

Conservation Biology Research Grant Program
Division of Ecological Services
© Minnesota Department of Natural Resources

COMPLETION OF THE ALGIFIC SLOPE/MADERATE CLIFF LANDSNAIL SURVEY IN MINNESOTA



Vertigo hubrichtii
Source: T. J. Frest

Wayne R. Ostlie
The Nature Conservancy
Midwest Regional Office
1313 Fifth Street SE
Minneapolis, MN 55414

BACKGROUND

Algific (cold-producing) talus slopes and maderate (cold-water) cliffs are the two most important natural communities in central North America in terms of biological diversity. Among the inhabitants of these communities are many glacial relict plant and landsnail species, left-overs from the Wisconsinan glaciation (14,000 YBP). Some of the snail species (eg., Vertigo hubrichtii and Discus macclintockii) were believed to be extinct prior to the discovery of live counterparts on these communities. Also located in these isolated cold-air pockets are several additional elements that are candidates for federal listing (figure 1), all requiring the equably cool summer/winter temperatures that were widespread during the Pleistocene. Algific slopes and maderate cliffs which mimic the equably cool summer/winter temperatures of the Wisconsinan glaciation, provide the only remaining suitable habitat for these rare species.

Structure

Algific talus slopes and maderate cliffs both form through stream undercutting and erosion of north-facing hillsides in unglaciated regions with karst topography. Over-steepening through stream erosion causes massive blocks of dolomite to shift forward along horizontal planes, creating upland sinkholes. As a result, internal air-flow networks form within a miniature cave system, thus creating an algific slope (figure 2). During a period of thousands of years, the stream may form a cliff face through continued erosion of bedrock and accumulating talus. In such situations, the small cracks that feed cold air are exposed on the surface of the cliff face (figure 3). A maderate cliff has been formed.

During winter months, air within the cave system is warmer than outside air. Consequently, it rises and exits through the upland sinkholes, drawing cold air in through the talus layer or cliff face. The cold air being drawn into the system freezes existing groundwater within the bedrock. As winter progresses, the slopes/cliffs gradually freeze solid with ice. In spring and summer, the air flow is reversed. Air within the cave system, now colder and heavier than the outside air, begins to exit through the talus layer or cliff face. This cold-air flow continues into the fall when air flow patterns again reverse. Temperatures on the coldest algific slopes frequently remain as low as 40° F during the entire summer. Readings of 33° F have been taken from some slopes in mid-June (Ostlie pers. obs.).

In weakly algific sites, cold intensity wanes during the summer as available cave ice diminishes. This is the typical situation in Prairie du Chien slopes. Unable to withstand the conversion to non-equable climates, relict taxa are conspicuously absent from such sites.

Although algific slopes and moderate cliffs are structurally similar in many ways, they are also quite distinct in terms of their rare flora and fauna (figure 1). Unlike moderate cliffs, cold air exits from algific slopes through a thick talus zone before escaping to the outside. In moderate cliffs, the talus layer and a substantial amount of hillside has been removed through stream erosion creating an internal geological structure (when compared to that of an algific slope) that is much reduced in size. As a result, ice accumulation in the system during winter is relatively small, and exiting air during summer months is diminished in volume and cold intensity. These subtle differences in physical structure and temperature equability allow for a different suite of glacial relict species that would not be found on algific slopes.

Range

Algific slopes are found only within the unglaciated Paleozoic Plateau of southeastern Minnesota, adjacent northeastern Iowa, southwestern Wisconsin and northwestern Illinois. Moderate cliffs are most commonly found in the Dunleith/Wise Lake dolomite/limestone formation. These cliffs occur frequently in a band extending from the vicinity of Decorah, Iowa, to an area just south of Rochester, Minnesota. Recently, additional moderate cliffs have been found in the Prairie du Chien limestone/dolomite formation north and east of Rochester. Together, roughly 300-400 algific talus slopes and moderate cliffs have been identified. These communities have not been identified in any other region of the world.

Previous Research

During the early to mid-1980's, Terry Frest, then with the University of Iowa, conducted surveys for algific (cold-producing) talus slopes and moderate (cold-water) cliffs within the Paleozoic Plateau region of southeastern Minnesota and adjoining Wisconsin, Iowa and Illinois. Within Minnesota, areas of investigation were centered primarily within the Dunleith-Wise Lake dolomite formation of Fillmore and Olmsted Counties (see Frest 1983a, Frest 1983b, Frest 1986 and Frest 1987).

Frest's work provided a windfall of information concerning the occurrences of some of Minnesota's rarest plant and invertebrate species. Located during his surveys were populations of Chrysosplenium iowense (G2S1), Sedum integrifolium ssp. leedyi (G5T1S1), Draba arabisans (G5S3), Adoxa moschatellina (G5S3), Vertigo hubrichtii (G1?), Novisuccinea sp. morph 1 and morph 2 (G?), Vertigo occulta (G1G2), Vertigo n. sp. (G?), Discus catskillensis (G3G5) and Zonitoides limatulus (G?).

During Frest's surveys, minor excursions were made into the adjoining Prairie du Chien formation, but these proved largely fruitless. Typically, the Prairie du Chien limestone formation is highly fractured with small crevices. As a consequence, winter ice formation is reduced and cold air flow during the summer is reduced in intensity and duration. Only in scattered instances do the right circumstances combine to form a high quality slope suitable to sustain Pleistocene relict species. Since the formation did not predictably yield good algific slopes and time expenditure with respect to potential yield was great, a decision was made to neglect the Prairie du Chien and concentrate on the higher-quality Dunleith-Wise Lake (Frest pers. comm.).

In 1989, with funding obtained through a Katherine Ordway Stewardship Endowment (KOSE) grant obtained from The Nature Conservancy, a preliminary search was made by Wayne Ostlie in the Prairie du Chien formation of southeastern Minnesota (Houston, Winona and portions of Fillmore, Olmsted and Wabasha Counties) in order to determine the need for additional survey work. This partial survey (Ostlie 1989a, Ostlie 1989b) substantiated the need for additional work within this formation. During the partial survey, a number of occurrences of rare landsnails [Vertigo hubrichtii, V. meramecensis (G2), Zonitoides limatulus] and plants (Chrysosplenium iowense, Sedum integrifolium ssp. leedyi and Adoxa moschatellina) were discovered. One of the landsnail species (Vertigo meramecensis) was a new record for the state, while another (Zonitoides limatulus) had been previously known in the state from two sites, an algific slope in Beaver Creek Valley State Park and a non-algific Prairie du Chien slope above Crooked Creek (Frest 1983b). Both sites are in Houston County.

PURPOSE/OBJECTIVES

Algific slopes and maderate cliffs possess an inordinately high number of federally listed and candidate plant and landsnail species with respect to other Midwest natural communities. This fact, coupled with the success obtained in a preliminary

inventory for algific slopes/maderate cliffs in 1989 (Ostlie 1989a, Ostlie 1989b), deemed it appropriate to conduct additional survey work in the Prairie du Chien in 1990.

Most of the rare elements found on algific slopes/maderate cliffs (figure 1) occur in no other known habitat. Due to this highly restrictive habitat, completion of the algific slope/maderate cliff survey in Minnesota would provide a definitive estimate of the status and distribution of each element within the state.

Further inventory work within the Prairie du Chien of Minnesota might suggest a need to complete a preliminary search for additional sites in Wisconsin. As a state, Wisconsin possesses more land within the Paleozoic Plateau than any other. In addition, most (if not all) of the land is occupied by the Prairie du Chien formation. As of 1990, no substantial survey effort has been undertaken within the formation in Wisconsin.

Generally, it is believed that many of the species restricted to algific slopes/maderate cliffs possess little or no genetic variability due to the fact that they occur in isolated populations where outcrossing is unlikely. This is particularly true for landsnails, but has also been shown for cliff-dwelling plant species occurring in isolated populations, like Sullivantia renifolia (Soltis 1980). If genetic variability does exist, however, it is important for the long-term survival of each species that all genetic variants be preserved. Identification of peripheral occurrences is an important initial aspect in their protection.

The objectives of this inventory of unsurveyed algific slopes/maderate cliffs within the Prairie du Chien limestone formation were as follows:

- 1) To complete the survey for algific slopes/maderate cliffs in Minnesota.
- 2) To complete the survey of algific slopes/maderate cliffs in Minnesota for rare plant and landsnail species.
- 3) To acquire detailed information pertinent to the rangewide status and distribution of rare algific slope/maderate cliff species.
- 4) To identify high-quality sites (areas possessing one or more significant plant or animal species, or geological structure) for protection through registry or purchase.

PROCEDURES

Potential sites thought to possess algific slopes/moderate cliffs within the Prairie du Chien formation of southeast Minnesota were initially identified on 7.5' topographical maps using established criteria. Preliminary identification of algific slope/moderate cliff sites was based on one single factor, an over-steepened north-oriented hillside or cliff occurring largely within the 940-960' elevational contours.

Although this method proved convincingly accurate (< 90%) for determining algific slopes in the field, it could not be used as a predictor of slope quality. In order to assess the quality of each potential site, field reconnaissance had to be initiated. In the spring and fall of 1990, excursions into the dissected terrain of the region were made for this purpose. At each potential site, a survey for rare plants and mollusks was made.

Botanical surveys were conducted by walking along the base of moderate cliffs and scanning the face with binoculars, or walking through the algific slope in search of rare plant species. When encountered, and if population size could withstand collecting, single voucher specimens of rare plants were obtained, pressed and deposited within the University of Minnesota Herbarium in St. Paul under the supervision of Dr. Anita Cholewa. Information relating to the habitat, occurrence size and quality was also gathered.

In order to determine if rare landsnail species were present at any of the sites, samples of leaf litter and soil were collected throughout the features. These samples were later sifted and landsnails were removed. Specimens within the genus Vertigo (as well as the family Succineidae) were sent to Dr. Terry Frest of Seattle, Washington, for identification (appendix 1). All collected specimens were deposited within the Bell Museum of Natural History malacology collection under the supervision of Dr. Robert Bright.

Physical structure of each slope played an important role in determining where landsnail collections were made. Within the Prairie du Chien formation, the structure of algific slopes typically follow a distinct physical pattern. At the base, a short (2-3 m) cliff occurs immediately above eroding stream channels. This cliff gives way to a more gradual slope where plants grow and litter duff accumulates. Above this slope, frequently towering more than 10 m in height, is a second cliff face. Landsnail sampling was conducted in all three areas at all sites. Several litter and soil collections were made from the short cliff face at the base, from scattered localities around the gradually sloping mid-section, as well as the face and base

of the upper cliff. On moderate cliffs, litter and soil samples were gathered from the top of the cliffs, cliff faces, talus fans below cliff faces (if present), and peripheral areas to the sides of the cliffs.

On any given slope or cliff complex, roughly 10-20 hand-sized grab samples of litter and/or soil (depending on the size of the feature) were made throughout available habitat. Dead landsnails tend to be concentrated along bases of cliffs and cliff faces, as such areas accumulate large numbers of dead shells throughout the year. As snails living on or above the cliff faces die, they fall or are washed downward by rains. Consequently, such areas are targeted for concentrated collecting.

