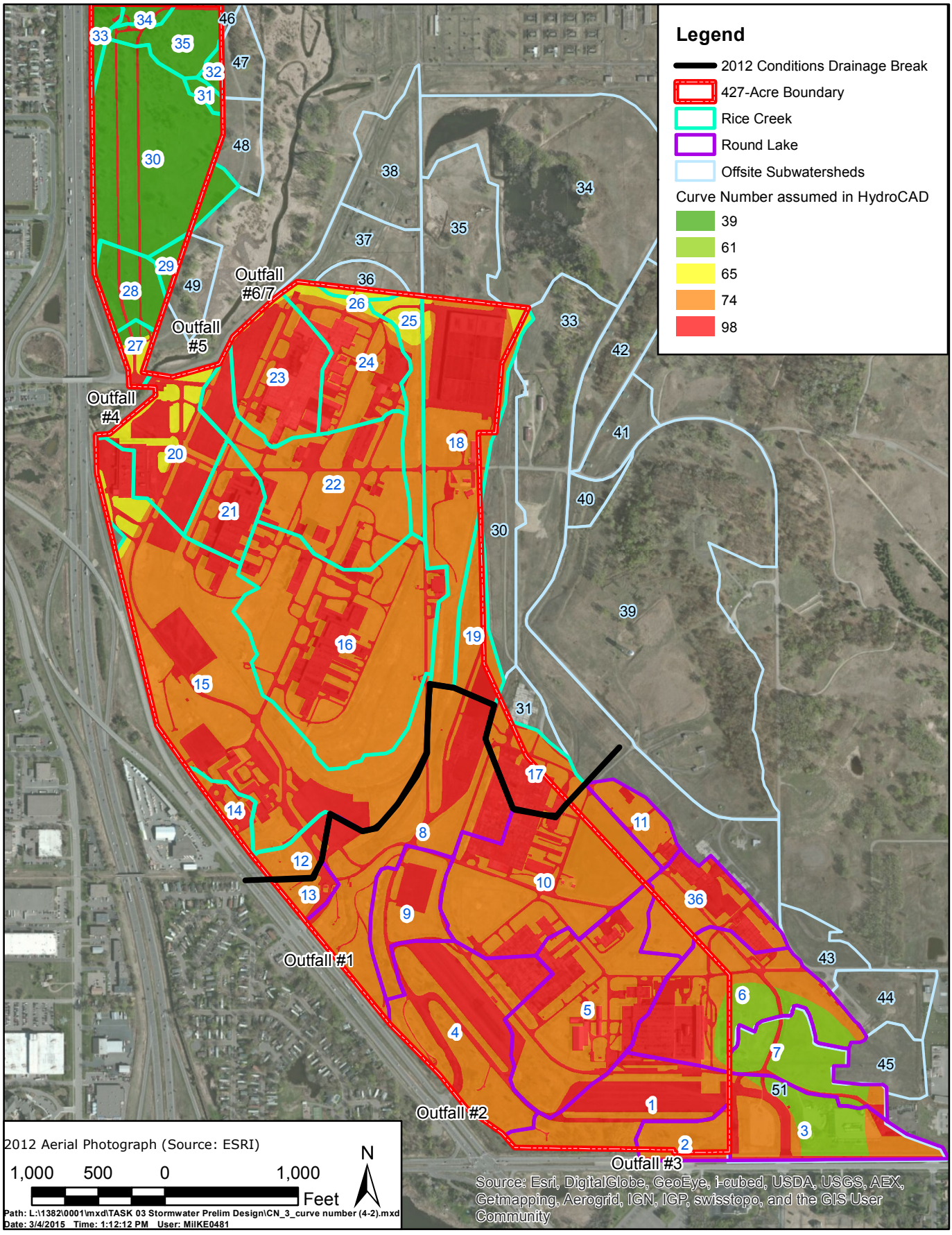
RAMSEY COUNTY

Pre-Development (2012): Subwatershed Map

WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.

JUNE 2015

Figure 4-1



RAMSEY COUNTY

Pre-Development (2012): Subwatershed Map with Curve Number

WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.

