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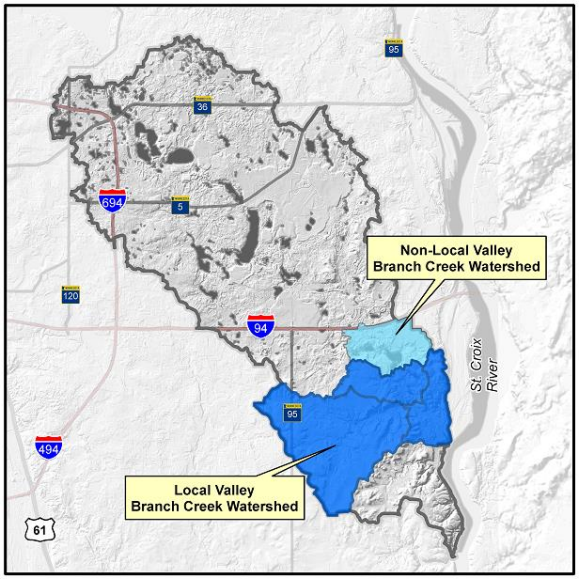
5.20 Valley Creek Watershed Management Plan

5.20.1 General Information



Valley Creek Local Watershed Information	
Tributary Area (acres)	7,515 (local, 9,091 total)
MDNR-Designated Basins within Watershed	82-1P, 82-7W, 82-467W, 82-468W, 82-8W
Downstream Watershed	St. Croix River
Valley Creek Information	
Typical Baseflow of South Fork at Stagecoach Trail (cubic feet per second, cfs)[1]	8.2
2-year Flowrate of South Fork at Stagecoach Tr. (cfs)[1]	22.2
100-year Flowrate of South Fork at Stagecoach Tr. (cfs)[2]	2070
Typical Baseflow of North Fork at Belwin Station (cfs)[1]	5.1
2-year Flowrate of North Fork at Belwin Station (cfs)[1]	10.2
100-year Flowrate of North Fork at Belwin Station (cfs)[2]	690
Typical Baseflow of Main Stem at Putnam Station (cfs)[1]	16.5
2-year Flowrate of Main Stem at Putnam Station (cfs)[1]	32.4
100-year Flowrate of Main Stem at Putnam Station (cfs)[2]	2,710
South Fork Perennial Channel Length from dam to confluence with North Fork (miles)	2.5
North Fork Channel Length from Lake Edith to confluence with South Fork (miles)	1.6
Main Stem Channel Length from confluence of South and North Forks to St. Croix River (miles)	1.8
VBWD Water Quality Priority Category	High

[1] Flow data based on SCWRS monitoring data (1998 – 2013)
[2] Flows based on 2006 XP-SWMM modeling

The namesake of the Valley Branch Watershed District (VBWD) is Valley Branch Creek. When the State of Minnesota approved the citizen's petition to form a watershed district, the State named the watershed district "Valley Branch Watershed District" because State maps labeled the ultimate receiving waterbody of the area as "Valley Branch Creek." Local residents call the creek, "Valley Creek." The VBWD, and this Plan, also refer to the creek as Valley Creek.

Much of the drainage from VBWD land has been diverted from entering Valley Creek. The majority of the remaining Valley Creek watershed is located in the City of Afton and a small portion is located on the east edge of the City of Woodbury. The creek is comprised of three major reaches: the North Fork, the South Fork, and the Main Stem. The North Fork flows 1.6 miles from Lake Edith to the confluence with the South Fork. The South Fork, flows 2.5 miles from the point the creek become perennial-flowing (water flowing year around) to its junction with the Main Stem. Below the confluence of the

North and South Forks, the Main Stem of Valley Creek flows 1.8 miles to the mouth of the creek at the St. Croix River. The South Fork of the creek becomes perennial-flowing about 0.75 miles east of Neal Avenue (CSAH 71). Upstream of this location, the South Fork is an intermittent stream. Intermittent streams are dry most of the time, but flow during rain or snowmelt events. The most upstream end of the intermittent portion of the South Fork is about half a mile west of Manning Avenue (Highway 95) and north of Valley Creek Road, in Woodbury.

The local Valley Creek watershed has a local drainage area of 7,515 acres, in addition to the Lake Edith watershed of 1,576 acres, which is tributary to the Main Stem of the creek via Lake Edith. Therefore, the total watershed area of Valley Creek is 9,091 acres. Figure 5.20-1 shows the local Valley Creek watershed. Prior to the construction of storm sewer improves connecting Fahlstrom Pond and Rest Area Pond (see Section 5.18), In the past, the Fahlstrom Pond surface water watershed was sometimes considered part of the ultimate Valley Creek watershed. However, based on current topography data, the Fahlstrom Pond watershed overflows to the Rest Area Pond and is therefore not considered part of the ultimate Valley Creek watershed. The majority of the flow at the mouth of Valley Creek comes from the South Fork, which is fed by springs and has very little pond storage.

Much of the Valley Creek watershed is currently (2010) occupied by undeveloped or agricultural land use, with pockets of single family residential land use throughout. The future (2030) estimate land use for the Valley Creek watershed is primarily rural or large-lot residential. Current (2010) and future (2030) land uses are shown on Figure 5.20-2.

The Minnesota Department of Natural Resources (MDNR) has designated the perennial reaches of Valley Creek as a trout stream. Valley Creek is one of 17 trout streams in the seven county metropolitan area. The cold, relatively clean waters of Valley Creek are suitable for trout, and trout have naturally reproduced in the creek throughout recorded history. The MDNR has previously identified brook, brown and rainbow trout present in Valley Creek. The reach from the Lake Edith outlet to its junction with the South Fork is a marginal trout stream, mainly because of the warm water discharges from Lake Edith.

Valley Creek is located entirely on privately owned lands and there is no public access. Landowners generally use the creek for aesthetic viewing, but some fish out of the creek. A large percentage of the Valley Creek watershed is operated by the Belwin Conservancy. The Belwin Conservancy is privately owned, but has a program with St. Paul Public Schools where several hundred school children visit the conservancy annually and learn about natural resources. The public can also purchase memberships to the Belwin Conservancy. The Belwin Conservancy hosts several events per year, which allow members access to the land.

5.20.2 Water Quality Management Plan

The VBWD has classified Valley Creek as a High Priority waterbody according to the VBWD's waterbody classification system (see Section 4.1 – Water Quality) due to Valley Creek's classification as a trout stream by the MDNR. The water quality management goal for Valley Creek

is preservation of its water quality and ecological functions, which include trout stream habitat. Foremost among local concerns is the problem of siltation, which destroys trout spawning habitat. Siltation in the stream has occurred and could still occur as a result of four major watershed factors:

- sheet erosion from agricultural practices on uplands
- gully erosion along the streambank and ravines adjacent to the stream
- construction site erosion in and near the stream
- post-construction runoff from developments

The MDNR's underlying philosophy regarding stream management is that streams are self-forming and self-maintaining systems. When there they are artificially manipulated (i.e., structures placed in-stream for various purposes) there can be negative impacts to channel stability. The MDNR encourages the removed or modification of in-stream alterations with the goal of achieving channel stability (MDNR, 2013). In addition, the MDNR has recommended that VBWD manage the tributary watershed in order to:

- maintain its current dissolved oxygen concentration
- avoid increases in water temperature
- avoid increased discharge

5.20.2.1 Water Quality Implementation Plan

The VBWD has identified implementation tasks for Valley Creek based on the 2002 Valley Creek Subwatershed Plan, the 2005 VBWD Plan, and development process for this Plan. Specific water quality implementation tasks that the VBWD plan to undertake for Valley Creek include the following:

1. The VBWD will cooperate with other entities to monitor the water quality of Valley Creek and perform the actions discussed in Section 4.4. The VBWD will continue to work with the Metropolitan Council to collect water chemistry and flow data through a continuous water monitoring station as part of the Watershed Outlet Monitoring Program (WOMP). The VBWD will report the results of its stream monitoring.

2. The VBWD will regularly monitor the physical condition of the Valley Creek, if the VBWD can gain access. The purpose of this monitoring is to assess stream degradation, including the identification of streambank and gully erosion sites. VBWD will monitor the intermittent streams within the Valley Creek watershed only in response to problems.

3. The VBWD will perform, or cooperate with other entities to perform, biological monitoring of Valley Creek and report the results of such monitoring.

4. The VBWD will cooperate with the MDNR or other entities to perform fisheries monitoring of Valley Creek at approximately three year intervals.

5. The VBWD will continue to fund a volunteer stream monitoring program conducted by students of Stillwater Area High School on Valley Creek.

6. The VBWD will continue to implement stream management and stream restoration projects to address identified stream degradation problems. The VBWD will maintain a list of areas of stream degradation, utilizing available information from the 1999 natural resources inventory and subsequent monitoring. The VBWD will prioritize reaches for habitat improvement or streambank stabilization projects and determine most appropriate project methods. The VBWD will work with properties owners to design and implement habitat improvement and streambank stabilization projects for priority reaches of the creek. The VBWD will seek to use soft-armoring techniques (e.g., vegetative plantings, root wads) where feasible.

7. The VBWD will continue to provide technical assistance for removal of in-stream structures that may negatively impact stream channel stability.

8. The VBWD will continue to implement its Rules and Regulations (2013, as amended) in the Valley Creek watershed. The VBWD Rules and Regulations are included in this Plan as Appendix A-4.5.

5.20.2.2 Water Quality Issues and History

Currently, surface water quality in the Valley Creek watershed (as indicated by biological monitoring. see Section 5.20.2.4.2) is good. This is largely the due to the small amount of development within watershed. Land use is mainly agricultural and low-density residential, resulting in low levels of imperviousness. There are also some unfragmented tracts of forest and grassland, contributing valuable habitat. The largest threats to surface water quality are development and poor vegetation management, which could carry excessive nutrients and contaminants to the stream and increase erosion into and within the creek.