Representative areas on algific slopes, particularly areas near cold-air vents, were also selected for concentrated collecting. Some of the rarest species of Vertigo snails tend to be concentrated in close proximity to these cold air vents. Also, areas below deciduous trees and shrubs (Betula papyrifera, B. lutea, Tilia americana, Cornus spp., etc.) were sampled more frequently than areas beneath conifers (Taxus canadensis and Pinus strobus). Whereas decaying deciduous litter and herbaceous plants and fungi (another landsnail food source) provide a primary food source for landsnails, tannins released by decaying conifer needle duff repel landsnails. The lack of available food supplies in conifer-dominated habitats also deter landsnails from thriving in such areas.

Since dead shells are typically destroyed in two or three years by humic acids formed by decaying organic matter, non-living shells collected from slopes in this manner can be assumed to be of recent age. Elapsed time since death can also be determined from shell color. Recently deceased snails still possess much of their living color while older dead snails appear bleached. Some caution needs to be taken regarding the collection of snails from cliff faces, however. Due to the lack of humic acid in such habitats, snails may remain intact for many (perhaps thousands) of years. In such situations, color is an important factor in determining if shells are recent.

Special animal and plant survey forms were completed for each occurrence of rare element encountered during the survey (appendix 6). In many instances, rare plant populations were encountered on walks to the potential algific slope sites. Forms for these populations were also completed.

Preserve designs for each of the high quality sites found during this survey were completed (appendix 3). Rankings of all Prairie du Chien sites possessing verified occurrences of rare taxa were completed with respect to overall community and species occurrence quality (figure 4).

Funding for this 1990 algific slope/moderate cliff landsnail survey in Southeastern Minnesota was obtained through a grant from the Nongame Wildlife Program, Minnesota Department of Natural Resources.

RESULTS

Twenty-seven potential sites were field-checked for algific slope/moderate cliff communities, rare plant and landsnail species. Of these, 21 sites were at least marginally algific and potentially provided habitat for rare landsnails and/or plants. See appendix 2 for a list of these sites and element associates.

A number of rare plant occurrences were located this past season, including those of the state-ranked Adoxa moschatellina, Jeffersonia diphylla, Dodecatheon amethystinum, Dicentra canadensis and Hydrastis canadensis. Of these species, only A. moschatellina and Dicentra canadensis were characteristically found on algific slopes. Occurrences of the others, although occasionally found in close proximity to algific slopes, were typically found while hiking to potential sites. For site-specific information pertaining to each, see appendix 6.

Thirteen actual or potential occurrences of federal candidate snail species were discovered during this field season, as identified by Terry Frest. This include occurrences of Vertigo meramecensis, Vertigo hubrichtii n. ssp. and Vertigo bollesiana. In addition, a potential site for one of the Novisuccinea morphs was discovered on the Hemingway Creek 3 moderate cliff. The fragmentary condition of the single collected specimen made specific identification impossible (Frest pers. comm.: appendix 1). For a complete list of landsnails documented from each survey site, see appendix 4.

Vertigo meramecensis is a species relatively new to science, having been described from the northern Ozark Plateau of east-central Missouri in 1979 (Van Devender 1979). The species was first documented in Minnesota from two sites during preliminary Prairie du Chien algific slope/moderate cliff survey work in 1989 (Ostlie 1989c). Four additional populations were discovered this year (1990), bringing to six the number of known populations in the state. New sites include South Branch Whitewater River 1, South Branch Whitewater Tributary and Holt Spring, as well as the potential occurrence at North Branch Whitewater River 5.

The Pleistocene relict, Vertigo hubrichtii, is endemic to the algific slopes/moderate cliffs of the Driftless Area. Roughly 40 occurrences were known prior to survey work initiated in 1989.

One occurrence of this species was discovered during field work in 1989, while an additional five were discovered in 1990: South Branch Whitewater 1, South Branch Whitewater River 2, Hemingway Creek 2, Beaver Creek Valley State Park 1 and Holt Spring. All populations discovered in the Prairie du Chien fall into a subspecies which has tentatively been assigned V. hubrichtii ssp. iowensis (Frest pers. comm.: appendix 1).

Vertigo bollesiana, a species previously unknown from Minnesota, was discovered at three sites. Surveys in 1989 suggested that the species may occur at Logan Branch 1, but the immature or fragmentary specimen(s) from the site made precise identification impossible. In 1990, Vertigo bollesiana was found at the South Branch Whitewater River 1, South Branch Whitewater Tributary and Beaver Creek Valley State Park 1 sites. The potential occurrence at Logan Branch 1 still remains to be verified.

In addition to the federal candidate landsnail species listed above, another occurrence of Zonitoides limatulus was discovered this year. Currently, four populations of this species are known to be extant in the state. Several individuals were found in the samples at Logan Branch 3, a tributary to the North Branch Whitewater River. Zonitoides limatulus has a widespread distribution extending from Maine to Minnesota, south to Missouri and Kentucky. It is apparently uncommon throughout its range. Since the species is not restricted to algific slopes, but also prefers moist sandstone outcrops, there is some certainty that additional occurrences will be found in Minnesota. Due to the low number of known occurrences of Z. limatulus in the state, there may be some cause to consider its listing at the state threatened or special concern level.

Additional Work

Although dubbed as the work that would complete the survey for algific slopes in Minnesota, this turned out not to be entirely the case. It can be said, however, that over 90% of all the potential sites have been visited and surveyed for rare elements. Still, a small number of sites remain unsurveyed. Additional sites may likely turn up in the future, having slipped through the preliminary search image developed for this work. These sites, although comprising a small minority of the total potential algific slope/moderate cliff number, should nevertheless be surveyed.

Landsnail collection efforts at some sites should also be considered incomplete. There is a strong need to verify occurrences of snails that were represented by in collections by single specimens. In such instances, it is not always possible to definitively determine if specimens are subfossil or recent in

origin (Frest pers. comm.: appendix 1). In addition, the potential Novisuccinea site needs to be revisited for verification purposes. Other sites that were identified in 1989 (but not sampled for snails) should also be revisited. These sites are identified in appendix 5.

Due to the success in identifying "new" rare plant and landsnail occurrences (16 G1-G3 landsnail and 2 G1-G2 plant occurrences) in the past two years, it is recommended that additional survey work be undertaken in adjoining Wisconsin. It remains to be seen, however, if habitat quality is sufficiently high within the Wisconsin portion of the Prairie du Chien to warrant extensive efforts. A preliminary effort focusing on sites with high potential should be initiated to determine the need for extensive efforts along this line.

LITERATURE CITED

Frest, T. J. 1990. Personal communication: Algific slope landsnail species lists. Letter to Wayne Ostlie, MRO, The Nature Conservancy. 2 pp.

_____. 1989. Personal communication: algific slope landsnail species lists. Letter to Wayne Ostlie, MNFO, The Nature Conservancy. 2 pp.

_____. 1987. Iowa Pleistocene snail project. Unpublished report to the USFWS, Twin Cities, MN. 39 pp

_____. 1986. Minnesota "Succinea chittenangoensis" survey. Unpublished report to the USFWS, Twin Cities, MN. 25 pp.

_____. 1983a. Iowa Pleistocene snail project. Unpublished report to the USFWS, Twin Cities, MN. 25 pp.

_____. 1983b. Northern Driftless Area survey. Unpublished report to the USFWS, Twin Cities, MN 17 pp.

Frest, T. J. and L. P. Fay. 1981. Vertigo meramecensis (Pulmonata: Pupillidae) from the Niagaran escarpment, Iowa. *Nautilus* 95(1): 33-37.

Ostlie, W. R. 1989a. Preliminary algific talus slope survey: Houston and Winona Counties, Minnesota. Unpublished report to The Nature Conservancy, Minnesota Field Office, Minneapolis. 7 pp.

_____. 1989b. 1989 Minnesota algific slope survey. Unpublished report to The Nature Conservancy, Minnesota Field Office, Minneapolis. 7 pp.

_____. 1989c. Algific slope landsnail lists. Unpublished report to The Nature Conservancy, Minnesota Field Office, Minneapolis. 4 pp.

Soltis, D. E. 1980. A biosystematic study of Sullivantia and related studies in the Saxifragaceae. Phd. dissertation, Indiana University, Bloomington. 235 pp.

Van Devender, A. S. 1979. A new Vertigo (Pulmonata: Pupillidae) from the Ozarkian Uplift. Nautilus 93: 70-73.

FIGURE 1: G1-G3 ELEMENTS OF ALGIFIC SLOPES AND MADERATE CLIFFS

ALGIFIC SLOPES

MADERATE CLIFFS

PLANTS

Chrysosplenium iowense
Aconitum novae-boracense

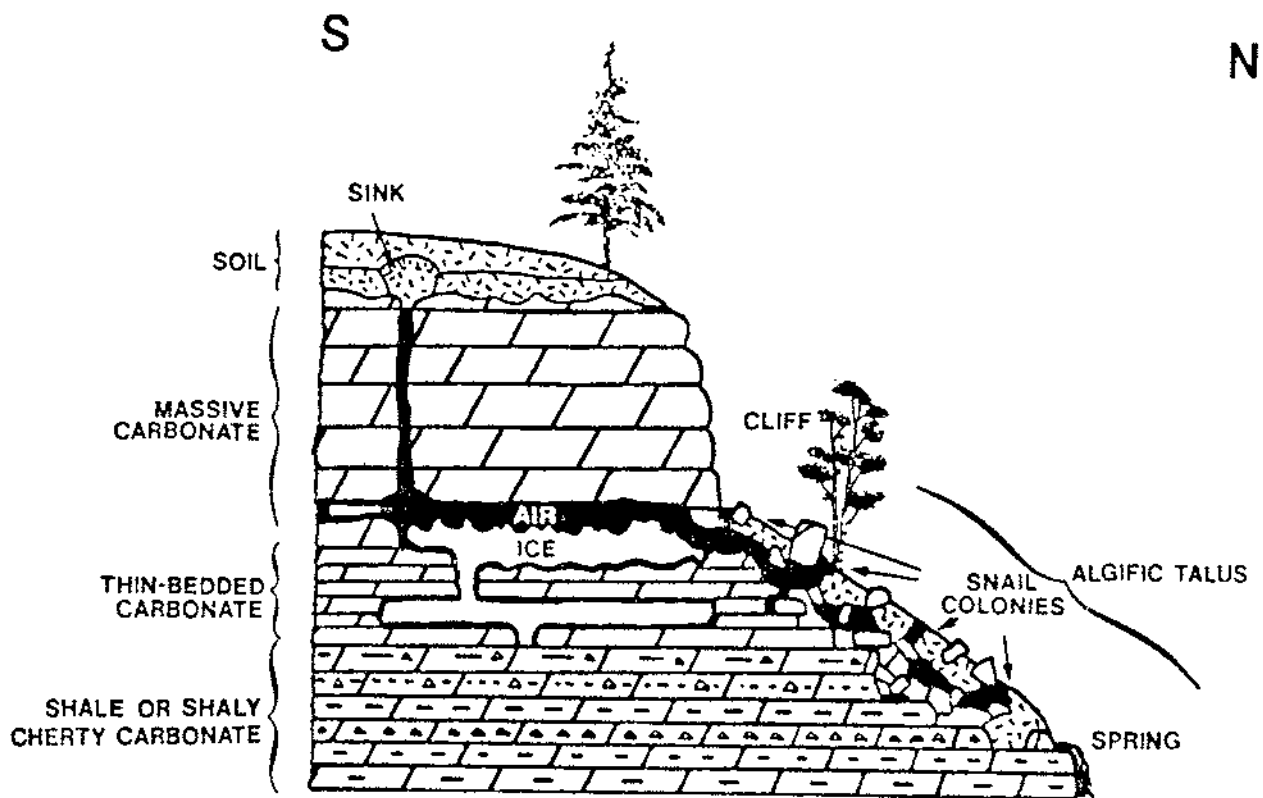
Sedum integrifolium ssp.
leedyi

LANDSNAILS

Vertigo bollesiana
V. meramecensis
V. occulta
V. cristata ssp. brierensis
V. hubrichtii n. ssp. 1
V. hubrichtii n. ssp. 2
Vertigo n. sp.
Discus macclintockii