JUNE 2015

Figure 4-2

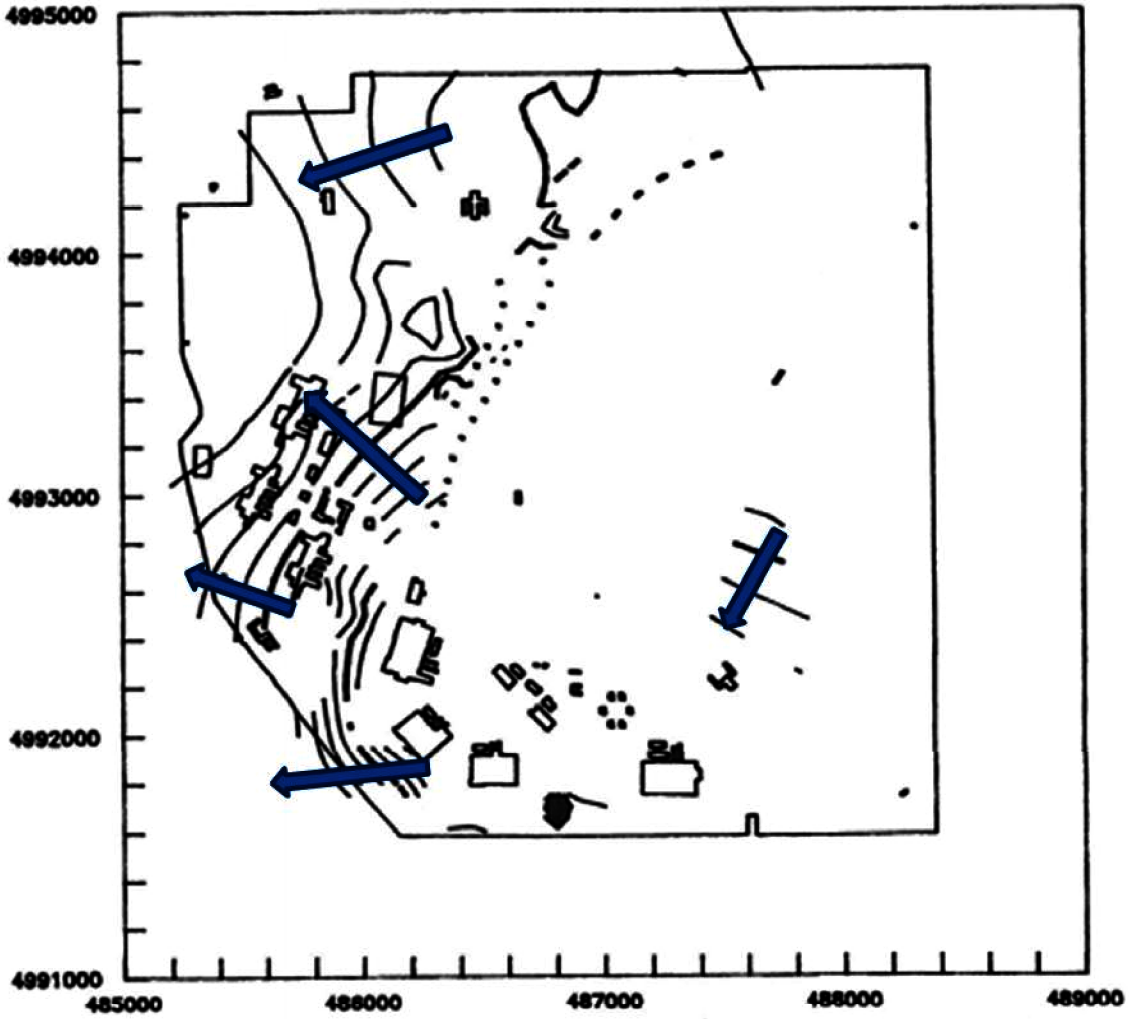


FIGURE 2.16 Water-Level Elevations for Hydrologic Unit 1 at TCAAP, February 17, 1987 (Source: USATHAMA database)

Source: Wenck, "Five-year review report of the final remedy for the New Brighton/Arden Hills Superfund Site" Figure 2-16, August 2009

Path: L:\1382\0001\mxd\TASK 03 Stormwater Prelim Design\Fig4-3 Pre-Development (1987) Groundwater Gradient Map.mxd
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RAMSEY COUNTY	WENCK ASSOCIATES Responsive partner. Exceptional outcomes.	JUNE 2015
Pre-Development (1987): Groundwater Gradient Map (Unit 1)		Figure 4-3

SEE INSET A

SEE INSET B

1,200 600 0 1,200 Feet

INSET A

01U052 876.03
01U128 876.32
482083 883.72
01U047 875.07
01U048 875.59
01U612 880.06
01U603 880.27
01U607 886.54
01U615 880.13
01U617 880.11
01U628A 880.39
01U627A 880.32
01U621 881.04
01U618 882.98
01U065 874.91
01U626A 880.01
01U625A 880.65
875
876
877
878
879
880
881
882
883
884
885
886
01L581 884.86
01U581 885.28
01L584 884.19
01U584 884.65
01U583 885.08
01L583 884.94
01U580 885.46
01U579 885.79

350 175 0 350 Feet

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

INSET B

01U132 Dry
03U028
01U668 Dry
01U667 947.15
03U659
03U029
03U301

200 100 0 200 Feet

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Legend

- Unit 1 Wells
- 2012 APR Groundwater Elevation Contours (ft)
- 427-Acre Boundary

Note: Various Unit 1 groundwater wells have been sealed, since 2012. This figure only shows symbolized well locations for those wells that have not been abandoned and sealed. The unique well identifications and the water level observations are provided in this figure as label leaders. The source of this information is the 2012 TCAAP Annual Performance Report (APR).

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RAMSEY COUNTY

2012 Groundwater Elevation Map (Unit 1)

WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.

JUNE 2015

Figure 4-4

EX. 60" STORM

EX. 24" STORM

W-1
NWL=914.75
HWL=915.61

P-4
NWL=915.00
HWL=917.86

48" RCP
STORM
SEWER

P-5
NWL=929.00
HWL=932.61

P-3
NWL=914.00
HWL=919.50

60" RCP
STORM
SEWER

P-2
NWL=924.00
HWL=925.70

P-6
NWL=929.00
HWL=932.61

W-2
NWL=929.00
HWL=929.48

W-3
NWL=914.75
HWL=915.08

EXISTING WETLAND TO
REMAIN

P-8
NWL=897.00
HWL=900.00

EX. 72"
OUTFALL

REALIGNED CREEK

RICE CREEK
10-YR WSL=874.8

P-1
NWL=924.0
HWL=925.7

P-7
NWL=915.00
HWL=915.87

24" RCP
STORM
SEWER

ACTIVE
MONITORING
WELL (TYP.)