In June 2002, the Valley Creek Watershed Advisory Committee completed the *Valley Creek Subwatershed Plan* (2002 Subwatershed Plan). The Valley Creek Watershed Advisory Committee included watershed residents and representatives from the Cities of Afton and Woodbury, the VBWD, the MDNR, the St. Croix Watershed Research Station (SCWRS) of the Science Museum of Minnesota, the Washington Conservation District (WCD), the Minnesota Pollution Control Agency (MPCA), the University of Minnesota (UMN), the Minnesota Board of Water and Soil Resources (BWSR), and other groups and agencies. The 2002 Subwatershed Plan provides technical background and recommends strategies for watershed protection. The recommendations included tasks for the Cities of Afton and Woodbury, the VBWD, landowners, and several others. The provided technical and educational information about Valley Creek's watershed and what can be done to maintain and protect it with a long term vision.

The 2002 Subwatershed Plan identified strategies and tasks applicable to the Valley Creek watershed, including

- identifying critical areas of concern for surface water and groundwater protection
- developing a stormwater volume control policy
- establishing vegetation buffer requirements
- cooperating with others to complete stormwater management demonstration projects

Several of these strategies were implemented in the 2005 VBWD Plan. Since the 2005 Plan, the VBWD has updated its rules and requirements (see Appendix A-4.5) to include requirements for both stormwater volume and buffers.

In 2003, the VBWD began to develop a prioritized list of potential stabilization projects, culminating in an erosion inventory developed in 2005. In January 2006 the VBWD engineer presented the managers with options to consider in the stabilization of Valley Creek. The managers agreed to begin Phase I of the Valley Creek Dam Safety Review. In October 2006, the MPCA finalized a 319 grant contract with the VBWD to implement stabilization projects within the Valley Creek watershed. In December 2006, the VBWD engineer met with property owners of some priority restoration sites on Valley Creek identified for repair to begin a planning and coordination process to develop a project.

Throughout 2007, the VBWD developed plans for several projects within the Valley Creek watershed. The primary project (later called Oakgreen Avenue Infiltration Basin), included constructing a large infiltration basin at the top of an eroding ravine that feeds runoff directly into Valley Creek. In 2007, the plans were prepared, permits were obtained, and a contractor was selected to construct the infiltration basin. A land appraiser prepared a report for the necessary easement, and the easement was obtained in early 2008.

Following a public hearing held on May 22, 2008, the VBWD ordered projects for the Oakgreen Avenue Infiltration Basin, the Upstream Stabilization Project (addressing approximately 2,500 feet of the South Fork of Valley Creek), and the Downstream Stabilization Project (addressing approximately 2,200 feet of the Main Stem of Valley Creek). All three projects were completed and vegetated in 2008. In November 2008, the Star Tribune published an article regarding the VBWD's Valley Creek stabilization projects.

In July 2010, private landowners adjacent to Valley Creek petitioned the VBWD for funding and assistance from the VBWD for their restoration project along Valley Creek. The VBWD managers approved to fund the requested restoration up to $15,000.00. In August 2010, Mr. Steve Hobbs, the representative for the landowners, gave a presentation on the restoration project.

In April 2011, VBWD completed the Valley Creek feasibility study for stabilizing the south fork of the creek generally from Stagecoach Trail and to Putnam Boulevard. VBWD continued to complete

maintenance activities on the previously-constructed the Valley Creek stabilization project in 2011.In September 2012, the VBWD applied for a Clean Water Fund Grant assistance from the BWSR for infiltration and ravine stabilization projects within the Valley Creek watershed. The projects would develop an infiltration basin or basins at the head of Valley Creek and re-vegetate and control erosion at the intersection of 30th and Trading Post, where runoff discharges to a ravine. In December 2012, the BWSR awarded a $453,300 grant for these efforts. Throughout 2013, the VBWD began contacting landowners and worked to complete the work described in the grant work plan.

5.20.2.3 Water Quality Data

The overall water quality of Valley Creek is excellent and has not changed significantly since 1973, when the VBWD first began collecting water quality chemistry data from the creek. The VBWD sampling stations are shown on Figure 5.20-3. Twelve water quality parameters were analyzed by the VBWD for samples collected from 1973 to 1994, although not all variables were measured for the entire period. The VBWD began collecting invertebrate samples from two stations on the creek in 1984. Invertebrate samples have been collected and analyzed by the VBWD from 1984 through 1991, 1993, and 1995 through the development of this Plan (see Section 5.20.2.4.2). In 1997, the VBWD worked with the Metropolitan Council to establish a continuous monitoring station on Valley Creek as part of the Metropolitan Council's Watershed Outlet Monitoring Program (WOMP). That station has operated since the fall of 1997. Other organizations, including the UMN, the MDNR, the Wisconsin Department of Natural Resources, and the St. Croix Watershed Research Station of the Science Museum of Minnesota have also collected water quality and/or fishery information from the creek. The VBWD began financing a volunteer stream monitoring program for Stillwater Area High School (SAHS) students in 2002. Prior to the VBWD funding the activity, the MDNR funded the program and the SAHS students began collecting data from the stream in the spring of 1998.

The following sections summarize key water quality variables, including temperature, dissolved oxygen, and fecal coliform bacteria. In 2014, the MPCA established nutrient water quality standards for streams (see Section 4.1 – Water Quality). As of the writing of this Plan, Valley Creek as not been assessed by the MPCA relative to these to nutrient standards. Future monitoring of Valley Creek will include parameters relevant to applicable MPCA standards.

5.20.2.3.1 Temperature

Water temperature is one the most important variables because of its relationship with dissolved oxygen and its influence on living organisms. As the water gets warmer, an aquatic organism's metabolism speeds up, increasing its need for oxygen, but the warmer the water gets, the less oxygen it can hold. Aquatic organisms are adapted to a variety of water temperatures, but each species has its own optimum for growth and reproduction. The preferred temperature for trout is generally considered to be below 64 degrees Fahrenheit, and sustained temperatures above 75 degrees Fahrenheit are considered lethal.

The difference in water temperature between the North and South Forks of Valley Creek is due to the difference in surface water and groundwater inputs. Most of the time, the majority of the water in the

North Fork of Valley Creek comes from a surface water outlet on Lake Edith, while most of the water of the South Fork comes directly from groundwater. This is corroborated by field surveys and chemical analyses of the water. Water level measurements show that flow is stable in the North Fork and the South Fork, with brief increases associated with rainfall events. The continuous flow of groundwater allows the South Fork of Valley Creek to have a stable base flow of clean, cold water, making the stream habitable by trout and a diverse group of aquatic insects.

The VBWD measured water temperatures in the South Fork and Main Stem two to three times per year from 1973 to 1997 (except 1995). In 1997, the VBWD continuously measured the water temperature of the North Fork and South Fork. Water temperatures measured in the South Fork were consistently between 39 and 61 degrees Fahrenheit; while temperatures in North Fork were between 39 and 78 degrees Fahrenheit. Water temperatures of the Main Stem reflect a mixture of both branches, generally falling between 38 and 68 degrees Fahrenheit. The VBWD has continuously measured water temperatures in the North Fork, South Fork, and Main Stem of Valley Creek since 1998. Water temperatures in the South Fork ranged from 29 to 60 degrees Fahrenheit between 1998 and 2014, while water temperatures in the North Fork ranged from 32 to 81 degrees Fahrenheit during the same period. Water temperatures in the Main Stem fell between those observed in the North and South Forks (31 to 67 degrees Fahrenheit). The data for minimum, median, and maximum annual stream temperatures for the period from 1998 through 2014 are shown in Figure 5.20-4.

Based on Afton's and Woodbury's current land use plans, there does not appear to be a strong thermal impact threat to Valley Creek. However, the VBWD will consider thermal impacts when updating its rules and requirements.

5.20.2.3.2 Dissolved Oxygen

Dissolved oxygen is a measure of the amount of oxygen that is dissolved in the water and available for aquatic organisms to use. The capacity for water to hold oxygen in dissolved form decreases as water temperature increases. Trout require a minimum of about 5 mg/l to survive, and the MPCA has established a minimum of 5 mg/l as a water quality standard for the state. The VBWD measured dissolved oxygen of grab samples between 1973 and 1994. Measurements from three different locations on Valley Creek indicate some major differences in dissolved oxygen between the North Fork and South Fork. The North Fork had dissolved oxygen levels ranging from 11 mg/l to 1 mg/l, with 64% of measurements at or below 5 mg/l, while the South Fork had dissolved oxygen levels between 16 mg/l and 7.5 mg/l, with 98% of measurements at or above 8 mg/l. These measurements are further indication of the better water quality in the South Fork than the North Fork. Downstream of these two branches, the Main Stem's dissolved oxygen levels ranged from 4.5 mg/l to 12.5 mg/l, with 97% of measurements above 7 mg/l.

As part of its continuous stream monitoring, the VBWD (through its contracts with the SCWRS and WCD) has measured dissolved oxygen in the North Fork, South Fork, and Main Stem of Valley Creek since 1998. Dissolved oxygen (calculated as an average of grab samples) measured 11.7 mg/L in the South Fork, 11.5 mg/L in the North Fork, and 11.8 mg/L in the Main Stem.