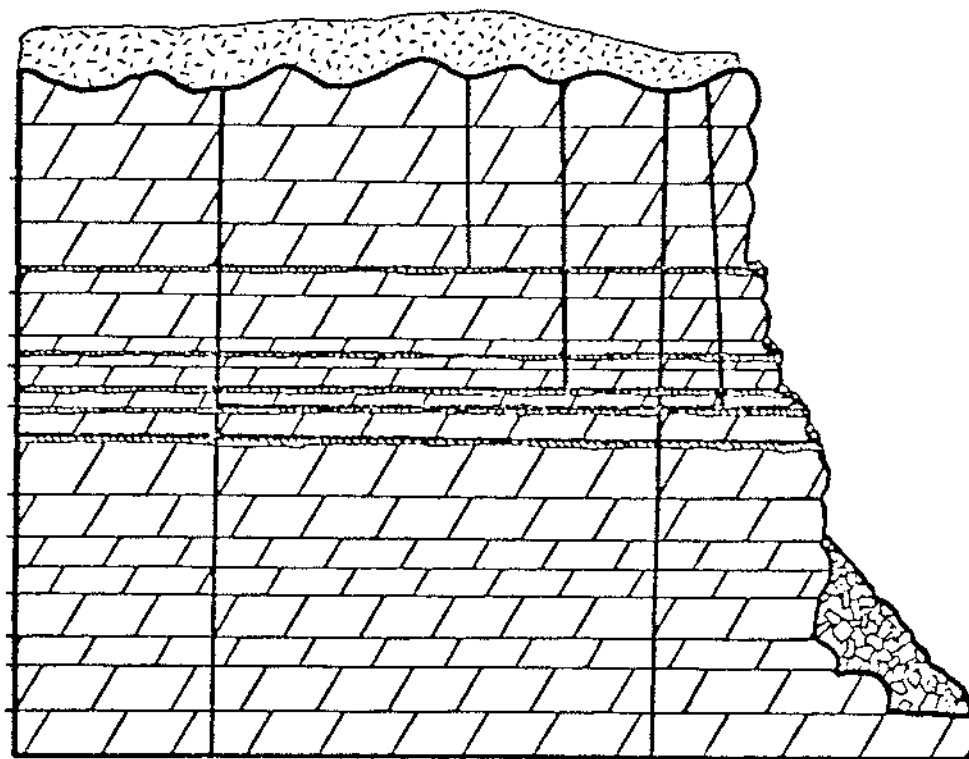
Catinella gelida
Novisuccinea sp. morph 1
Novisuccinea sp. morph 2
Vertigo meramecensis
V. bollesiana
V. hubrichtii n. ssp. 1
V. hubrichtii n. ssp. 2

FIGURE 2: ALGIFIC SLOPE CROSS-SECTION



Source: Terrence J. Frest

FIGURE 3: MADERATE CLIFF CROSS SECTION



Source: Terrence J. Frest

FIGURE 4: OCCURRENCE RANKS

Occurrence ranks are based on the structural quality of each site, the number of elements associated with each, and the population size of each element occurrence. Only sites possessing plant and/or landsnail elements were ranked. Sites which are thought to possess a single element occurrence, but where there exists some uncertainty over identification or existence (eg., North Branch Whitewater River 5, Hemingway Creek 2 and Hemingway Creek 3) have not been ranked, pending clarification of element status.

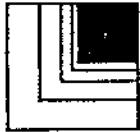
ALGIFIC SLOPES

<u>RANK</u>	<u>SITE/SPECIES</u>	<u>QUALITY</u>		
		FLORAL	FAUNAL	COMMUNITY
1)	Beaver Creek Valley State Park 1 <u>Chrysosplenium iowense</u> <u>Adoxa moschatellina</u> <u>Vertigo hubrichtii</u> <u>V. bollesiana</u>	HIGH	MEDIUM	MEDIUM
2)	Beaver Creek 1 - Whitewater WMA <u>Adoxa moschatellina</u> <u>Dicentra canadensis</u>	MEDIUM	LOW	HIGH
3)	South Branch Whitewater River 2 <u>Adoxa moschatellina</u> <u>Dicentra canadensis</u> <u>V. hubrichtii</u>	MEDIUM	LOW	MEDIUM
4)	North Branch Whitewater River 1 <u>Zonitoides limatulus</u>	LOW	LOW	HIGH

MADERATE CLIFFS

<u>RANK</u>	<u>SITE</u>	<u>QUALITY</u> FLORA	FAUNA	COMMUNITY
1)	South Branch Whitewater River 1 <u>V. hubrichtii</u> <u>V. meramecensis</u> <u>V. bollesiana</u>	LOW	HIGH	HIGH
2)	North Branch Whitewater River 3 <u>Sedum integrifolium</u> ssp. <u>leedyi</u>	HIGH	LOW	HIGH
3)	Logan Branch 1 <u>V. hubrichtii</u> <u>V. meramecensis</u> <u>V. bollesiana?</u>	LOW	HIGH	MEDIUM
4)	Holt Spring <u>V. hubrichtii</u> <u>V. meramecensis</u>	LOW	MEDIUM	HIGH
5)	South Branch Whitewater River Tributary <u>V. meramecensis</u> <u>V. bollesiana</u>	LOW	MEDIUM	MEDIUM
6)	Logan Branch 2 <u>V. meramecensis</u>	LOW	LOW	MEDIUM

**APPENDIX 1: COMMUNICATION REGARDING LANDSNAIL
IDENTIFICATIONS MADE BY TERRENCE J. FREST**



Deixis

environmental consultants

December 4, 1990

Wayne Ostlie
The Nature Conservancy
Iowa Field Office
431 East Locust Street, Suite 200
Des Moines, IA 50309

Dear Wayne;

The identifications of the Minnesota Prairie du Chien group algific slope land snails you sent are as follows:

LOCALITY	SPECIES	NO. SPEC.
South branch Whitewater R. 1	<u>Vertigo gouldi gouldi</u>	24
	<u>Vertigo meramecensis</u>	3
	<u>Vertigo bollesiana</u>	1
	<u>Vertigo hubrichti</u> n. subsp.	30
	<u>Vertigo</u> sp. (unidentifiable)	5
South branch Whitewater R. 2 (sample 1)	<u>Vertigo gouldi gouldi</u>	4
	<u>Vertigo hubrichti</u> n. subsp.	6
	<u>Vertigo</u> sp. (unidentifiable)	3
	<u>Carychium exiguum</u>	1
	<u>Columella simplex</u>	1
South branch Whitewater tributary	<u>Vertigo gouldi gouldi</u>	15
	<u>Vertigo meramecensis</u>	8
	<u>Vertigo bollesiana</u> = <u>Vertigo</u> sp. (unidentifiable)	1
North branch Whitewater R. 3	<u>Vertigo gouldi gouldi</u>	11
	<u>Gastrocopta pentodon</u>	1
North branch Whitewater R. 5	<u>Vertigo gouldi gouldi</u>	27
	<u>Vertigo meramecensis?</u>	1
Hemingway Creek 2	<u>Vertigo gouldi gouldi</u>	11
	<u>Vertigo hubrichti</u> n. subsp.	1
	<u>Vertigo</u> sp. (unidentifiable)	1
Hemingway Creek 3	<u>Novisuccinea</u> sp. (unidentifiable)	frags.
Beaver Creek Valley State Park 1 (sample 1)	<u>Vertigo gouldi gouldi</u>	37
	<u>Vertigo bollesiana</u>	6
	<u>Gastrocopta holzingeri</u>	1
	<u>Columella simplex</u>	2

LOCALITY	SPECIES	NO. SPEC.
Beaver Creek Valley State Park 1 (sample 2)	<u>Vertigo gouldi gouldi</u>	1
	<u>Vertigo hubrichti</u> n. subsp.	5
	<u>Columella simplex</u>	2
Holt Spring	<u>Vertigo gouldi gouldi</u>	18
	<u>Vertigo meramecensis</u>	9
	<u>Vertigo hubrichti</u> n. subsp.	5
	<u>Physella (P.) gyrina?</u>	3
Logan Branch 3	<u>Vertigo gouldi gouldi</u>	18
	<u>Columella simplex</u>	1
Root River 2	<u>Vertigo</u> sp. (unidentifiable)	1
	<u>Columella simplex</u>	3
Root River 3	<u>Vertigo gouldi gouldi</u>	2
Bee Creek	<u>Vertigo gouldi gouldi</u>	67
	<u>Columella simplex</u>	4

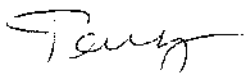
=====

A few comments may be helpful. The V. hubrichti are the common form, not the nominate subspecies. I'm considering naming them V. h. iowensis. The succineid looks like a Novisuccinea of some kind (hence could be either of the two new forms; or a described species); but I just can't pin it down from the fragments. The V. meramecensis are typical; there are very few sites in Minnesota, as you likely know. The aquatics are Physella; they are immature, but appear to be in the gyrina complex. The site with the single meramecensis specimen is a problem, as I can't be completely sure it isn't a subfossil; but this is unlikely. There is a similar problem with the site with a single hubrichti. In the case of the unidentified Vertigo, this usually means that the aperture is missing or incomplete, or that the specimen is so young that a species can't be assigned.

The specimens will be returned separately; but if possible I'd like to borrow the hubrichti; I am in the process of finishing up the listing materials for the rest of the algific site snails for Ron Refsnider, and would like to recheck all of the Minnesota material carefully.

Happy holidays in beautiful Des Moines, IA!