HISTORICAL
DRAINAGE BREAK

P-9
NWL=915.00
HWL=915.84

P-10
NWL=896.00
HWL=898.42

PLACE FILL MATERIAL IN TOWN

54" RCP
STORM SEWER

SITE K

EX. 36"±
OUTFALL

54" RCP STORM
SEWER

P-11
NWL=909.00
HWL=912.74

SITE K GROUNDWATER SYSTEM

60" RCP
STORM SEWER

P-13
NWL=883.00
HWL=885.61

W-5
NWL=882.75
HWL=883.00

100-YR
FLOODPLAIN=883.7

P-12
NWL=893.00
HWL=895.58

EX. 36"
OUTFALL

W-4
NWL=908.00
HWL=909.80

12" RCP
STORM
SEWER

EX. 24"
OUTFALL

PLACE FILL MATERIAL IN
CREEK NEIGHBORHOOD

P-14
NWL=892.00
HWL=894.72

1097.60

LEGEND

- PROPOSED ROADWAY
- PROPOSED BRIDGE
- TRAILS, WALKS
- PROPOSED MEDIAN
- PROPOPSED STORMWATER POND (OTHER)
- PROPOSED STORMWATER POND (NRC)
- PROPOSED WETLAND MITIGATION
- PROPOSED CREEK MEANDER
- PROPOSED STORM SEWER

Kimley»Horn
2550 UNIVERSITY AVENUE WEST, SUITE 238N
SAINT PAUL, MINNESOTA 55114
PH: 651-645-4197 www.kimley-horn.com