5.20.2.3.3 Fecal Coliform and Escherichia coli Bacteria

Fecal coliform bacteria are measured because of their implications for human health and aquatic ecosystems. Fecal coliform bacteria live in the digestive tract of warm-blooded animals. They are excreted in the solid waste of humans and other mammals, such as cattle. The primary sources of fecal coliform are improperly treated wastewater, septic systems, and surface runoff from animal stockyards and pastures. Fecal coliform bacteria are indicators that other pathogens, such as those that can cause diarrhea, dysentery, cholera, and typhoid fever in humans, may be present in the water. Bacteria can also deplete the water of oxygen, potentially killing fish. The MPCA water quality standard for fecal coliform includes a mean of 200 colonies per 100 ml and an acute standard of 2,000 colonies per 100 ml. The bacterium *Escherichia coli* (*E. coli*) is often sampled as an indicator of pathogenic bacteria. The MPCA water quality standards for *E. coli* include a mean standard of 126 colonies per 100 ml and an acute standard of 1,260 colonies per 100 ml.

The VBWD measured fecal coliform bacteria 58 times in Valley Creek from 1973 to 1994 in the North Fork, South Fork, and Main Stem of Valley Creek. The VBWD also sampled fecal coliform 92 times in the Main Stem of Valley Creek from 1999 through 2010. The Main Stem of Valley Creek was sampled for *E.coli* 61 times since 2009. *Escherichia coli* and fecal coliform were monitored in 2015, but are not included in the ongoing monitoring of Valley Creek (see Section 5.20.2.1).

The South Fork generally had less than 100 CFU (coliform forming units) per 100 ml of stream water, but on three occasions it exceeded MPCA's standard of 200 CFU/100 ml. The North Fork exceeded 200 CFU/100 ml seven times during the same period with 21 of 58 measurements above 100 CFU/100 ml. From 1927 to 1994, the Main Stem of Valley Creek exceeded 200 CFU/100 ml three times and was generally close to or below 100 CFU/100 ml during most measurements. Since 1999, the Main Stem of Valley Creek has not exceeded the mean or acute standard for fecal coliform. Since 2009, the Main Stem of Valley Creek has not exceeded the mean or acute standard for *E.coli*. Among data collected since 1999 the Main Stem of Valley Creek, individual measurements have occasionally exceeded the standard applicable to mean values for both fecal coliform and *E.coli*, but have not exceeded the acute standards for either parameter.

Through education efforts, the VBWD will work with property owners to protect the creek from excessive amounts of fecal coliform bacteria.

5.20.2.3.4 Nutrient Dynamics

The St. Croix Watershed Research Station of the Science Museum of Minnesota completed a study in June 2001 entitled *Nutrient Dynamics and Water Quality of Valley Creek, a high-quality trout stream in southeastern Washington County* (Zapp, 2001). The study was funded by a Challenge Grant as recommended by the Legislative Commission on Minnesota Resources, and by funds of the VBWD, the UMN, and the Science Museum of Minnesota. The study is available from the VBWD. The specific goals of the study were to:

- Continue hydrologic monitoring efforts

- Measure annual sediment and nutrient output loads from the creek
- Identify sources of nitrogen, phosphorus, and sediment to the creek
- Conduct a stream survey to inventory macrophyte populations, gullies, and stream bed sediments, along with identifying sources of sediment (and its associated phosphorus) to the creek
- Investigate the role of sediment-bound phosphorus plays in macrophyte growth and density
- Estimate gross nutrient and sediment budgets (inputs vs. outputs)

The study found that high nitrogen loads in the creek were attributable to the regional groundwater sources during baseflow conditions in the South Fork of Valley Creek. There was no evidence to suggest that point sources contribute large inputs of nitrogen along the creek. Considering groundwater flow rates in the watershed, the study concluded that it may take decades for the nitrate-rich groundwater to flush through the system.

Dissolved phosphorus was found to be a larger component of the total phosphorus load for the South Fork than previously thought. Intermittent branches were determined to supply the majority of this dissolved phosphorus load during runoff events. The source of this dissolved phosphorus could be from water running over dead plant tissue and/or soils with excessive phosphorus levels from fertilizer or manure applications.

Most of the annual suspended sediment load was found to not enter the South Fork from intermittent branches. The majority of suspended sediment came from unmeasured sources. Because banks were fairly stable and overland runoff was minimal, gully inputs and streambed scouring were most likely responsible for these large unmeasured inputs.

Macrophyte (large aquatic plants) coverage and density were found to be greatest in the stream reaches with highest light availability, not those with the highest water-column or sediment-phosphorus concentrations. Overall, macrophytes in the stream provided a small, short-term reservoir of phosphorus, both as plant biomass and as sediment within macrophyte patches. These patches appear to be reduced significantly by high-energy, flushing flow that occurs during snowmelt runoff events.

Compared to the annual output of total phosphorus, the estimated inventory of sediment-bound phosphorus stored in the stream channel was found to be quite small. Furthermore, much of this inventory was of a form not available to plants. This small inventory sediment-total phosphorus may be a result of Valley Creek's substantial baseflow, which was apparently large enough to minimize the deposition of phosphorus-rich fine-grained particles in the stream.

The 2001 study estimated that 14,000 metric tons of sediment have collected behind the dam located on the South Fork. The study also determined that the reservoir behind the dam did not appear to alter downstream water temperatures significantly.

In 2014, the MPCA established nutrient water quality standards for streams (see Section 4.1 – Water Quality). As of the writing of this Plan, Valley Creek as not been assessed by the MPCA relative to these to nutrient standards. As part of its ongoing continuous stream monitoring, the SCWRS collects grab samples which are analyzed for phosphorus, nitrogen, and other nutrients. Future monitoring of Valley Creek will include parameters relevant to applicable MPCA standards.

5.20.2.4 Biological Data

5.20.2.4.1 Fishery Data

Valley Creek is unique because it is one of only a few streams in the Twin Cities metropolitan area that has a naturally reproducing population of brook trout, the only trout species native to Minnesota. In addition to brook trout, Valley Creek sustains large populations of brown trout and rainbow trout. The creek also supports native brook lamprey, which are fairly rare in Minnesota and require cold, spring-fed streams similar to trout.

Many of the trout streams in Minnesota depend on stocking to maintain their trout populations because the habitat and water quality are marginal or poor, which limits reproductive success. In some streams, angling reduces the population to very low numbers. However, in Valley Creek's high-quality habitat and clean, cold water, the trout populations maintain themselves through natural reproduction. Valley Creek is one of the best trout producing streams in the State of Minnesota, and is believed to be in the top 10% of trout streams in the world in terms of trout production (Tom Waters and Ray Newman, personal communication.) Although trout in Valley Creek are relatively slow growing fish, they regularly reach lengths of 12 to 15 inches, and fish exceeding 18 to 20 inches are not uncommon.

Further evidence of the excellent water quality in Valley Creek is the presence of the American brook lamprey. While American brook lamprey have been found in other streams in the Twin Cities metropolitan area, Valley Creek has an abundant population. The American brook lamprey is a non-parasitic filter feeder and it does not exceed 8 inches in length. Because a trout habitat is also suitable for the American brook lamprey, protection of the trout habitat in Valley Creek will also ensure the survival of this species.

The Minnesota MDNR conducted fish surveys on the North Fork, South Fork, and Main Stem in June 1999. These data are included in Appendix A-5.20.

On July 18, 2000, the Wisconsin Department of Natural Resources (WI DNR) conducted a 26-minute fish survey on the South Fork of Valley Creek, about 11 meters upstream of Stagecoach Trail. The following table summarizes the data of their fish survey.

Table 5.20-1 Summary of WI DNR Valley Creek fish survey

Fish	Number Caught	Minimum Length (millimeters, mm or inches, in)	Maximum Length (mm or in)	Minimum Weight (grams, g or ounces, oz)	Maximum Weight (g or oz)
Sculpin	38	--	--	--	--
Brown Trout	49	122 mm or 4.8 in	282 mm or 11.1 in	20 g or 0.7 oz	201 g or 7.1 oz
Rainbow Trout	8	123 mm or 4.8 in	163 mm or 6.4 in	20 g or 0.7 oz	40 g or 1.4 oz
Brook Trout	3	139 mm or 5.5 in	162 mm or 6.4 in	25 g or 0.9 oz	36 g or 1.3 oz
Young of the Year Brown Trout	98	--	--	--	--
Young of the Year Rainbow Trout	8	--	--	--	--

One of the intents of the Valley Creek Downstream Stabilization Project (see Section 5.20.2.2) was to improve the trout habitat of the creek by raising the profile of the streambed, creating deeper water and more diverse stream structure. Through the 2008 stabilization project, eight rock riffles were installed in the stream; floodplain terraces were excavated, and the streambanks were graded and replanted with native vegetation. The rock riffles raised the water level of the stream throughout the project reach and created more trout habitat in an area which was previously quite poor quality trout habitat.

The MDNR completed a fishery assessment of parts of Valley Creek in 2006 with electro shocking equipment. Two sites sampled in 2006 by the MDNR were also sampled by the VBWD's contractor in 2009, including one site within the downstream restoration project and one upstream control site (see Appendix A-5.20). The fish data collected at the restoration and the upstream control location were compared based upon number of fish collected, standardized for the sampling time (number of fish per hour of sampling effort). The survey identified:

- Four species were collected in both 2006 and 2009 – native brook trout, non-native brown trout, non-native rainbow trout, and non-native hybrid tiger trout (a brown-brook hybrid). However all four species were collected at the restoration site only in 2009.
- The number of trout per hour was significantly higher at both sites in 2009 than in 2006.
- Brown trout numbers were higher at the restoration location in 2009 than in 2006.
- Most significantly, native brook trout were collected at the restoration site in 2009; there were no book trout collected at this location in 2006.

The increase in overall trout numbers at both locations could be due to a number of factors related to improved habitat quality and lower stream water temperatures. The increased numbers of trout and the presence of the previously absent brook trout at the restoration site is likely related to the improved habitat quality – increased water depth, lower water temperatures and a greater diversity of structure – within the restoration areas. Appendix A-5.20 presents more detailed information from the 2009 VBWD survey.