Best wishes,



Terrence J. Frest

APPENDIX 2: SURVEY SITES

Listed below are sites that have been (A) field-checked and were surveyed for landsnails in 1990, or were (B) field-checked but were not of sufficient quality to sample for landsnails. Elements are listed below the legal description of each site. Communities were also listed if quality was sufficiently high to warrant listing.

A. Surveyed Sites:

- 1) Beaver Creek Valley State Park 1: NW4, NW4, Sec. 17, T102N, R6W, Caledonia Township, Houston County, MN. Revisit from 1989.

Vertigo bollesiana
Vertigo hubrichtii n. ssp.

- 2) Beaver Creek 1 - Whitewater WMA: SW4, NW4, Sec. 24, T108N, R11W, Plainview Township, Wabasha County, MN.

- 3) Beaver Creek 2 - Whitewater WMA: SE4, NW4, Sec. 24, T108N, R11W, Plainview Township, Wabasha County, MN.

Adoxa moschatellina
Algific Talus Slope

- 4) Choice: S2, NE4, Sec. 9, T102N, R8W, Preble Township, Fillmore County, MN.

- 5) Crystal Creek: SE4, SE4, Sec. 24, T103N, R6W, Sheldon Township, Houston County, MN.

Dodecatheon amethystinum

- 6) Hemingway Creek 1: SW4, SE4, Sec. 28, T105N, R9W, Fremont Township, Winona County, MN.

- 7) Hemingway Creek 2: NE4, NE4, Sec. 33, T105N, R9W, Fremont Township, Winona County, MN.

Vertigo hubrichtii n. ssp.
Algific Talus Slope

8) Hemingway Creek 3: NE4, NE4, Sec. 33 and NW4, NW4, Sec. 34, T105N, R9W, Fremont Township, Winona County, MN.

Novisuccinea sp. (?)
Moist Cliff, Driftless Section

9) Holt Spring: SE4, SW4, Sec. 1, T106N, R10W, St. Charles Township, Winona County, MN.

Vertigo meramecensis
Vertigo hubrichtii n. ssp.
Moist Cliff, Driftless Section

10) Logan Branch 3: SE4, SE4, Sec. 4, T107N, R11W, Quincy Township, Olmsted County, MN.

Zonitoides limatulus
Algific Talus Slope

11) Moen Bridge: N2, N2, Sec. 33, T104N, R10W, Pilot Mound Township, Fillmore County, MN.

12) North Branch Whitewater 3: NW4, Sec. 3, T107N, R11W, Quincy Township, Olmsted County, MN. Revisit from 1989.

13) North Branch Whitewater River 5: SE4, Sec. 33, T108N, R11W, Plainview Township, Wabasha County, MN.

Vertigo meramecensis (?)
Moist Cliff, Driftless Section

14) Pine Creek: NW4, NE4, Sec. 2, T105N, R9W, Arendahl Township, Fillmore County, MN.

Algific Talus Slope

15) Root River 1: SW4, Sec. 14, T104N, R11W, Chatfield Township, Fillmore County, MN.

16) Root River 2: SW4, SE4, Sec. 13, T104, R11W, Chatfield Township, Fillmore County, MN.

17) Root River 3: N2, SW4, Sec. 19, T104N, R10W, Pilot Mound Township, Fillmore County, MN.

18) South Branch Whitewater 1: SW4, SW4, Sec. 1, T106N, R10W, St. Charles Township, Winona County, MN.

Vertigo hubrichtii n. ssp.
Vertigo meramecensis
Vertigo bollesiana
Moist Cliff, Driftless Section

19) South Branch Whitewater 2: SE4, SW4, Sec. 36, T107N, R10W, Elba Township, Winona County, MN.

Vertigo hubrichtii n. ssp.

Adoxa moschatellina

Algific Talus Slope

20) South Branch Whitewater River 3: NW4, SW4, Sec. 36, T107N, R10W, Elba Township, Winona County, MN.

21) South Branch Whitewater Tributary: SW4, SW4, Sec. 6, T106N, R9W, Utica Township, Winona County, MN.

Vertigo meramecensis

Vertigo bollesiana

Moist Cliff, Driftless Section

B. Non-algific Sites:

1) Duschee Creek: N2, SW4, Sec. 25, T103N, R10W, Carrolton Township, Fillmore County, MN.

2) Mazeppa: N2, NW4, Sec. 7, T109N, R14W, Mazeppa Township, Wabasha County, MN.

3) Middle Creek: N2, S2, NW4, Sec. 19, T109N, R11W, Highland Township, Wabasha County, MN.

4) Riceford Creek 4: NW4, Sec. 29, T102N, R7W, Black Hammer Township, Houston County, MN.

5) Wisel Creek 1: S2, SE4, Sec. 29, T102N, R8W, Preble Township, Fillmore County, MN.

6) Wisel Creek 2: N2, NE4, Sec. 30, T102N, R8W, Preble Township, Fillmore County, MN.

APPENDIX 2: SURVEY SITES

Listed below are sites that have been (A) field-checked and were surveyed for landsnails in 1990, or were (B) field-checked but were not of sufficient quality to sample for landsnails. Elements are listed below the legal description of each site. Communities were also listed if quality was sufficiently high to warrant listing.

A. Surveyed Sites:

- 1) Beaver Creek Valley State Park 1: NW4, NW4, Sec. 17, T102N, R6W, Caledonia Township, Houston County, MN. Revisit from 1989.

Vertigo bollesiana
Vertigo hubrichtii n. ssp.

- 2) Beaver Creek 1 - Whitewater WMA: SW4, NW4, Sec. 24, T108N, R11W, Plainview Township, Wabasha County, MN.

- 3) Beaver Creek 2 - Whitewater WMA: SE4, NW4, Sec. 24, T108N, R11W, Plainview Township, Wabasha County, MN.

Adoxa moschatellina
Algific Talus Slope

- 4) Choice: S2, NE4, Sec. 9, T102N, R8W, Preble Township, Fillmore County, MN.

- 5) Crystal Creek: SE4, SE4, Sec. 24, T103N, R6W, Sheldon Township, Houston County, MN.

Dodecatheon amethystinum

- 6) Hemingway Creek 1: SW4, SE4, Sec. 28, T105N, R9W, Fremont Township, Winona County, MN.

- 7) Hemingway Creek 2: NE4, NE4, Sec. 33, T105N, R9W, Fremont Township, Winona County, MN.

Vertigo hubrichtii n. ssp.
Algific Talus Slope

8) Hemingway Creek 3: NE4, NE4, Sec. 33 and NW4, NW4, Sec. 34, T105N, R9W, Fremont Township, Winona County, MN.

Novisuccinea sp. (?) -
Moist Cliff, Driftless Section

9) Holt Spring: SE4, SW4, Sec. 1, T106N, R10W, St. Charles Township, Winona County, MN.

Vertigo meramecensis
Vertigo hubrichtii n. ssp.
Moist Cliff, Driftless Section

10) Logan Branch 3: SE4, SE4, Sec. 4, T107N, R11W, Quincy Township, Olmsted County, MN.

Zonitoides limatulus
Algific Talus Slope

11) Moen Bridge: N2, N2, Sec. 33, T104N, R10W, Pilot Mound Township, Fillmore County, MN.

12) North Branch Whitewater 3: NW4, Sec. 3, T107N, R11W, Quincy Township, Olmsted County, MN. Revisit from 1989.

13) North Branch Whitewater River 5: SE4, Sec. 33, T108N, R11W, Plainview Township, Wabasha County, MN.

Vertigo meramecensis (?)
Moist Cliff, Driftless Section

14) Pine Creek: NW4, NE4, Sec. 2, T105N, R9W, Arendahl Township, Fillmore County, MN.

Algific Talus Slope

15) Root River 1: SW4, Sec. 14, T104N, R11W, Chatfield Township, Fillmore County, MN.

16) Root River 2: SW4, SE4, Sec. 13, T104, R11W, Chatfield Township, Fillmore County, MN.

17) Root River 3: N2, SW4, Sec. 19, T104N, R10W, Pilot Mound Township, Fillmore County, MN.

18) South Branch Whitewater 1: SW4, SW4, Sec. 1, T106N, R10W, St. Charles Township, Winona County, MN.

Vertigo hubrichtii n. ssp.
Vertigo meramecensis
Vertigo bollesiana
Moist Cliff, Driftless Section

19) South Branch Whitewater 2: SE4, SW4, Sec. 36, T107N, R10W, Elba Township, Winona County, MN.

Vertigo hubrichtii n. ssp.
Adoxa moschatellina
Algific Talus Slope

20) South Branch Whitewater River 3: NW4, SW4, Sec. 36, T107N, R10W, Elba Township, Winona County, MN.

21) South Branch Whitewater Tributary: SW4, SW4, Sec. 6, T106N, R9W, Utica Township, Winona County, MN.

Vertigo meramecensis
Vertigo bollesiana
Moist Cliff, Driftless Section

B. Non-algific Sites:

1) Duschee Creek: N2, SW4, Sec. 25, T103N, R10W, Carrolton Township, Fillmore County, MN.

2) Mazeppa: N2, NW4, Sec. 7, T109N, R14W, Mazeppa Township, Wabasha County, MN.

3) Middle Creek: N2, S2, NW4, Sec. 19, T109N, R11W, Highland Township, Wabasha County, MN.