RAMSEY COUNTY

ARDEN HILLS

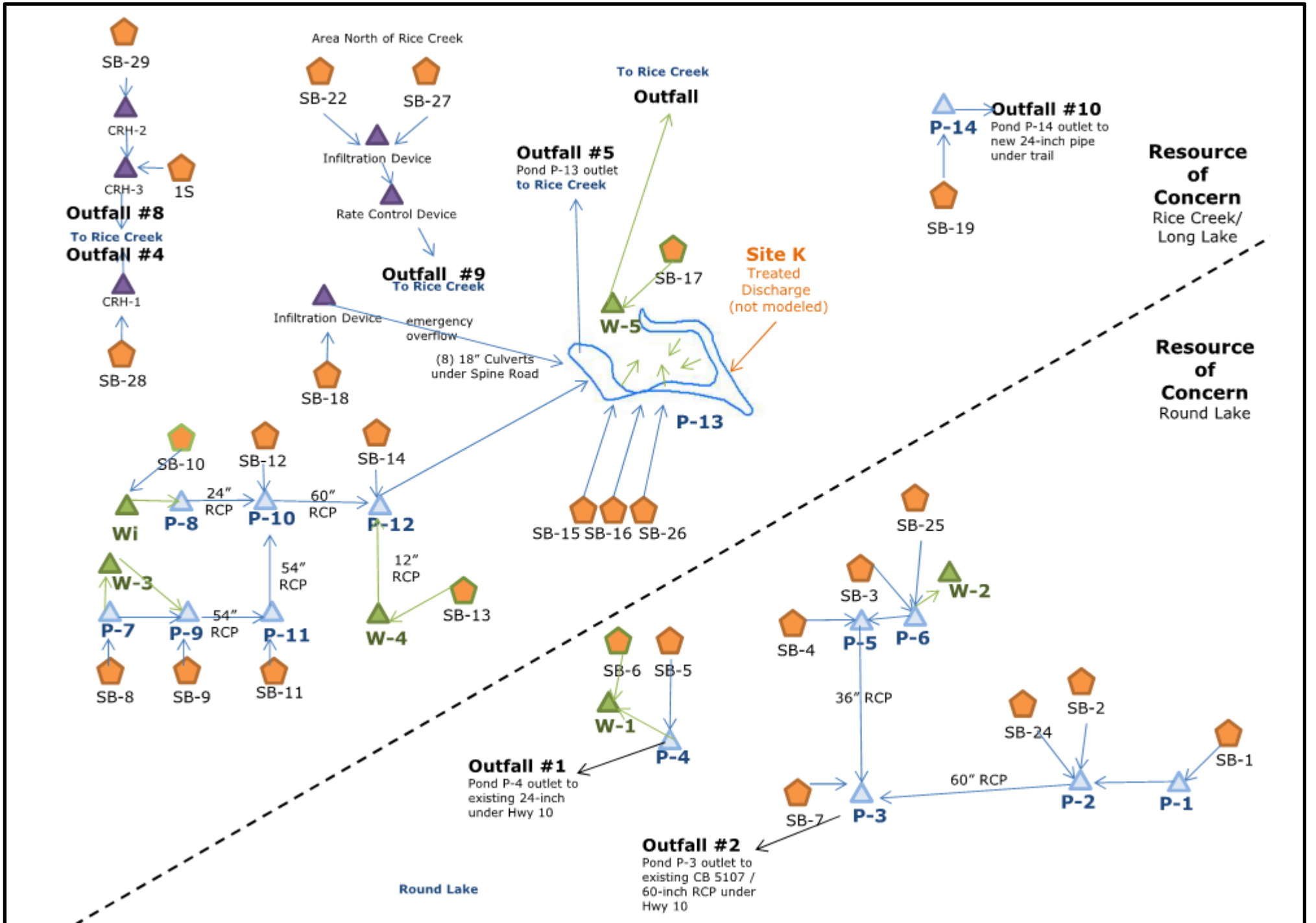
TCAAP Site Redevelopment
Infrastructure

0 125 250
SCALE IN FEET

COMPREHENSIVE STORMWATER MANAGEMENT PLAN

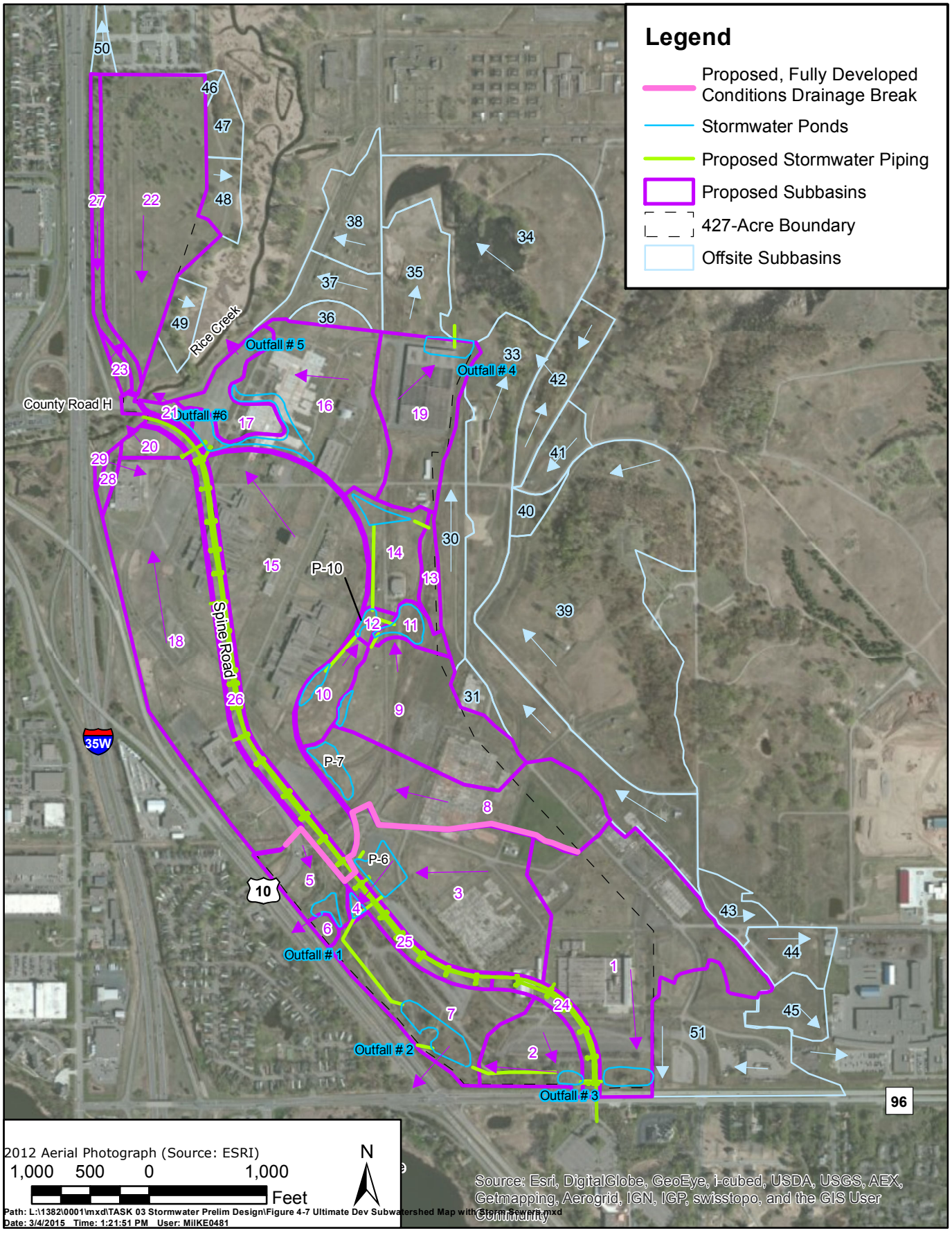
SITE GRADING AND STORM DRAINAGE IMPROVEMENTS
FIGURE 4-5

K:_TWC_Civil\County\RAMSEY\TCAAP Infrastructure\CADD\Plan Sheets\Exhibits\2015-06-17 CSMP Figure 4-5\2015-05-28 TCAAP_FES_GRAD_DRAIN_EXHIBITS.dwg July 8, 2015 7:31 AM



T:\1382 KimleyHorn\01 TCAAP\TASK 03 Stormwater Prelim Design\CSMP_Final\Figures\Figure 4-6 Stormwater Pond and Flow Diagram_31 JUL 2015.ppt

RAMSEY COUNTY	WENCK ASSOCIATES Responsive partner. Exceptional outcomes.	JULY 2015
Stormwater Pond and Wetland Flow Diagram		Figure 4-6