5.20.2.4.2 Aquatic Macroinvertebrates

Macroinvertebrate sampling provides an indicator of overall stream health. While water quality grab samples provide an assessment of stream water quality at the time of sample collection, benthic invertebrates provide a long-term assessment of water quality. They live on the bottom and in the vegetation of a stream as long as water quality conditions permit. As attached organisms, benthic aquatic invertebrates are exposed to all the temporal variations in stream quality and "integrate" the quality of passing water. Each type of benthic invertebrate has a different tolerance for pollution; studying the numbers and types of benthic invertebrates can indicate pollution in a stream. When sufficient pollutants enter the stream to prevent their survival, they are eliminated. Monitoring the presence or absence of biological indicator organisms provides indirect evidence of the effects of transitory changes in stream water quality.

The VBWD has collected benthic invertebrate samples from Valley Creek for many years and annually since 1995. Figure 5.20-3shows the location of the VBWD sampling on the creek. Samples were collected from a riffle location with a D-frame aquatic net. The substrate was disturbed with the sampler's feet, allowing dislodged invertebrate to drift into the net downstream. Samplers also passed the D-frame net through debris and vegetation near the banks. Rocks were examined, too. All the invertebrate samples were preserved in 80 percent alcohol and later identified. The samples collected by the VBWD were identified by Dr. Dean Hansen of the University of Minnesota. The sampled collected by the SAHS students were identified by the students, and verified by their teacher and staff of the WCD.

The most common invertebrate groups observed over the sampling times include black flies, mayflies, caddisflies, midges, and amphipods (a freshwater crustacean also known as a scud). Once individual invertebrates were identified, the VBWD used the Hilsenhoff's Biotic Index (HBI, Hilsenhoff, 1987) to quantify the results of the macroinvertebrate sampling. The index uses invertebrate data to rank a stream according to its water quality. Water quality categories include excellent, very good, good, fair, poor, and very poor. Other indicators of stream water quality include numbers of families and the dominant family percentage.

The data collected by the VBWD are included in VBWD annual reports. The HBI for the VBWD-collected data is shown on Figure 5.20-5 and Figure 5.20-6. The results generally show very good water quality for Valley Creek during the period from 1984 to 2013. Lower indices were collected for sampling done at station C in 1993 and 1995. Sampling staff observed that the stream substrate had changed from sandy/rocky to sediment during 1993. Therefore, it appears that conveyance of

sediment to Valley Creek caused the significant change noted by the biotic index assessment of the stream. Results at station B (monitored since 1997) are consistently within the range associated with very good water quality. SAHS surveys in and 1998 and 1999 compared insect communities from the North Fork and the South Fork found that the South Fork had excellent to good water quality, while the North Fork appeared to fall more in the good to fair range.

The MPCA is developing a biotic index that they will use to determine impairment of streams for invertebrates, referred to as M-IBI. The M-IBI provides a more comprehensive assessment of stream health than the HBI; a modified version of the HBI is included as one of the metrics for calculating M-IBI. The MPCA currently uses the M-IBI to determine stream impairment for its monitoring projects. More information regarding the M-IBI is available from the MPCA website.

5.20.3 Water Quantity Management Plan

The VBWD developed a hydrologic and hydraulic model of the Valley Creek watershed in 2006 to evaluate the flood flow characteristics of the creek; the modeling was done using XP-SWMM software. The VBWD provided the results of the model to the Federal Emergency Management Agency (FEMA) to be used in the development of updated Flood Insurance Rate Maps (FIRMs) for Washington County. In addition to determining regulatory flood levels, the results are also very useful for evaluating various management strategies for the watershed and creek. The updated FIRM became effective in 2010. Previously, the January 1976 FIRM was used; that FIRM =used analysis done by the United States Geologic Service (USGS) using Guetzkow regression methods on the lower reaches of Valley Creek in 1971.

In 2013, the National Oceanographic and Atmospheric Administration (NOAA) published Atlas 14, Volume 8 (see Section 4.7.6). Atlas 14 contains updated precipitation data for Minnesota and supersedes data sources used in the development of the Valley Creek XP-SWMM model. Over the next several years, the VBWD will update its hydrologic-hydraulic modeling of major subwatersheds, including Valley Creek. Updated modeling will incorporate the most recent precipitation data (see Section 4.7.7) which may increase 100-year flood levels relative to the existing FIRM.

In 1956, a dam was constructed by a property owner on the South Fork of Valley Creek. (See Figure 3-13.) The property owner and subsequent owners have not had annual inspections performed on the dam, as required by the MDNR. To verify the structural stability of the dam, the VBWD inspected the dam in 2007. Following the inspection, the Managers attempted to contact the dam's owner through letters and telephone messages, but the landowner did not respond. Because the District is not responsible for the dam, the Managers decided to take no further actions, but will continue to monitor the dam.

In addition to the XP-SWMM model, a MODFLOW model was developed to assess groundwater withdrawal impacts to Valley Creek and evaluate the long-term sustainability of the Valley Creek ground watershed. The Valley Creek model is based on a larger east metro groundwater model, but with finer resolution in the Valley Creek watershed and surrounding area. The model has been used

to assess the potential impact of proposed water supply wells on baseflow in Valley Creek. The results of the modeling effort indicated that fluctuations in Valley Creek baseflow are principally due to inter-annual climate variability. At annual time scales, influence from regional or local pumping was not evident. The modeling does indicate that superimposed on this climatically-induced flow variation is a longer-term trend of reduced baseflow that is likely attributed to regional groundwater pumping. At monthly time scales, it was unclear if minor effects from local pumping are present (Almendinger, 2012). More about the influence of groundwater on the creek is discussed in Section 5.20.4.

5.20.4 Groundwater and Other Information/Issues

In June 1999, the SCWRA of the Science Museum of Minnesota completed a study funded by the Legislative Commission on Minnesota Resources and others. The study is summarized in the final project report, *Monitoring and Modeling Valley Creek Watershed* (Almendinger and Grubb, 1999). Through the study, five automated stream-monitoring stations were established in the watershed. Each station measured stream stage, temperature, and specific conductance; discharge was estimated by empirical stage-discharge relationships. Samples were analyzed for suspended solids and nutrients; a subset of samples were analyzed for major ions, too. The primary finding from the study was that baseflow in Valley Creek was large enough to indicate contributions of groundwater from beyond the surface watershed boundary. The study concluded that the likely source of this groundwater was the Prairie-du-Chien/Jordan aquifer. The area of the aquifer that could contribute to Valley Creek was determined from maps of the potentiometric surfaces to be about 23 to 31 square miles, which is substantially larger than the surface watershed (about 12.4 square miles). Groundwater modeling efforts through the study estimated the time it takes groundwater to reach the creek at about 30 to 40 years over most of the area.

5.20.5 References

Almendinger, J.E., and Grubb, S.E. 1999. *Monitoring and Modeling Valley Creek Watershed: 5. Groundwater Hydrology and Flow Model*. Report to the Legislative Commission on Minnesota Resources: St. Croix Watershed Research Station, Science Museum of Minnesota.

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June 2002. *Valley Creek Subwatershed Plan, Developed by the Valley Creek Subwatershed Advisory Committee.*

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National Oceanographic and Atmospheric Administration (NOAA). 2013. Atlas 14 Precipitation-Frequency Atlas of the United States – Volume 8.

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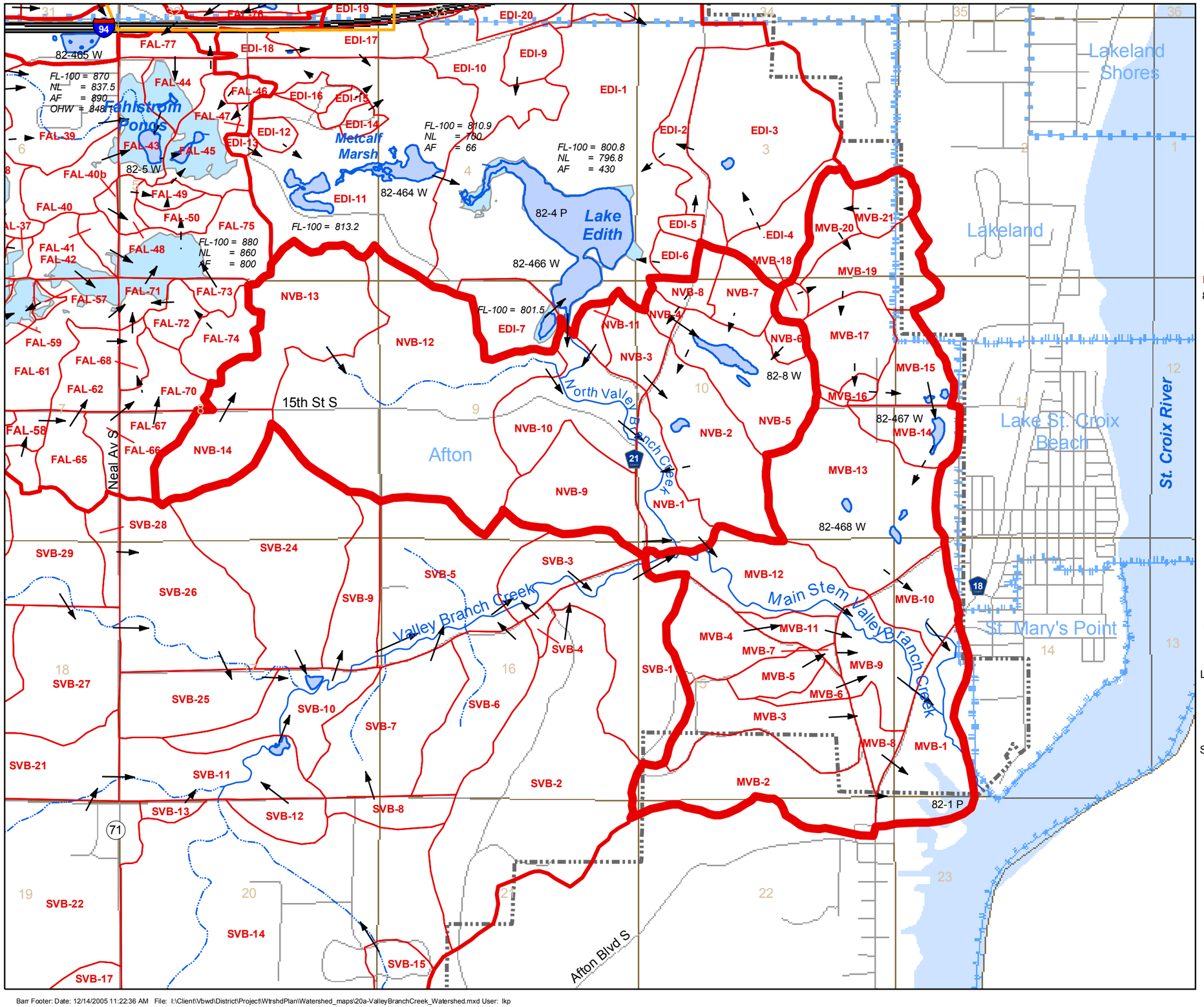
Zapp, Melinda J. and James Almendinger, St. Croix Watershed Research Station of the Science Museum of Minnesota. *June 30, 1999. Nutrient Dynamics and Water Quality of Valley Creek, a high-quality trout stream in southeastern Washington County*.