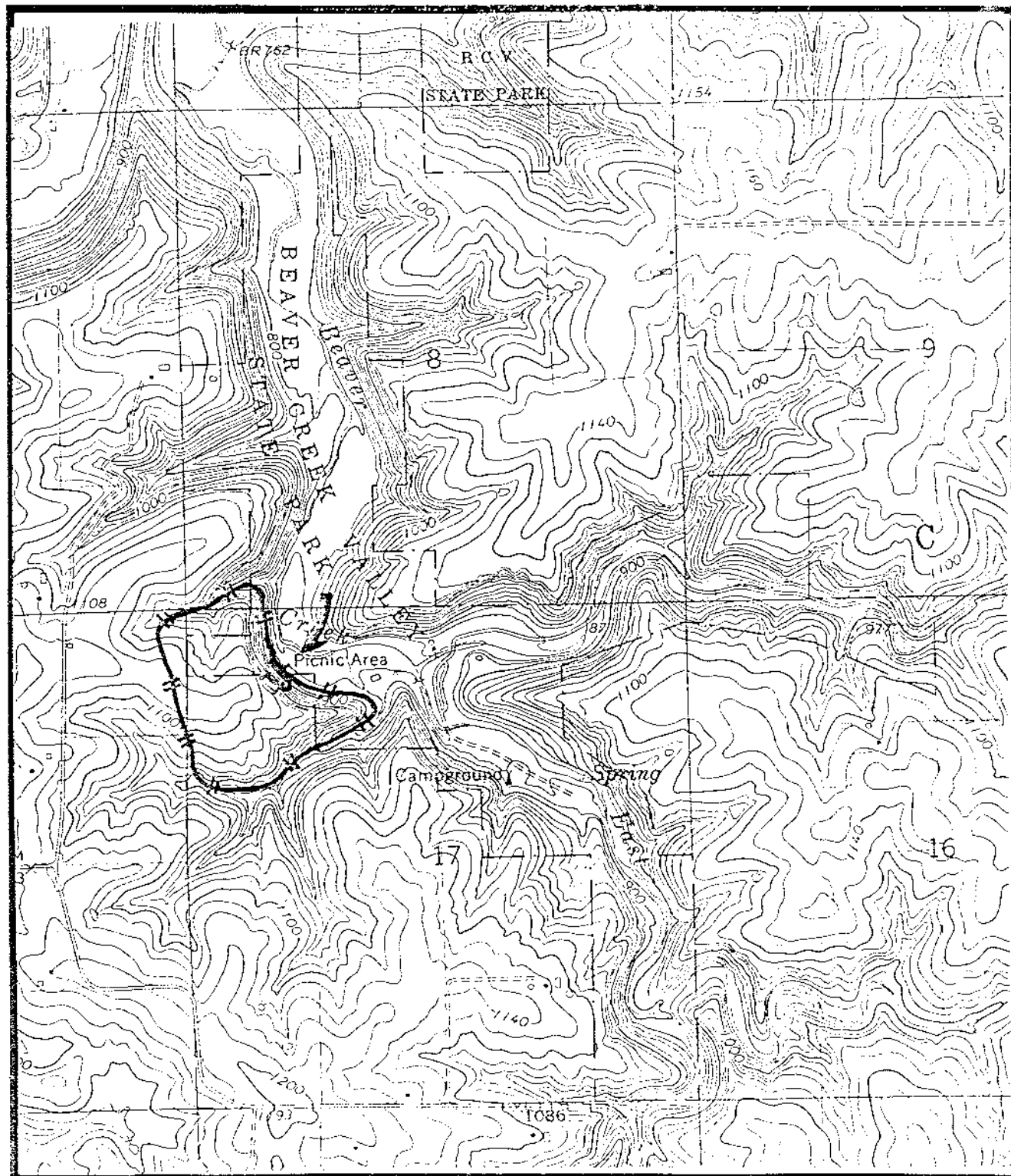
4) Riceford Creek 4: NW4, Sec. 29, T102N, R7W, Black Hammer Township, Houston County, MN.

5) Wisel Creek 1: S2, SE4, Sec. 29, T102N, R8W, Preble Township, Fillmore County, MN.

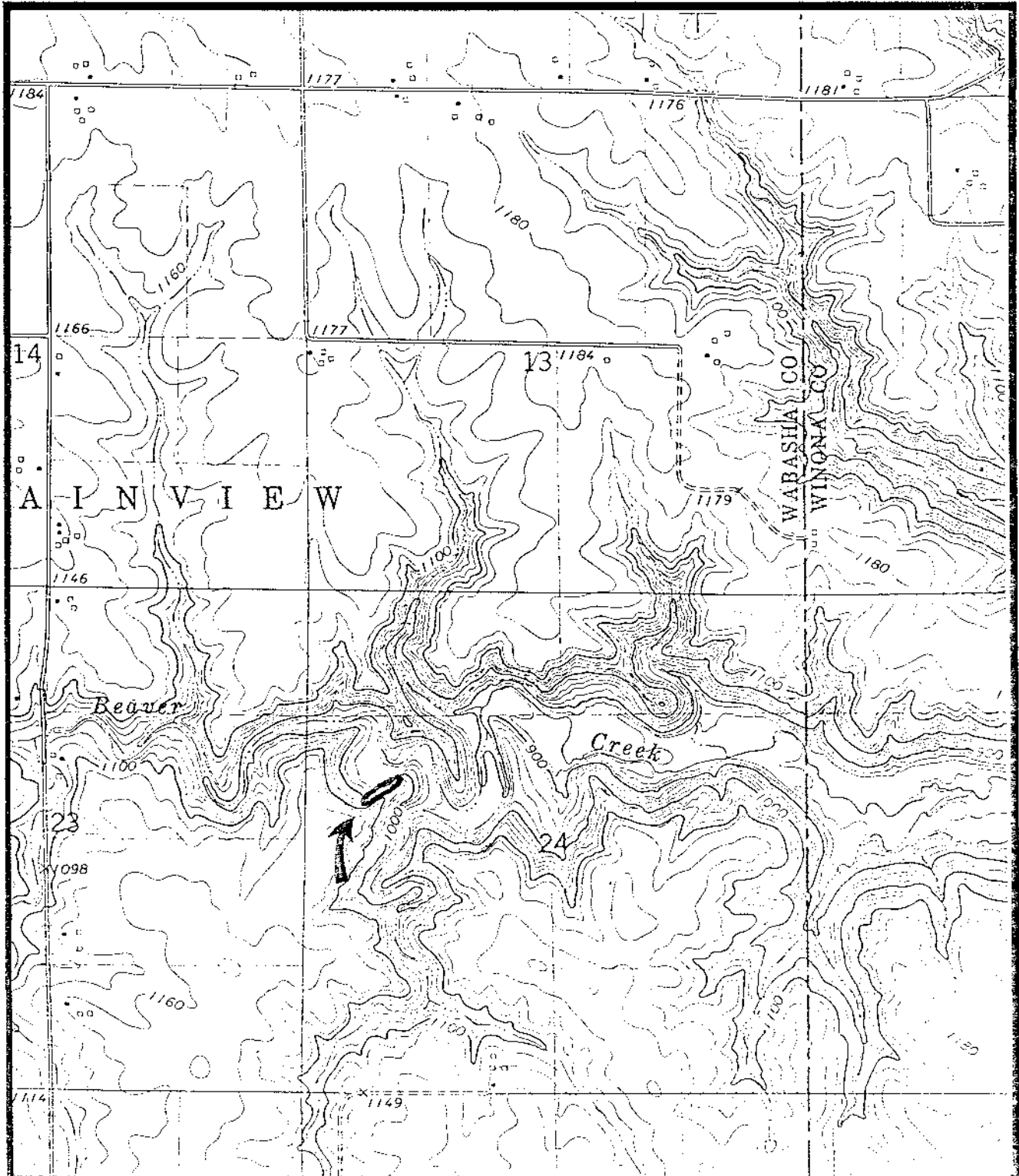
6) Wisel Creek 2: N2, NE4, Sec. 30, T102N, R8W, Preble Township, Fillmore County, MN.

APPENDIX 3: SITE MAPS

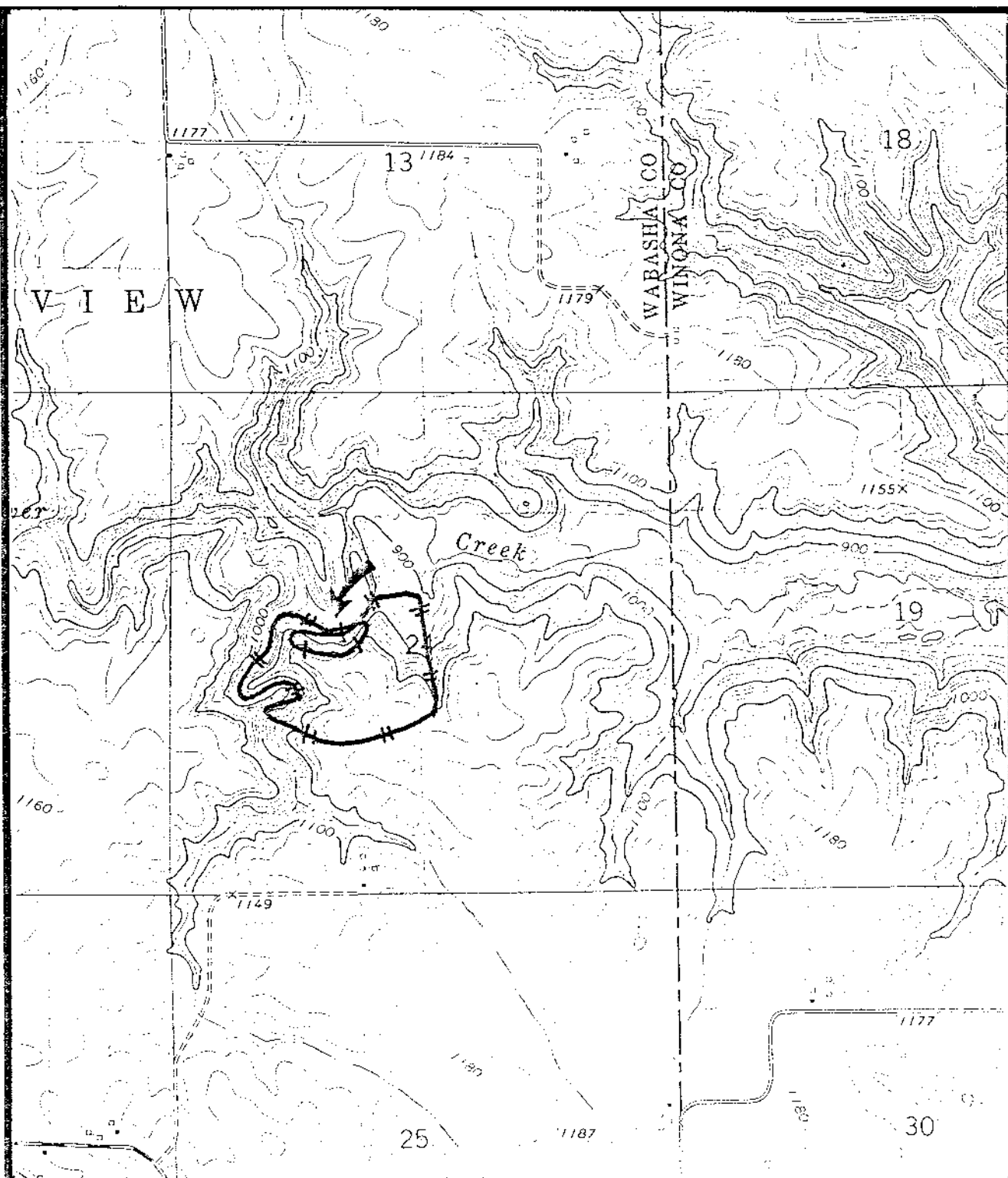
SITE NAME: Beaver Creek Valley State Park 1
QUAD NAME: Sheldon
LOCATION: NW4, NW4, Sec. 17, T102N, R6W, Caledonia Township,
Houston County, MN.