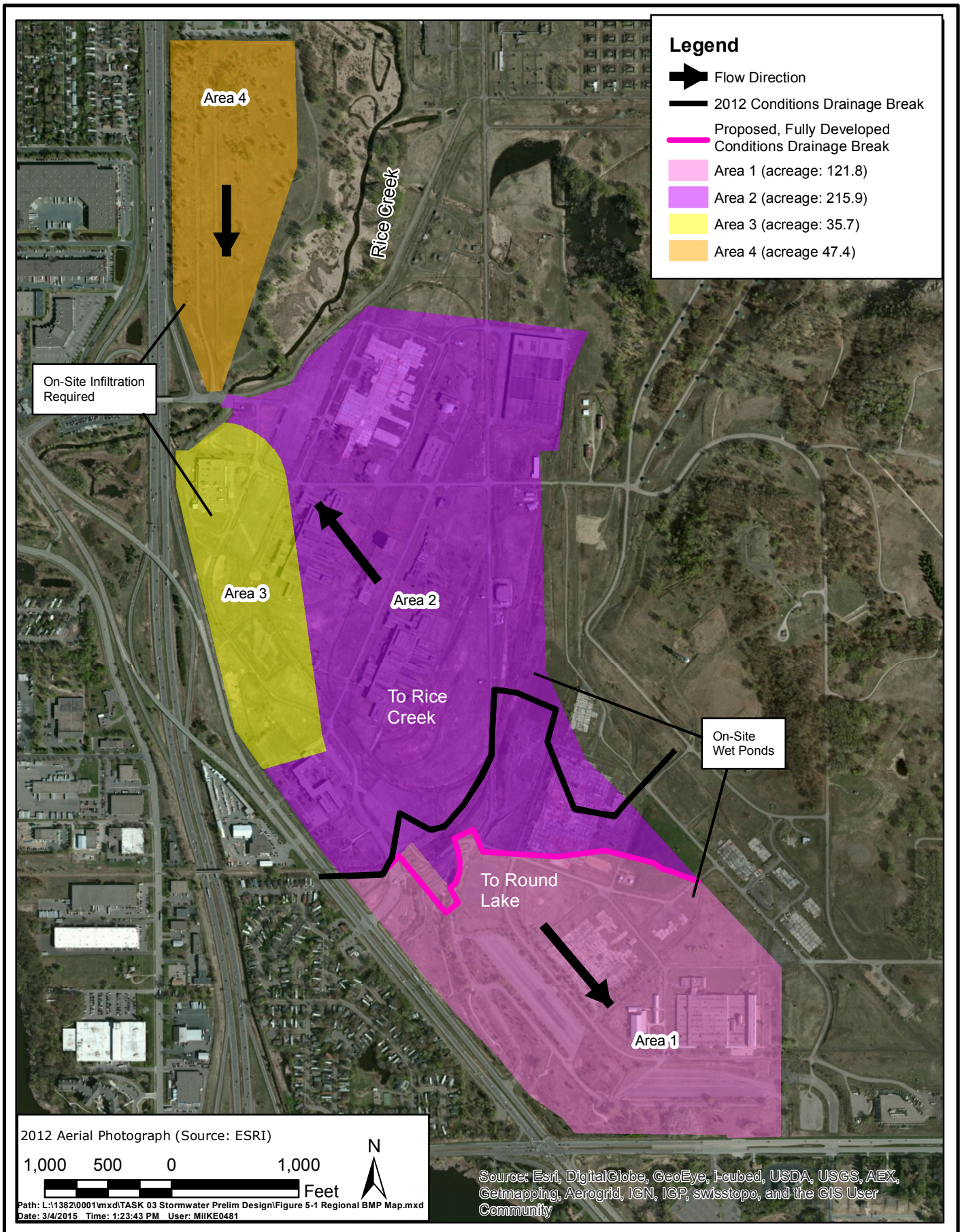
RAMSEY COUNTY

Fully Developed Conditions: Subwatershed Map & Storm Sewers

WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.

JUNE 2015

Figure 4-7



RAMSEY COUNTY

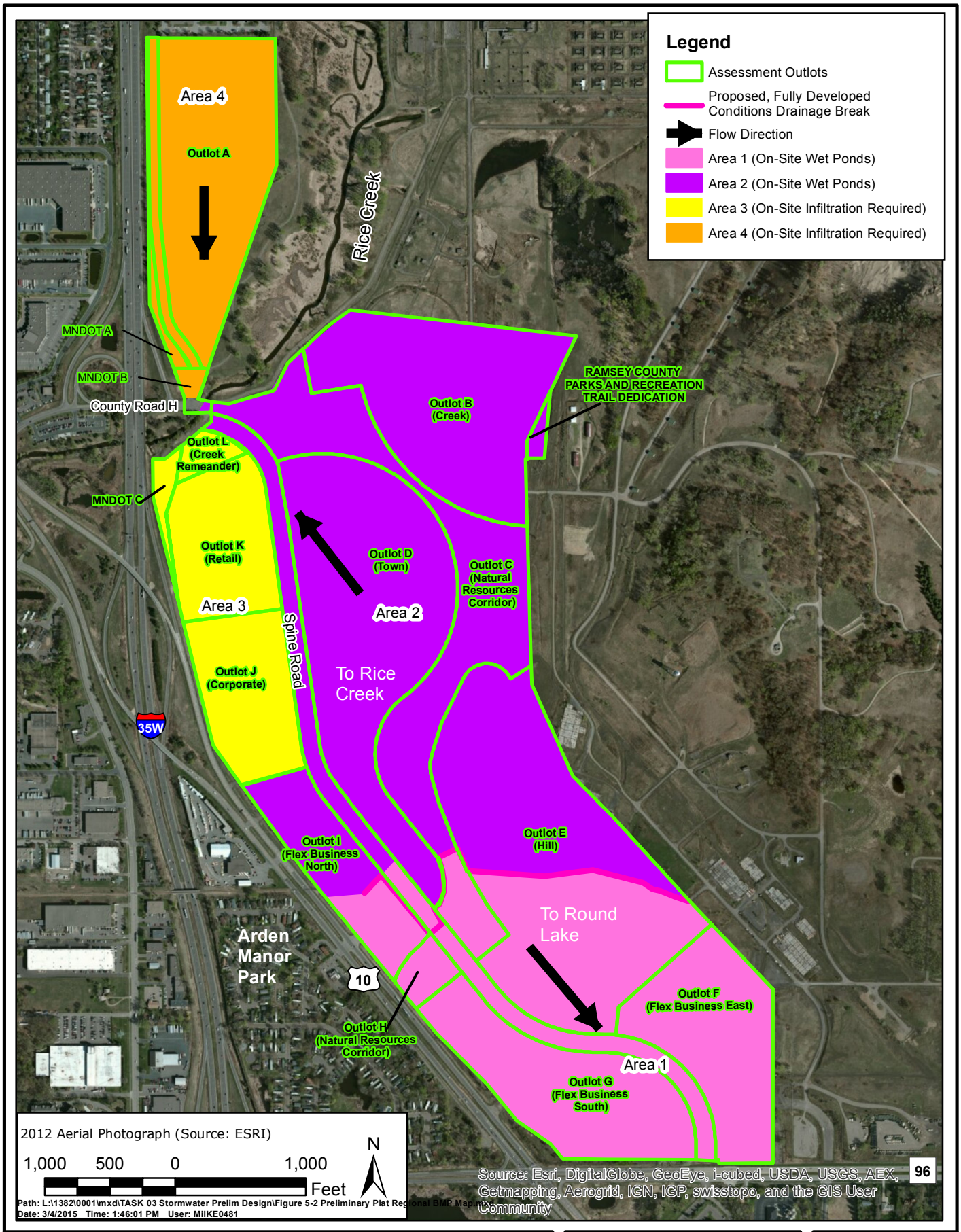
Regional BMP Map

WENCK ASSOCIATES

Responsive partner. Exceptional outcomes.