2,000 1,000 0 2,000 4,000

Scale in Feet

LEGEND

- Main Stem and North Fork Valley Branch Creek Watershed
- Major Watershed Divide
- Subwatershed Divide
- MVB-1 Subwatershed Designation
- 82-4P DNR Protected Waters Designation
- Subwatershed Contributing Runoff
- Overflow Path from Landlocked Watershed (Non-Contributing Subwatershed)
- Overflow Path from Semi-Landlocked Watershed
- Lakes, Ponds, Wetlands, Approximate Normal Water Surface Level
- Lakes, Ponds Wetlands, Approximate 100 Year Flood Surface Level
- FL-100 100 Year Flood Level
- NL Normal Level
- AF Acre Feet of Storage at 100 Year Flood Level
- OHW DNR Established Ordinary High Water Elevation

Project 1007

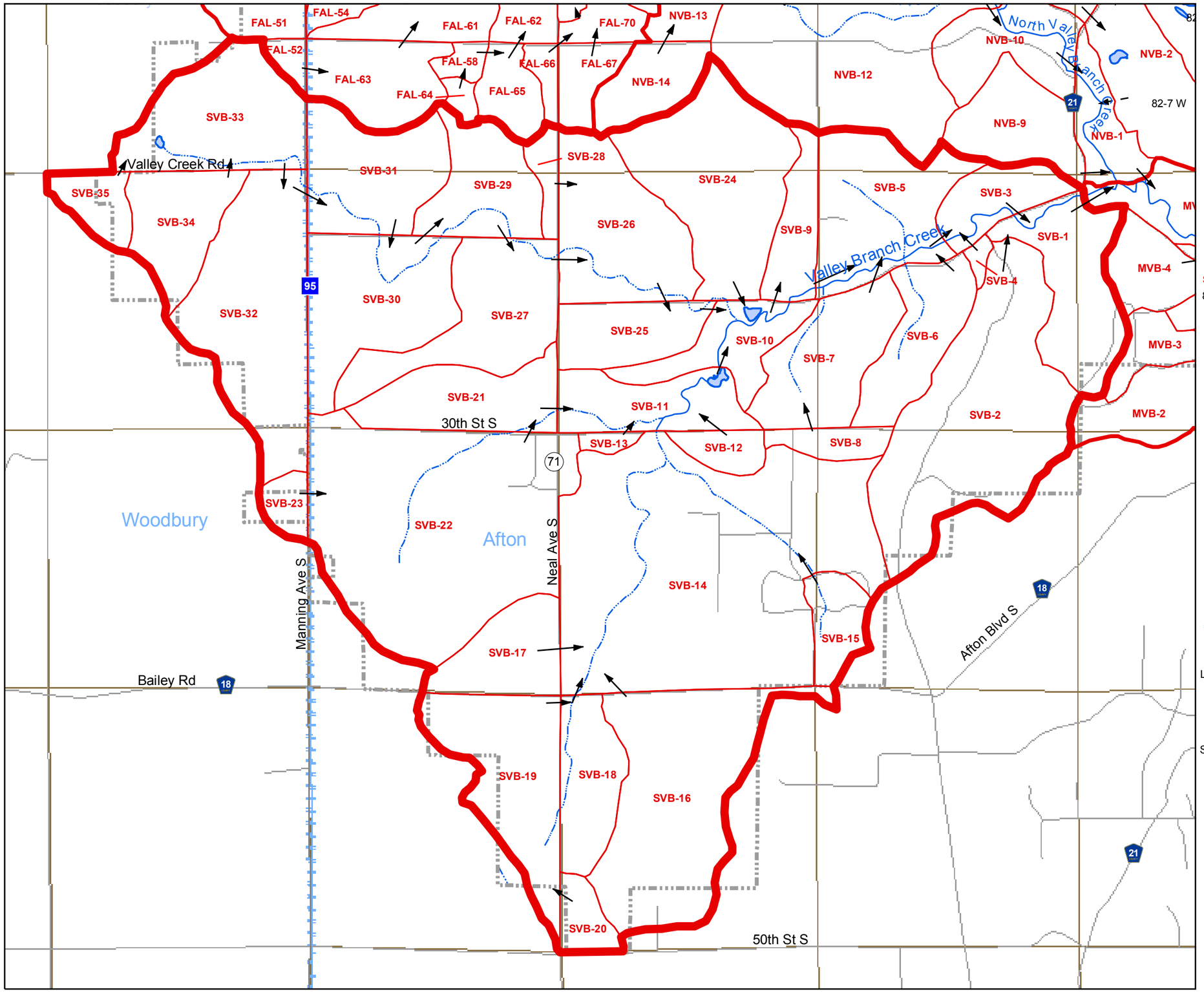
- Catch Basin
- Manhole Cover
- Open Channel
- Pipe
- MN-DOT Pipe
- Section Lines
- VBWD Legal Boundary
- Municipal Boundary

Landlocked: Basin does not overflow using VBWD simplified method for calculating its 100-year flood level or using a more detailed analysis, such as the 1% probability flood level.

Semi-Landlocked: Basin does not overflow in the 100-year 24-hour rainfall total or the 100-year 10-day snowmelt event, but does overflow when calulating its 100-year flood level based on the VBWD simplified method or the 1% probablility flood level.

Figure 5.20-1a

VALLEY BRANCH CREEK WATERSHED
MAIN STEM AND
NORTH FORK VALLEY BRANCH CREEK
Valley Branch Watershed District



LEGEND

- South Fork Valley Branch Creek Watershed
- Major Watershed Divide
- Subwatershed Divide
- SVB-1 Subwatershed Designation
- 82-74P DNR Protected Waters Designation
- Subwatershed Contributing Runoff
- Overflow Path from Landlocked Watershed (Non-Contributing Subwatershed)
- Overflow Path from Semi-Landlocked Watershed
- Lakes, Ponds, Wetlands, Approximate Normal Water Surface Level
- Lakes, Ponds Wetlands, Approximate 100 Year Flood Surface Level
- FL-100 100 Year Flood Level
- NL Normal Level
- AF Acre Feet of Storage at 100 Year Flood Level
- OHW DNR Established Ordinary High Water Elevation

Project 1007

- Catch Basin
- Manhole Cover
- Open Channel
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- MN-DOT Pipe
- Section Lines
- VBWD Legal Boundary
- Municipal Boundary