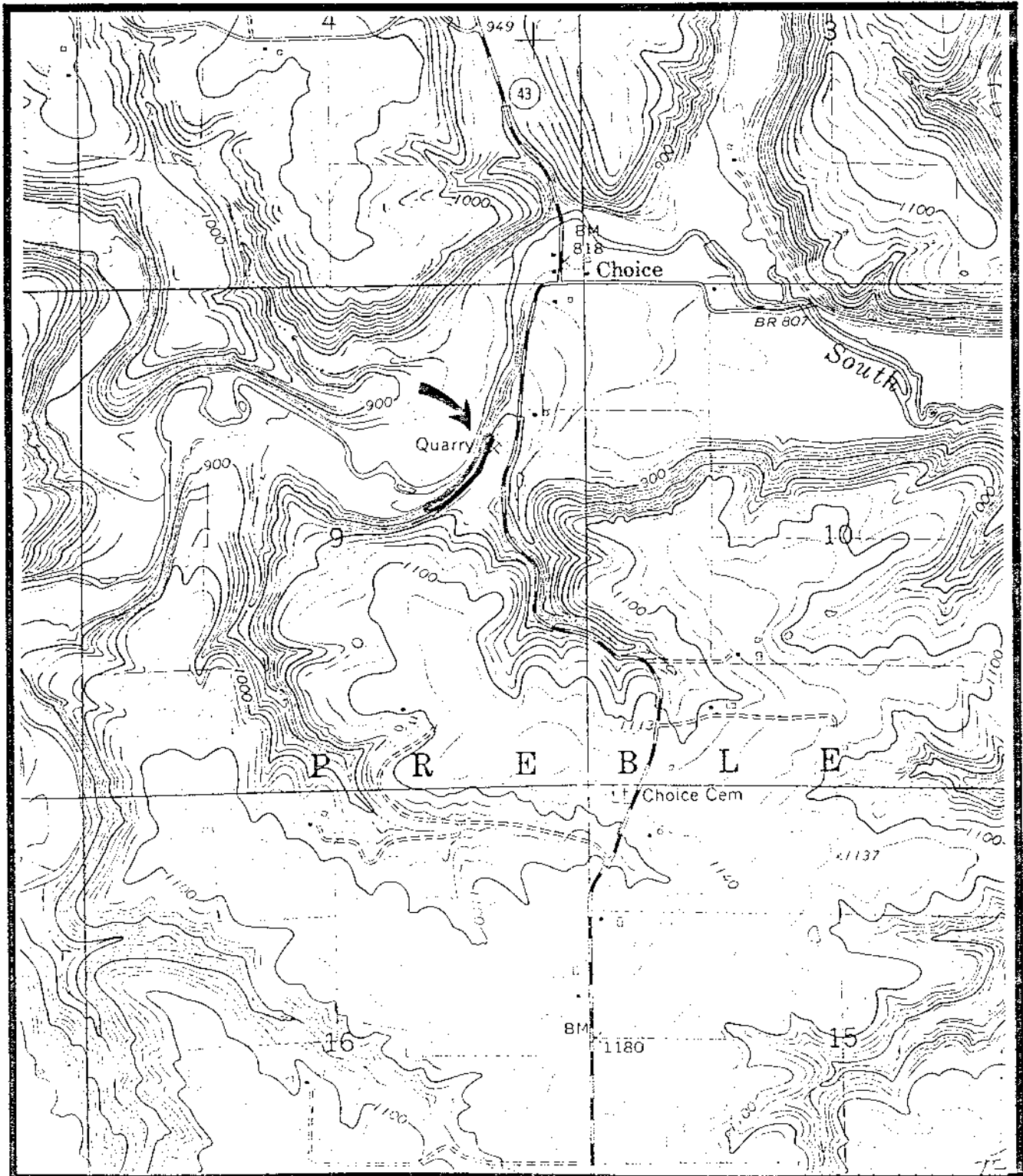
SITE NAME: Beaver Creek 1 - Whitewater WMA
QUAD NAME: Beaver
LOCATION: SW4, NW4, Sec. 24, T108N, R11W, Plainview
Township, Wabasha County, MN.



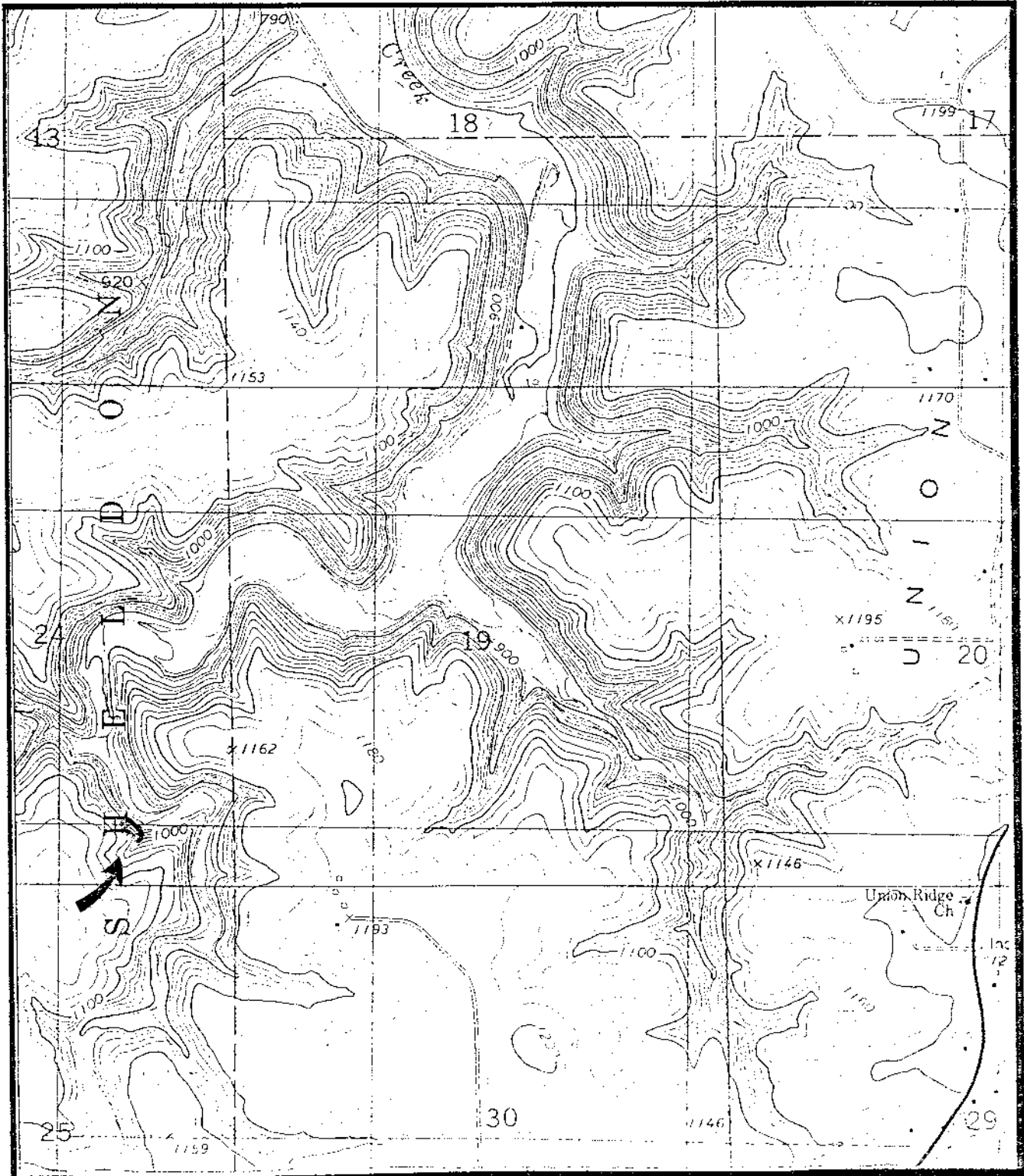
Topographic map of a section of Wabasha and Winona Counties, Minnesota. The map shows a creek labeled "Creek" with a dashed line indicating a boundary. A large area is outlined in black and labeled "VIEW". The map includes contour lines, elevation markers (e.g., 1160, 1177, 1184, 1179, 1180, 1155X, 1160, 1177, 1187, 1160), and section numbers (13, 18, 19, 25, 30). The map is oriented with North at the top.



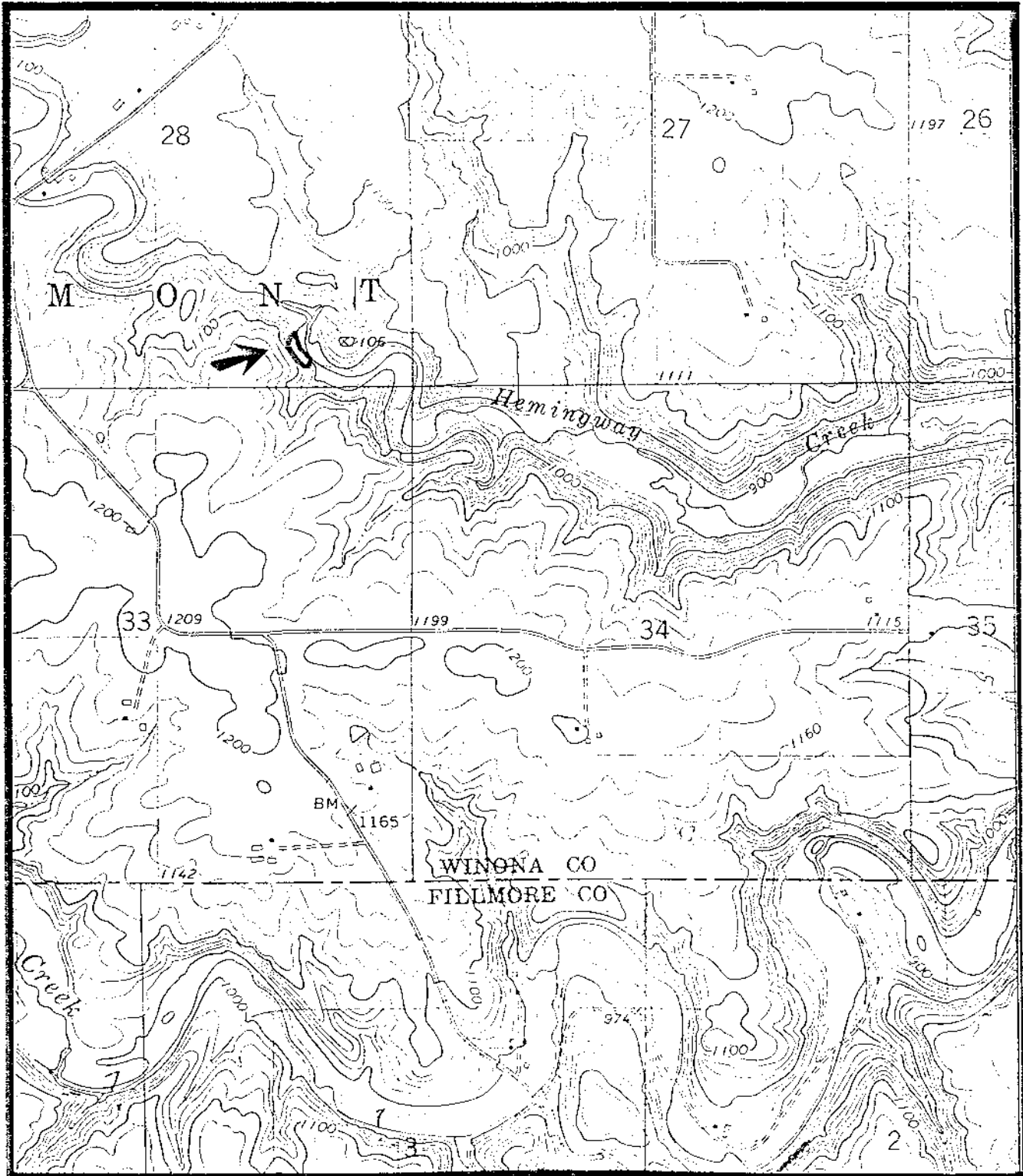
SITE NAME: Choice
QUAD NAME: Bratsberg
LOCATION: S2, NE4, Sec. 9, T102N, R8W, Preble Township,
Fillmore County, MN.