JUNE 2015

Figure 5-1



RAMSEY COUNTY

Preliminary Plat with Regional BMP Map

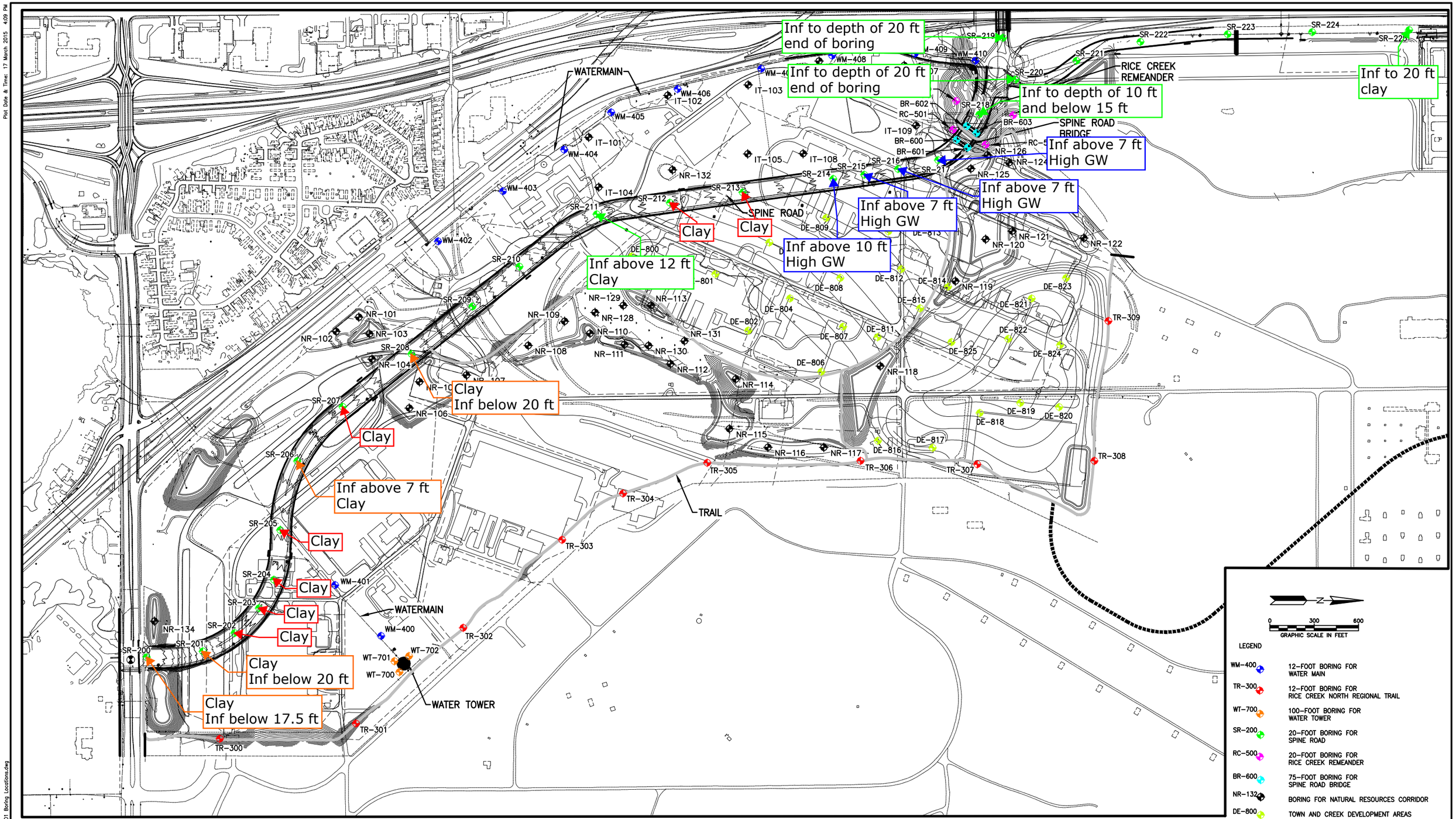
WENCK ASSOCIATES

Responsive partner. Exceptional outcomes.