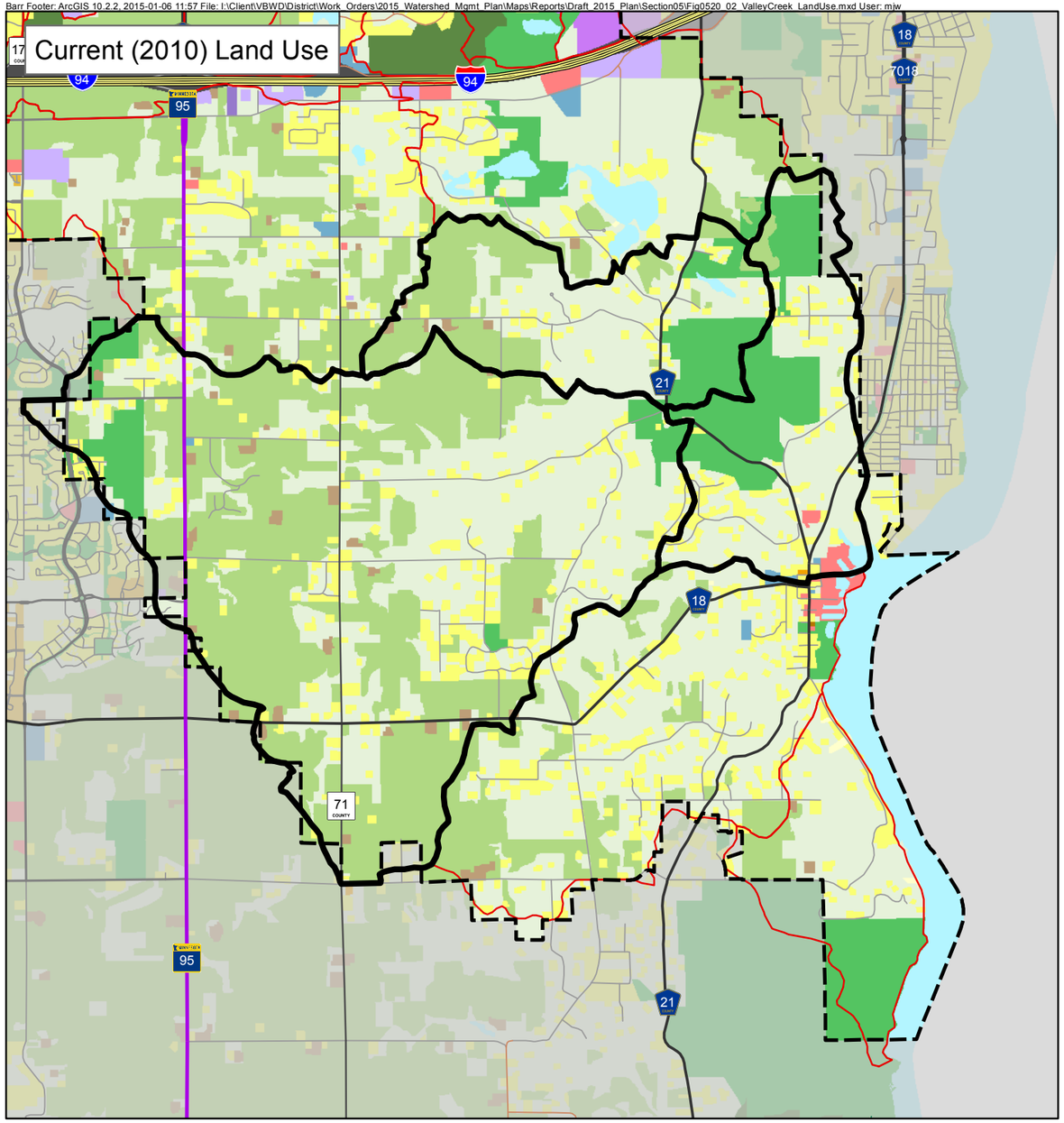
Landlocked: Basin does not overflow using VBWD simplified method for calculating its 100-year flood level or using a more detailed analysis, such as the 1% probability flood level.

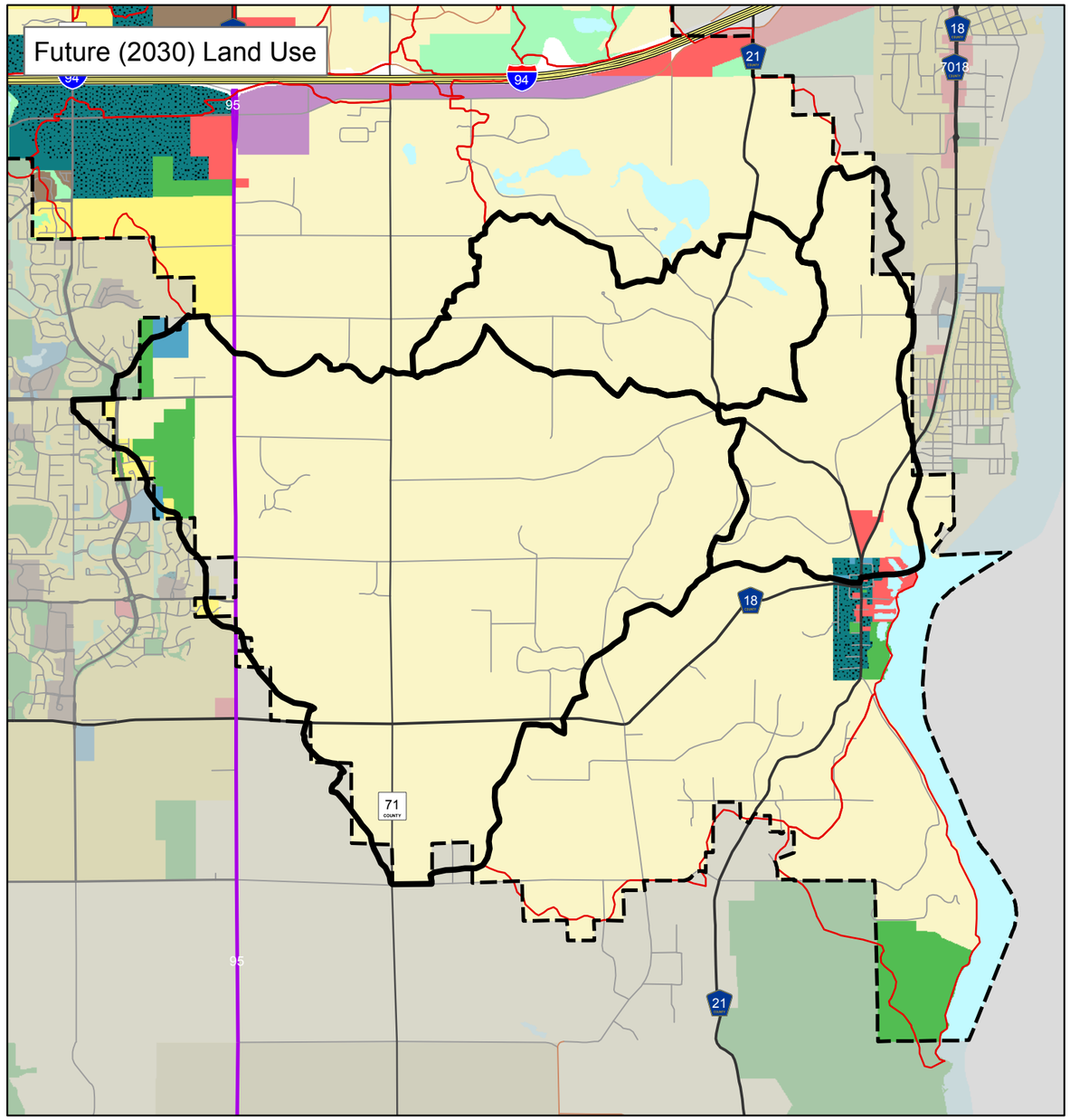
Semi-Landlocked: Basin does not overflow in the 100-year 24-hour rainfall total or the 100-year 10-day snowmelt event, but does overflow when calulating its 100-year flood level based on the VBWD simplified method or the 1% probablility flood level.

Figure 5.20-1b

VALLEY BRANCH CREEK WATERSHED
SOUTH FORK VALLEY BRANCH CREEK
Valley Branch Watershed District

Barr Footer: Date: 12/1/2005 5:09:39 PM File: I:\Client\Vbwd\District\Project\WtrshdPlan\Watershed_maps\20b-ValleyBranchCreek_Watershed.mxd User: lkp





Current (2010) Land Use
- Farmstead
- Seasonal/Vacation
- Single Family Detached
- Manufactured Housing Park
- Single Family Attached
- Multifamily
- Retail and Other Commercial
- Office
- Mixed Use Residential
- Mixed Use Industrial
- Mixed Use Commercial and Other
- Industrial and Utility
- Extractive
- Institutional
- Park, Recreational or Preserve
- Golf Course
- Major Highway
- Railway
- Airport
- Agricultural
- Undeveloped
- Water
- Valley Creek Subwatersheds
- Major Subwatershed Boundary
- VBWD Legal Boundary

Future (2030) Land Use
- Agricultural
- Rural or Large-Lot Residential
- Single Family Residential
- Multifamily Residential
- Commercial
- Industrial
- Institutional
- Mixed Use
- Multi-Optional Development
- Park and Recreation
- Open Space or Restrictive Use
- Rights-of-Way (i.e., Roads)
- Railway (inc. LRT)
- Airport
- Vacant or Unknown
- Open Water
- Valley Creek Subwatersheds
- Major Subwatershed Boundary
- VBWD Legal Boundary