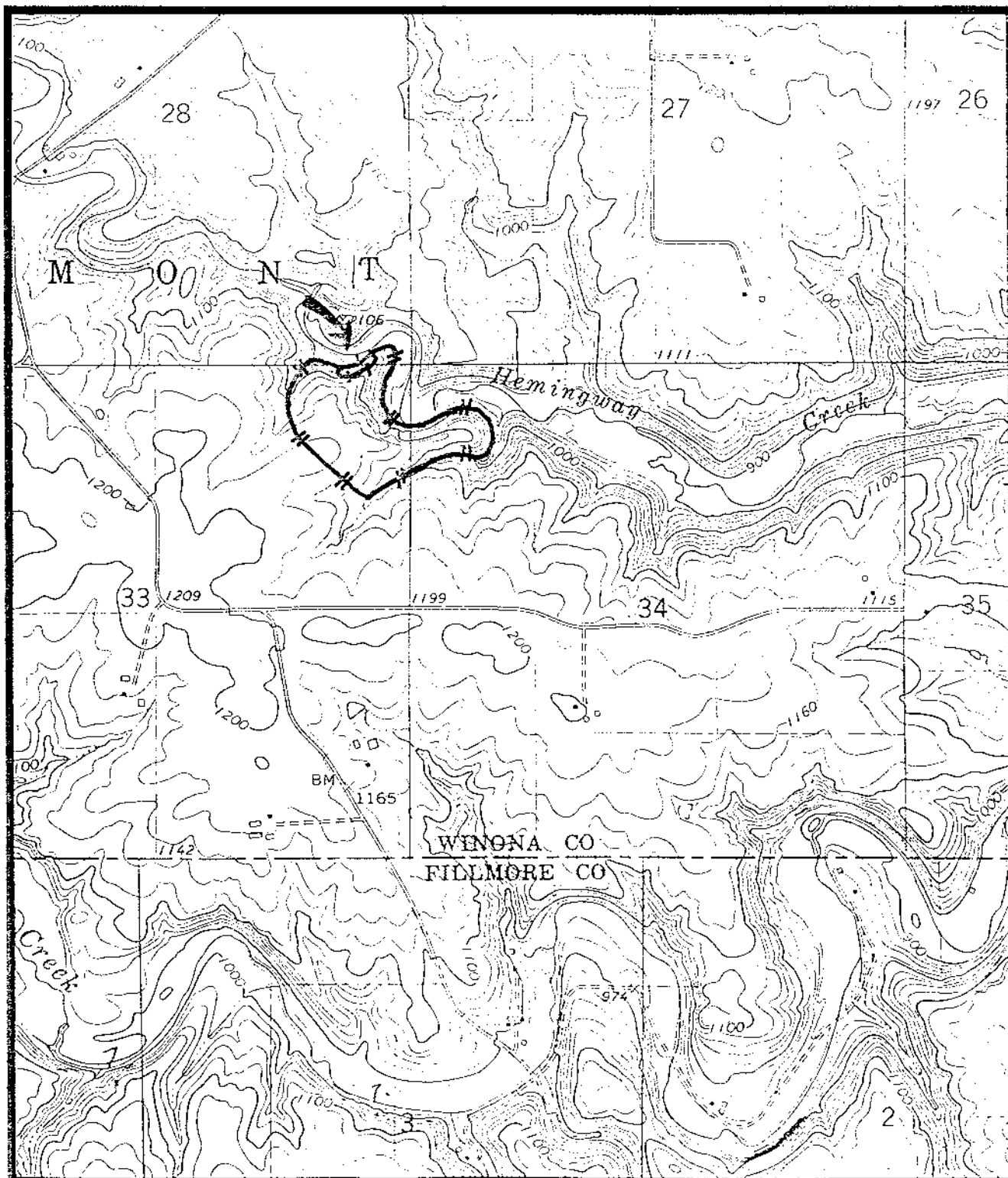
This is a detailed topographic map of a mountainous region, likely in the Adirondacks. The map features a grid with horizontal and vertical lines. Contour lines are drawn to represent elevation, with labels such as 1000, 1100, 1150, 1160, 1170, 1180, 1190, 1200, 1250, and 1300. A large arrow points to a specific location marked 'S'. Other labels include 'Creek', 'Union Ridge Ch', and 'Inc 12'. The map also shows various elevation points marked with 'x' and numbers like 1162, 1193, 1146, 1151, 1170, 1199, 1153, 1159, 1146, 1140, 1130, 1120, 1110, 1100, 1090, 1080, 1070, 1060, 1050, 1040, 1030, 1020, 1010, 1000, 990, 980, 970, 960, 950, 940, 930, 920, 910, 900, 890, 880, 870, 860, 850, 840, 830, 820, 810, 800, 790, 780, 770, 760, 750, 740, 730, 720, 710, 700, 690, 680, 670, 660, 650, 640, 630, 620, 610, 600, 590, 580, 570, 560, 550, 540, 530, 520, 510, 500, 490, 480, 470, 460, 450, 440, 430, 420, 410, 400, 390, 380, 370, 360, 350, 340, 330, 320, 310, 300, 290, 280, 270, 260, 250, 240, 230, 220, 210, 200, 190, 180, 170, 160, 150, 140, 130, 120, 110, 100, 90, 80, 70, 60, 50, 40, 30, 20, 10, 0.



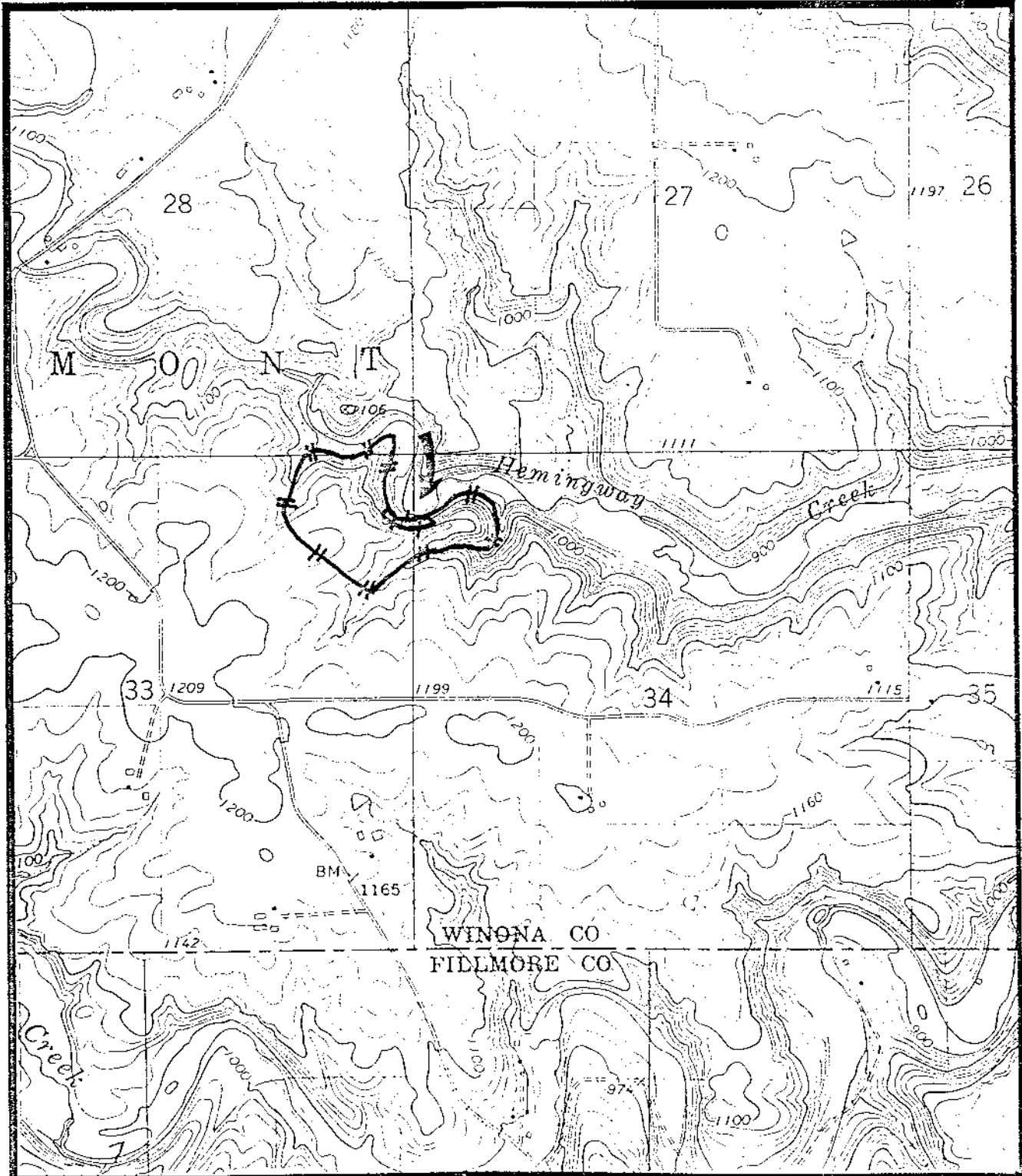
SITE NAME: Hemingway Creek 1
QUAD NAME: Arendahl
LOCATION: SW4, SE4, Sec. 28, T105N, R9W, Fremont Township,
Winona County, MN.