JUNE 2015

Figure 5-2

Plot Date & Time: 17 March 2015 4:09 PM



REV	REVISION DESCRIPTION	DWN	APP	REV DATE
0	ISSUED FOR bid	JVB	TR	03/19/15

SEAL

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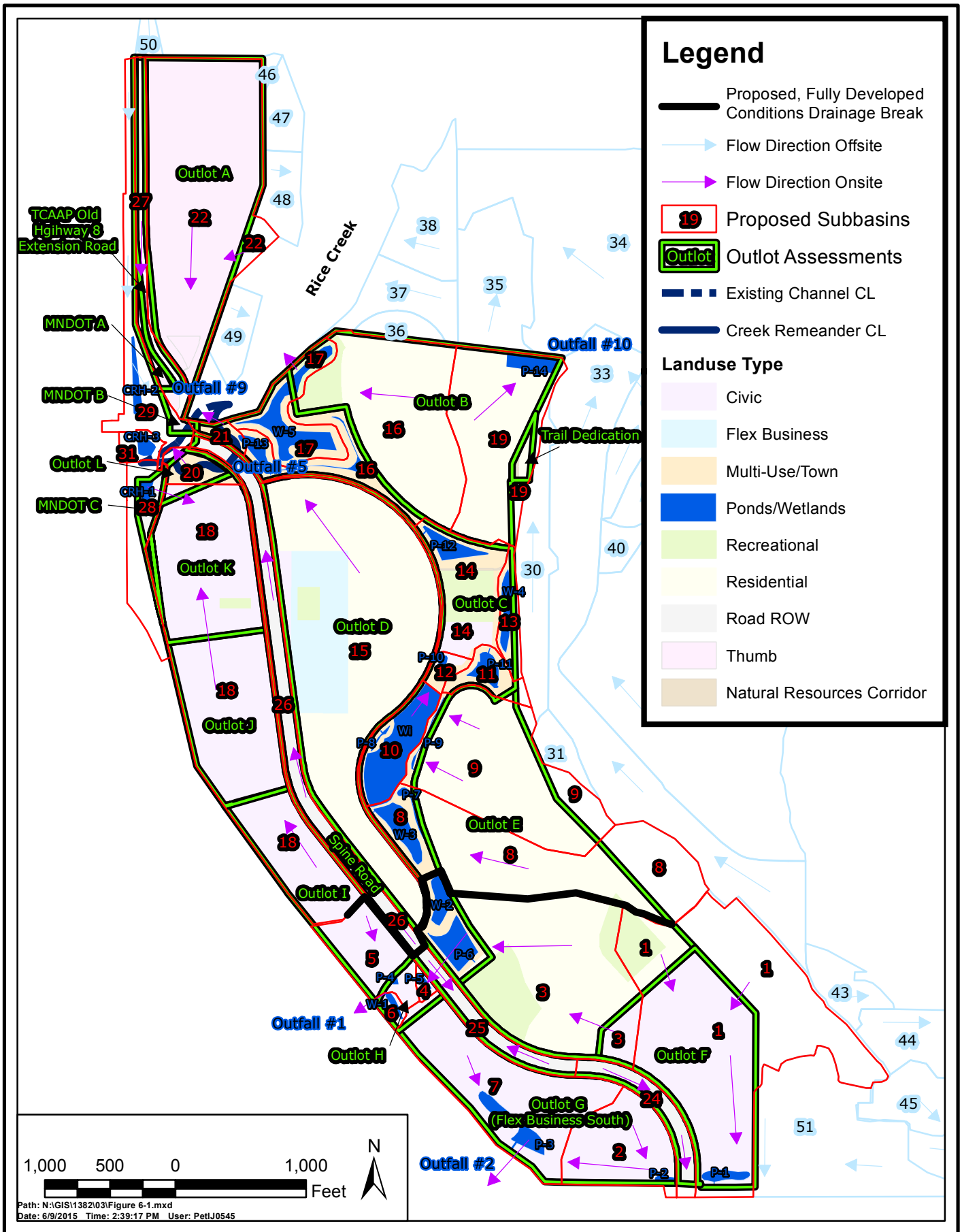
PROJECT TITLE
REQUEST FOR DRILLING QUOTE

SHEET TITLE
Preliminary (June 2015) Soil Borings along Spine Road

DWN BY	CHK'D	APP'D	DWG DATE	MARCH 2014
JVB	JW	TR	SCALE	AS NOTED

PROJECT NO.	SHEET NO.	REV NO.
1382-0001	Figure 5-3	0

M:\1382\01\PHASE 15\CAD\WKS\WKS-101 Boring Locations.dwg



RAMSEY COUNTY

Prelim. Plat (Outlots) Fully Developed Conditions Subwatersheds

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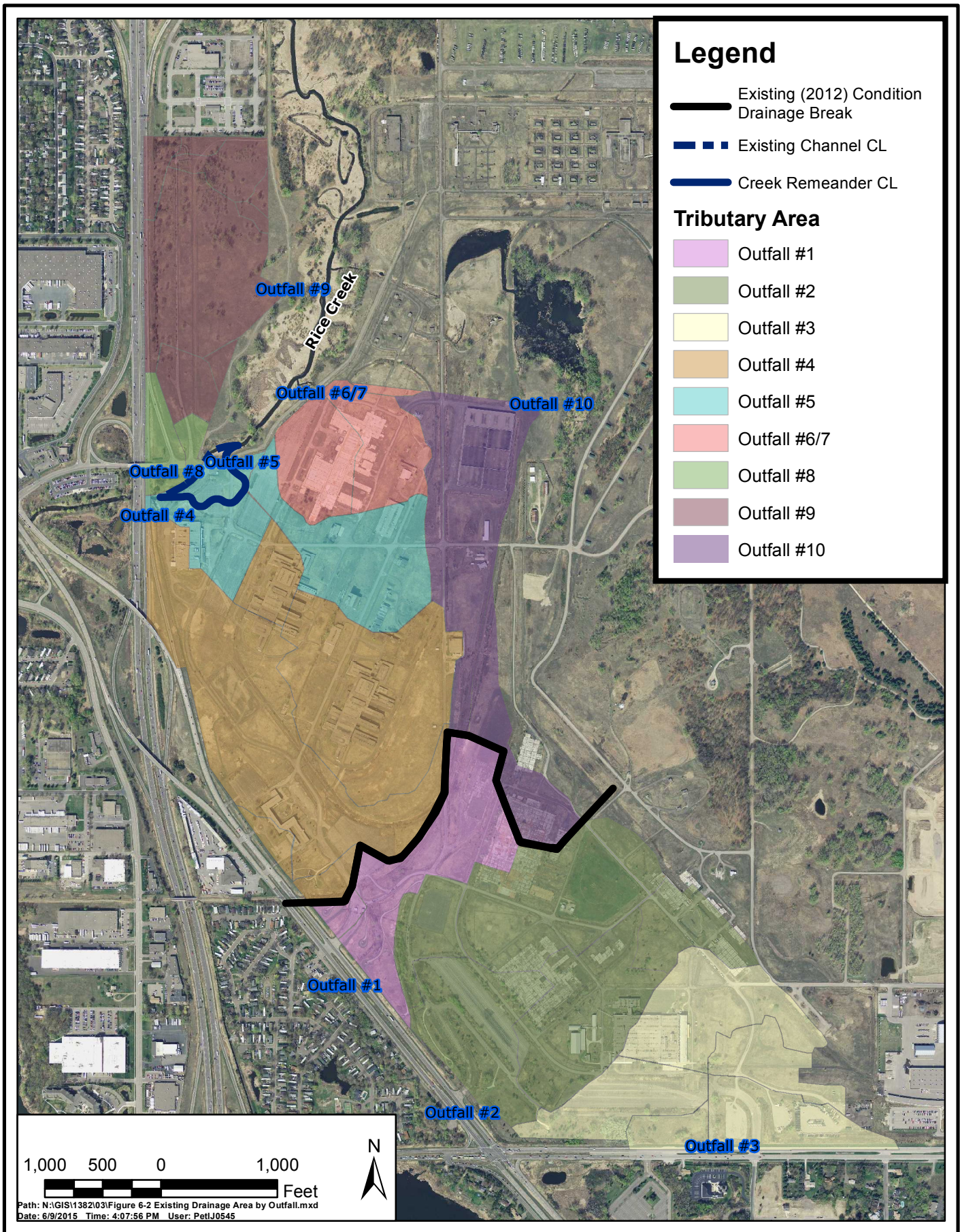
Figure 6-1