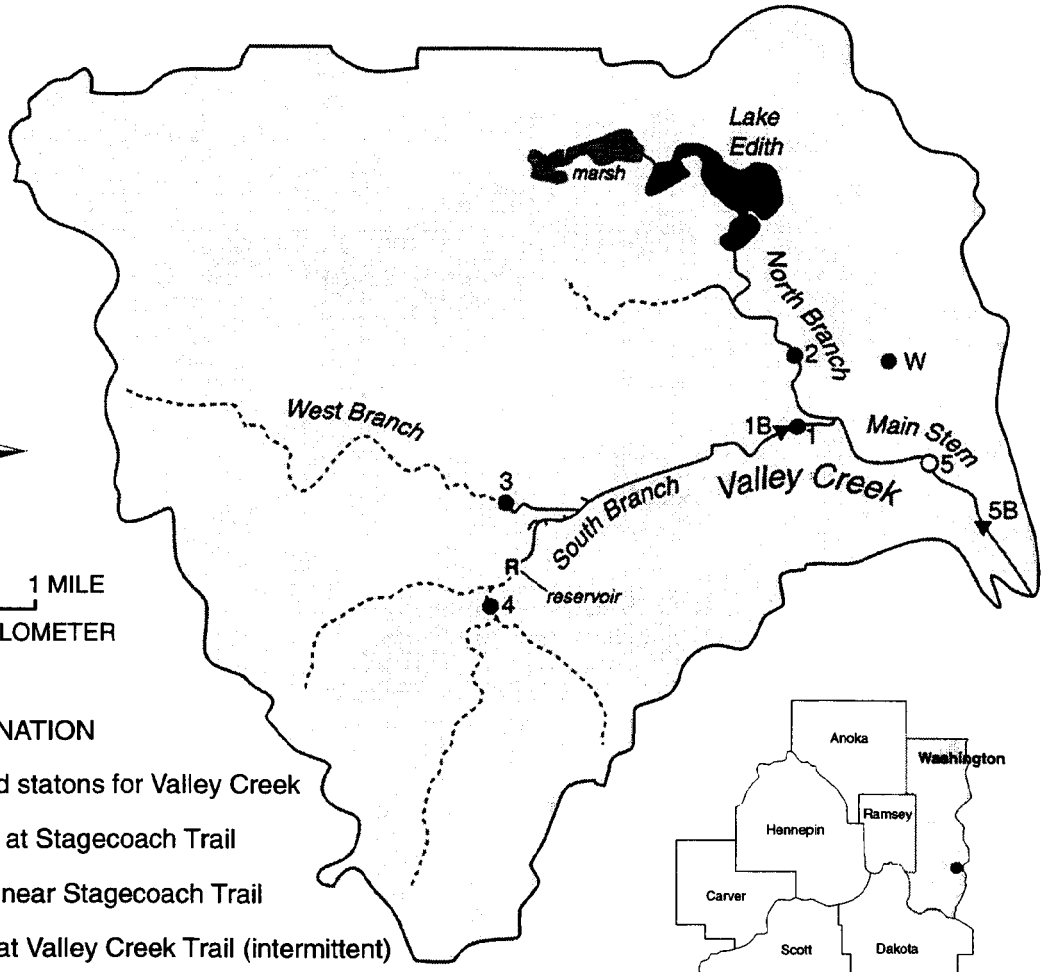
Feet
5,000 0 5,000

1 inch = 4,500 feet

Source: Metropolitan Council 2010

Figure 5.20-2

VALLEY CREEK WATERSHEDS
CURRENT (2010) AND FUTURE (2030) LANDUSE
2015-2025 Watershed Management Plan
Valley Branch Watershed District



EXPLANATION

- ● SCWRS automated statons for Valley Creek
  - 1 South Branch at Stagecoach Trail
  - 2 North Branch near Stagecoach Trail
  - 3 West Branch at Valley Creek Trail (intermittent)
  - 4 South Branch at 30th Street (intermittent)
  - W Automated weather station
- O Met Council automated station on Valley Creek
  - 5 Main Stem at Putnam Boulevard
- ▼ VBWD (Barr) sampling sites on Valley Creek
  - 1B South Branch at Stagecoach Trail (site B in VBWD Water Management Plan)
  - 5B Main stem at hwy 95 (site C in VBWD Water Management Plan)

SCWRS, St. Croix Watershed Research Station
Met Council, Metropolitan Council Environmental Services
VBWD, Valley Branch Watershed District
Barr, Barr Engineering

Approximate location
of Valley Creek watershed
in Twin Cities metropolitan area

Figure taken from Science Museum of Minnesota's June 20, 1999 LCMR report.

Figure 5.20-3

VALLEY CREEK MONITORING SITES
Valley Branch Watershed District

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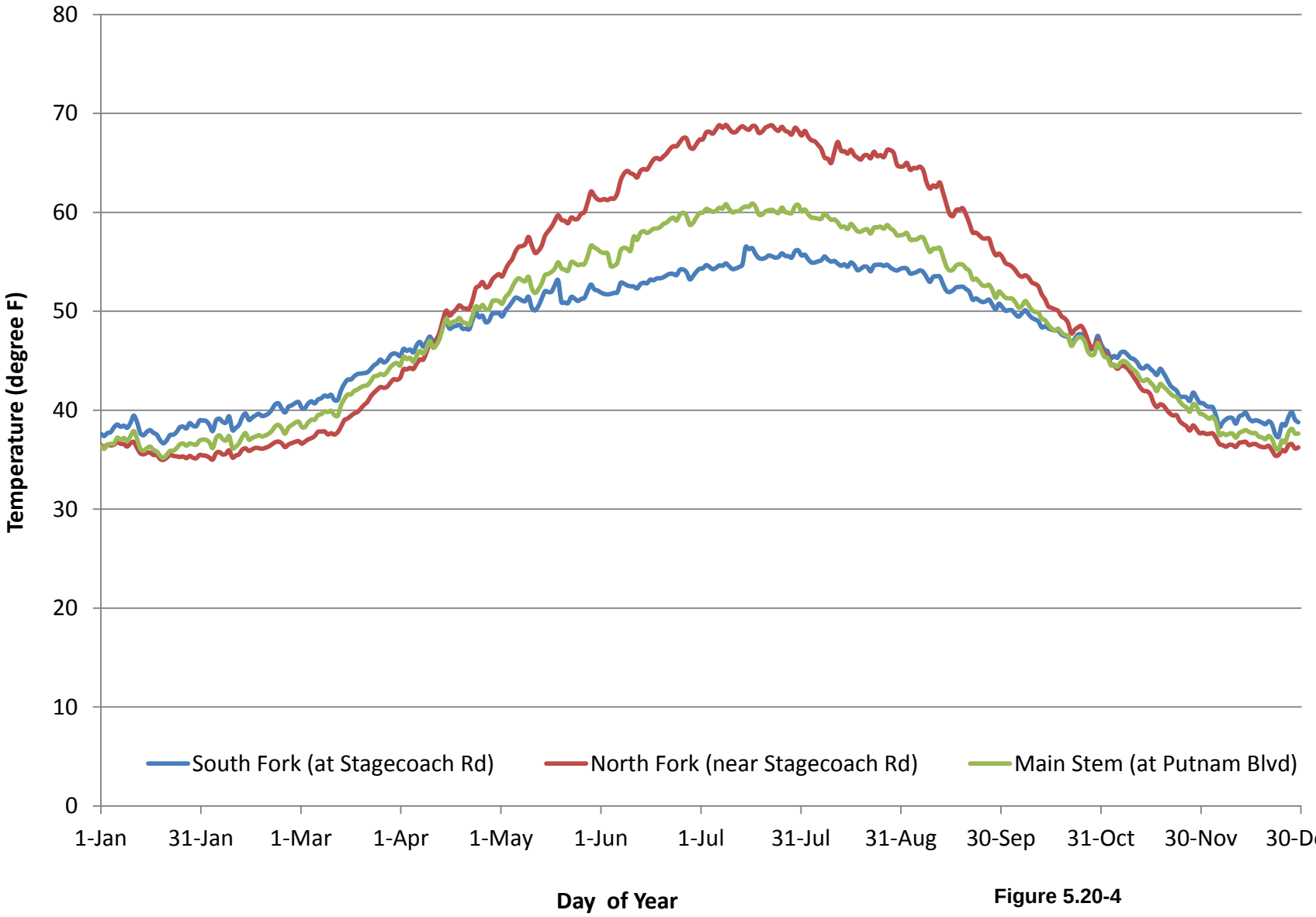

Figure 5.20-4

VALLEY CREEK WATER TEMPAREATURE DATA (1998-2014)
2025 Watershed Management Plan
Valley Branch Watershed District

Biotic Index Values 1998-2014
Station B, Valley Branch Creek

Hilsenhoff Biotic Index (HBI) is a measure of organic pollution and dissolved oxygen availability in streams based on indicator species of benthic invertebrates.
A higher HBI indicates a greater tolerance to low dissolved oxygen and, thus, lower water quality.

Figure 5.20-5
Valley Creek Biotic Index - Station B

Valley Branch Watershed District
2015-2025 Watershed Management Plan

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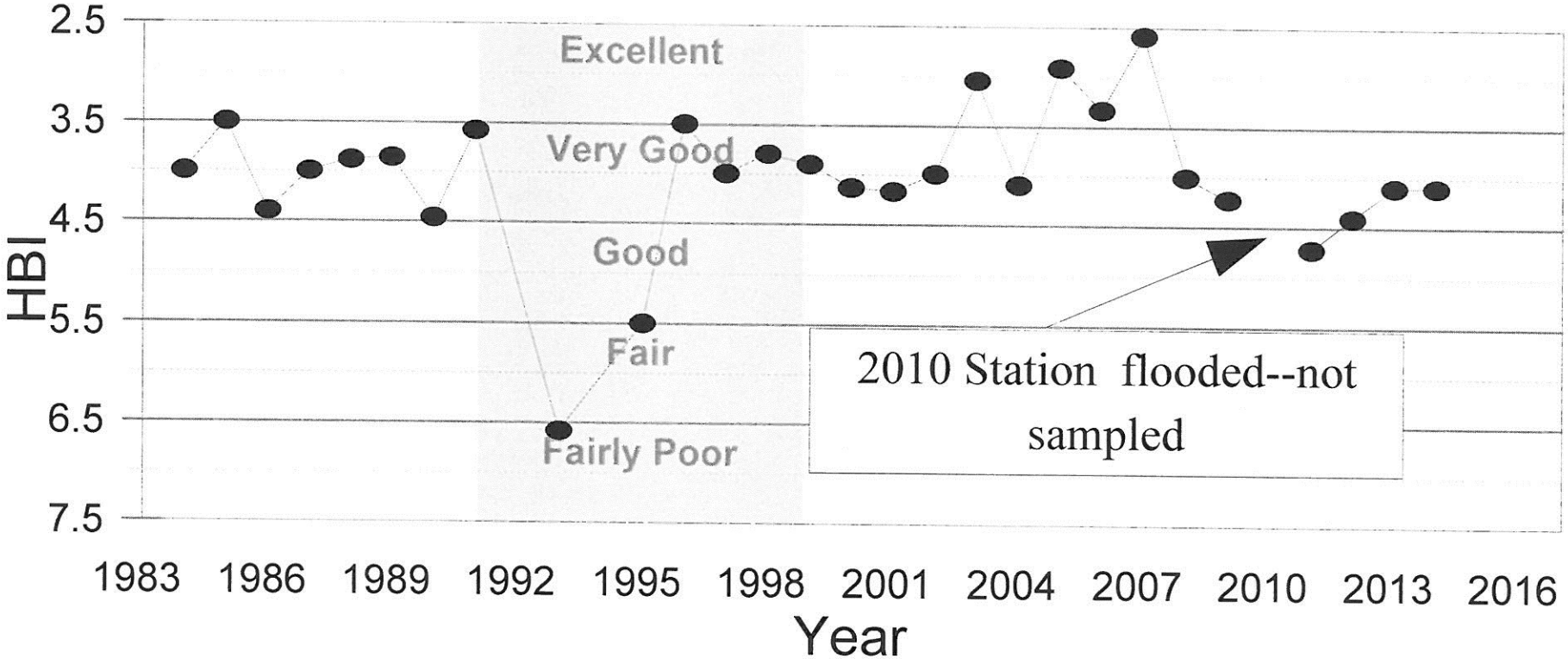
Biotic Index Values 1984-2014
Station C, Valley Branch Creek



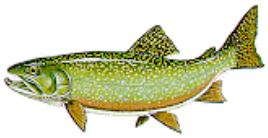
Hilsenhoff Biotic Index (HBI) is a measure of organic pollution and dissolved oxygen availability in streams based on indicator species of benthic invertebrates.
A higher HBI indicates a greater tolerance to low dissolved oxygen and, thus, lower water quality.
Station C flooded during 2010 monitoring event: not sampled

Figure 5.20-6
Valley Creek Biotic Index - Station C

Appendix A-5.20 Additional Fishery Data

Appendix A-5.20 Additional Fishery Data

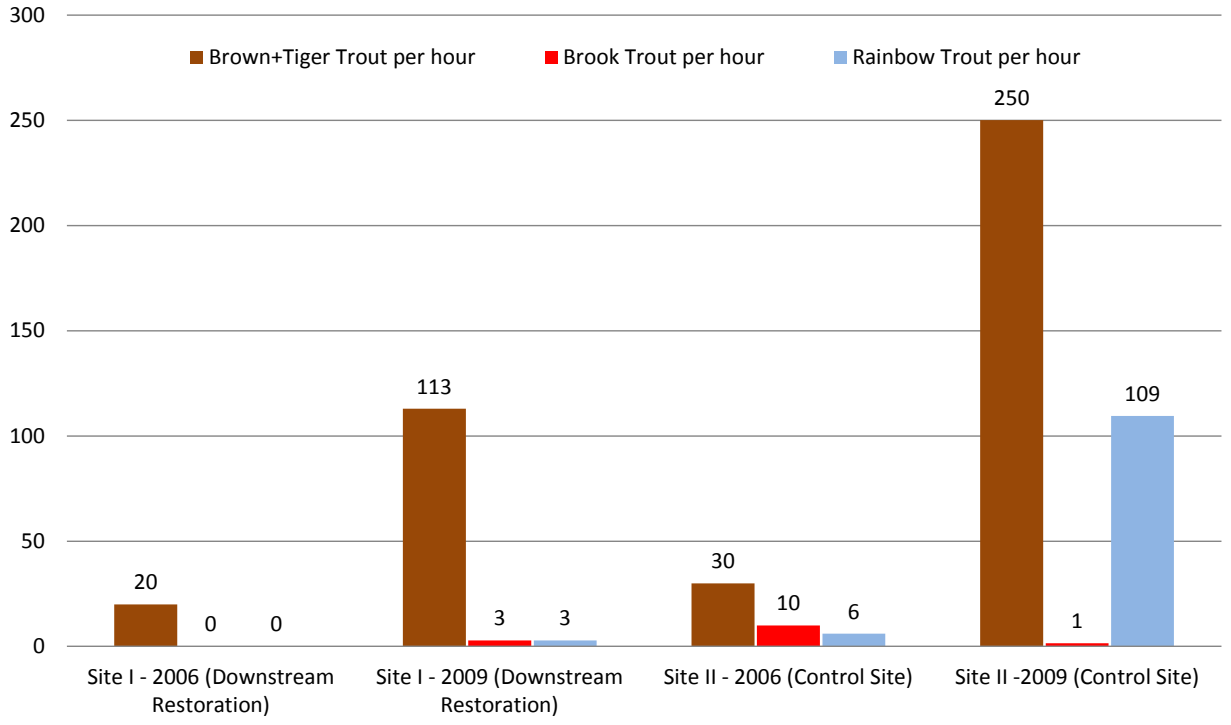
The following data were collected by the MDNR during a 1999 fish survey of the North Fork, South Fork, and Main Stem of Valley Creek.

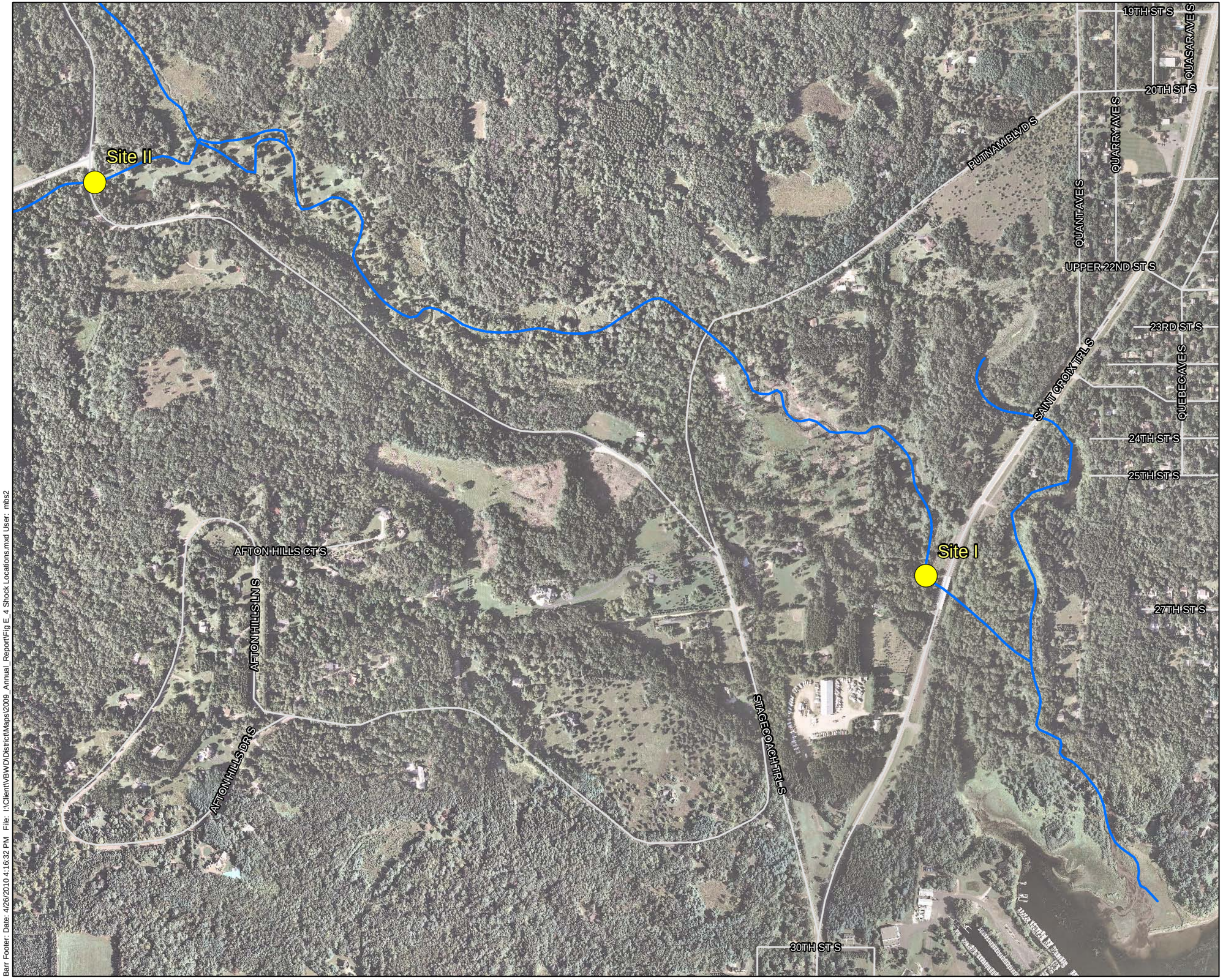
Site & Survey Date	Fish Species	Photograph (Not to Scale)	Number	Size Range (mm)	Size Range (inches)
North Fork June 24, 1999	Bluegill		1	137	5.4
	Brook Stickleback		1	47	1.9
	Brook Trout		19	32-208	1.3-8.2
	Brown Trout		8	65-321	2.6-12.6
South Fork June 24, 1999	American Brook Lamprey		1	158	6.2
	Brook Trout	See Above	21	39-193	1.5-7.6
	Brown Trout	See Above	132	33-304	1.3-12.0
	Rainbow Trout		11	57-233	2.2-9.2
	Slimy Sculpin		56	51-104	2.0-4.1
Main Stem June 22, 1999	American Brook Lamprey	See Above	1	174	6.9
	Brook Stickleback	See Above	1	40	1.6
	Brown Trout	See Above	97	50-282	2 – 11.1
	Tiger Trout		1	162	6.4

2009 VBWD Fish Survey

In 2009, the VBWD performed fish surveys at two locations on Valley Creek. Site I is located within the reach restored by the VBWD in 2008. Site II is located upstream of the restoration area and serves as a control location. Both sites were surveyed by the MDNR in 2006. Figure E-5 compares the results of the 2006 and 2009 surveys by location. Figure E-4 shows the sampling locations.

Figure E-5
Trout Collected per Hour of Sampling
Valley Creek 2006 and 2009





Sampling Location

Stream

Imagery Source: Aerials Express, 2009

N

Feet

600 0 600

Figure E-4

SHOCK LOCATIONS
Valley Branch Creek
Valley Branch Watershed District

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