RAMSEY COUNTY

Pre-development (2012): Drainage Areas by Outfalls

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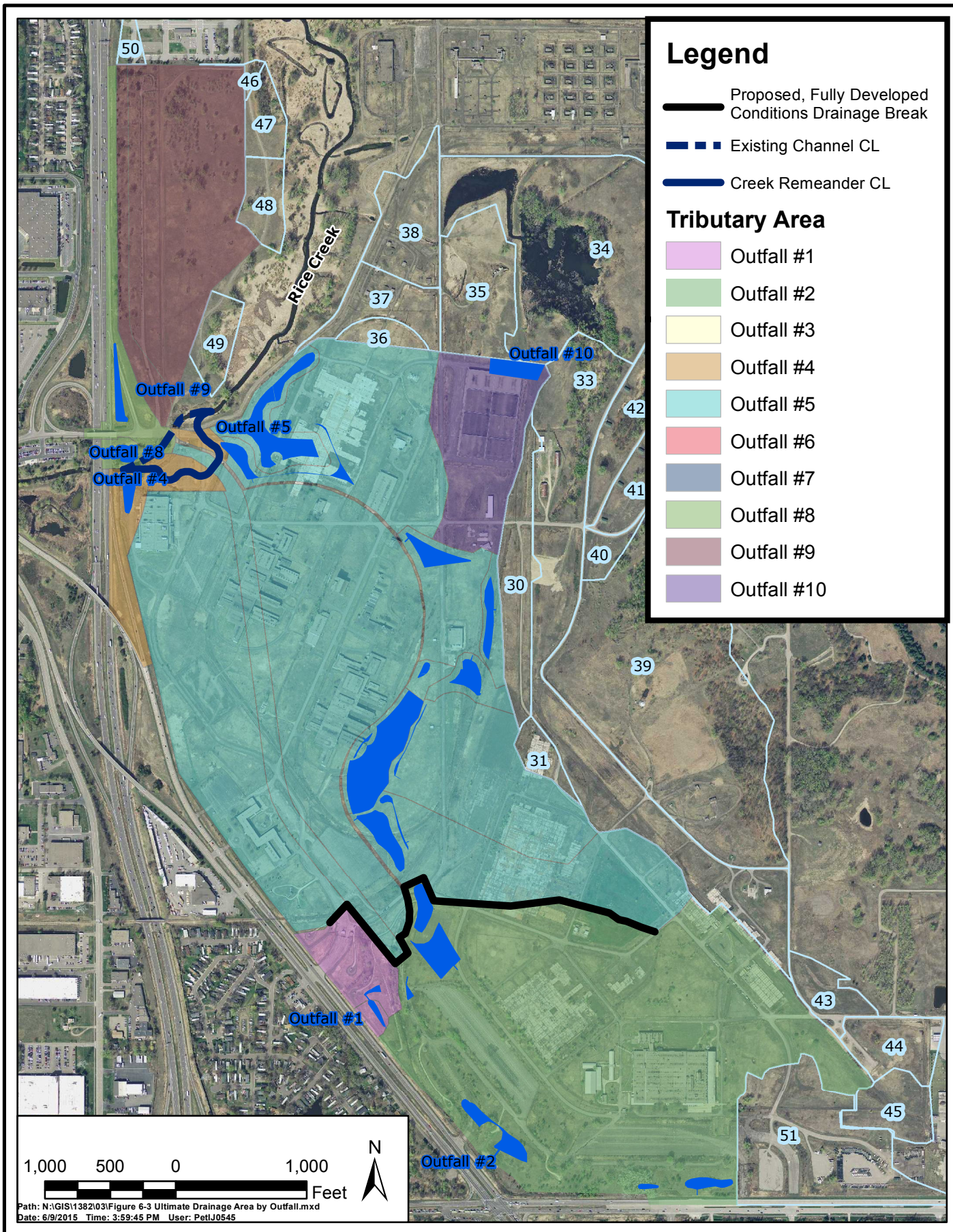
Figure 6-2



RAMSEY COUNTY

Fully Developed Conditions: Drainage Areas by Outfalls

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Figure 6-3