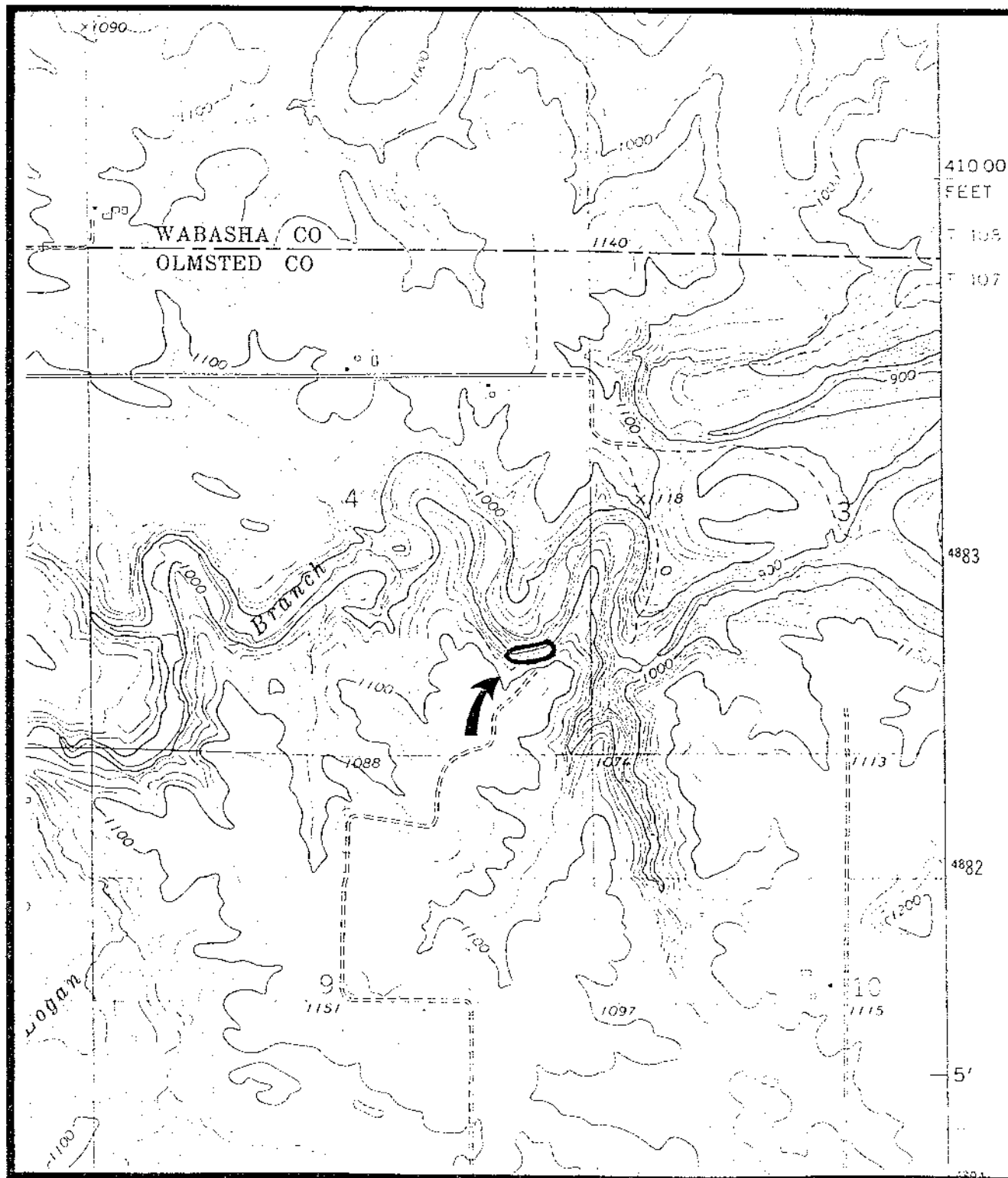
SITE NAME: Hemingway Creek 2
QUAD NAME: Arendahl
LOCATION: NE4, NE4, Sec. 33, T105N, R9W, Fremont Township,
Winona County, MN.



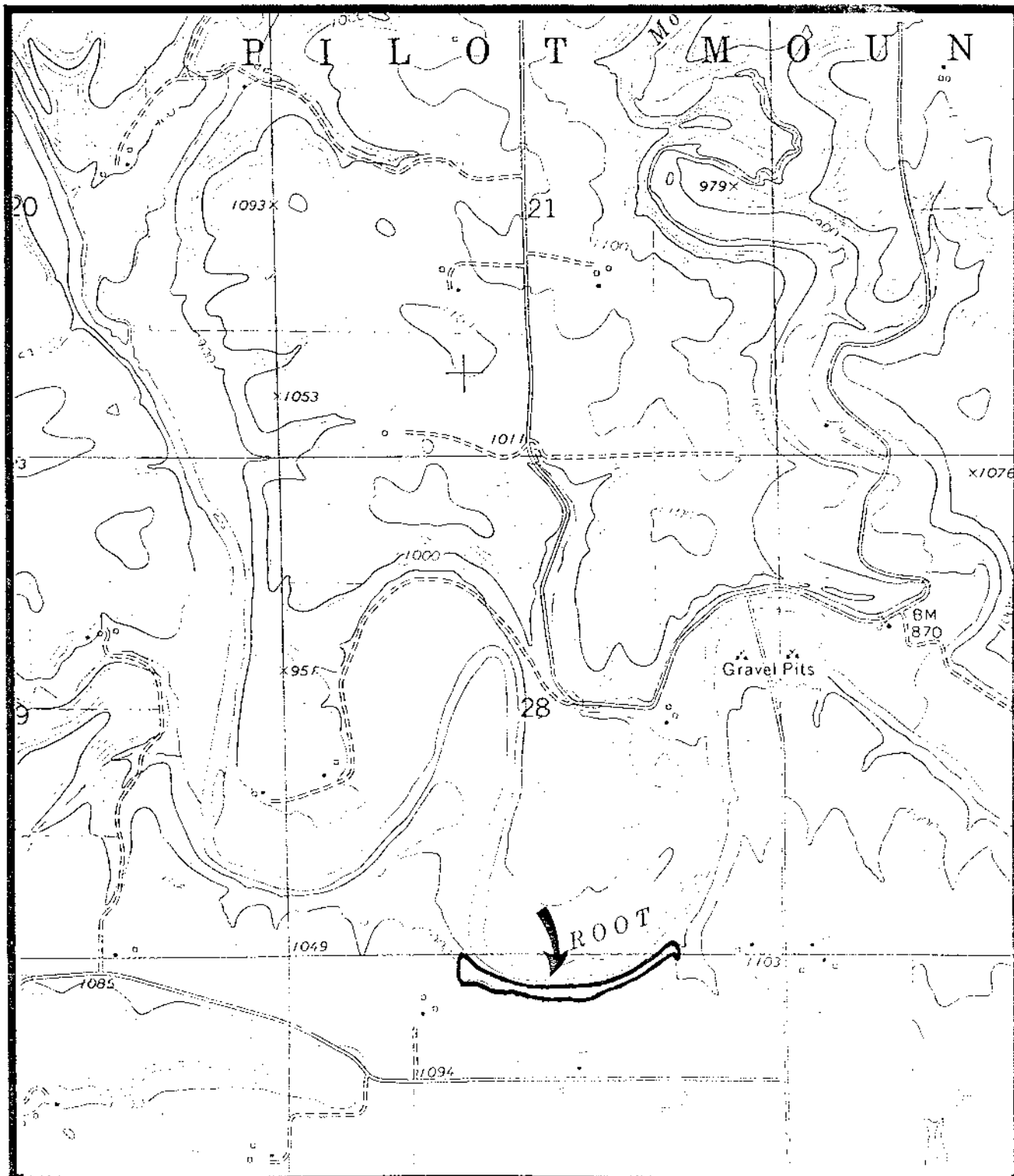
SITE NAME: Hemingway Creek 3
QUAD NAME: Arendahl
LOCATION: NE4, NE4, Sec. 33 and NW4, NW4, Sec. 34, T105N,
R9W, Fremont Township, Winona County, MN.



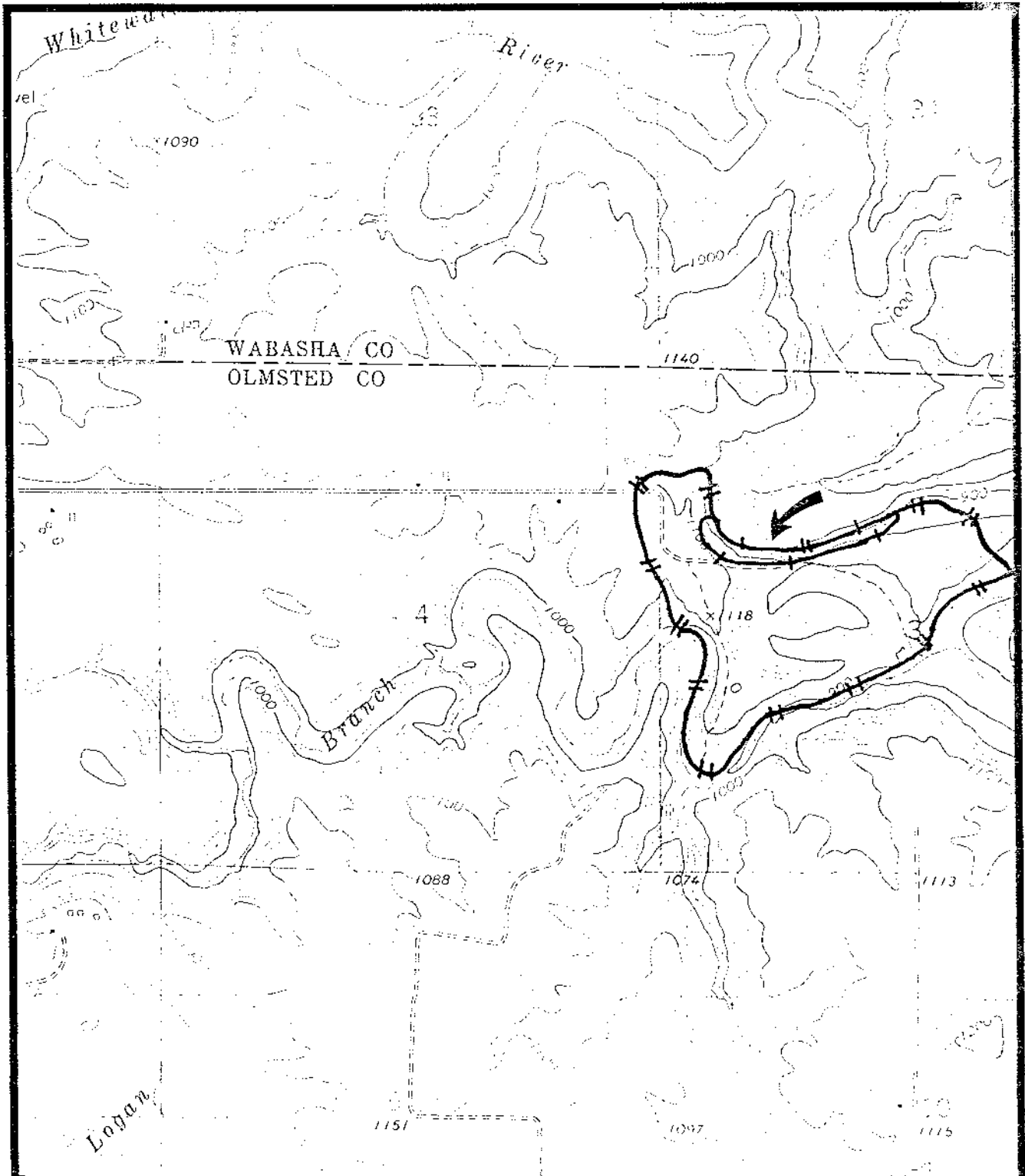
SITE NAME: Logan Branch 3
QUAD NAME: Plainview SW
LOCATION: SE4, SE4, Sec. 4, T107N, R11W, Quincy Township,
Olmsted County, MN.



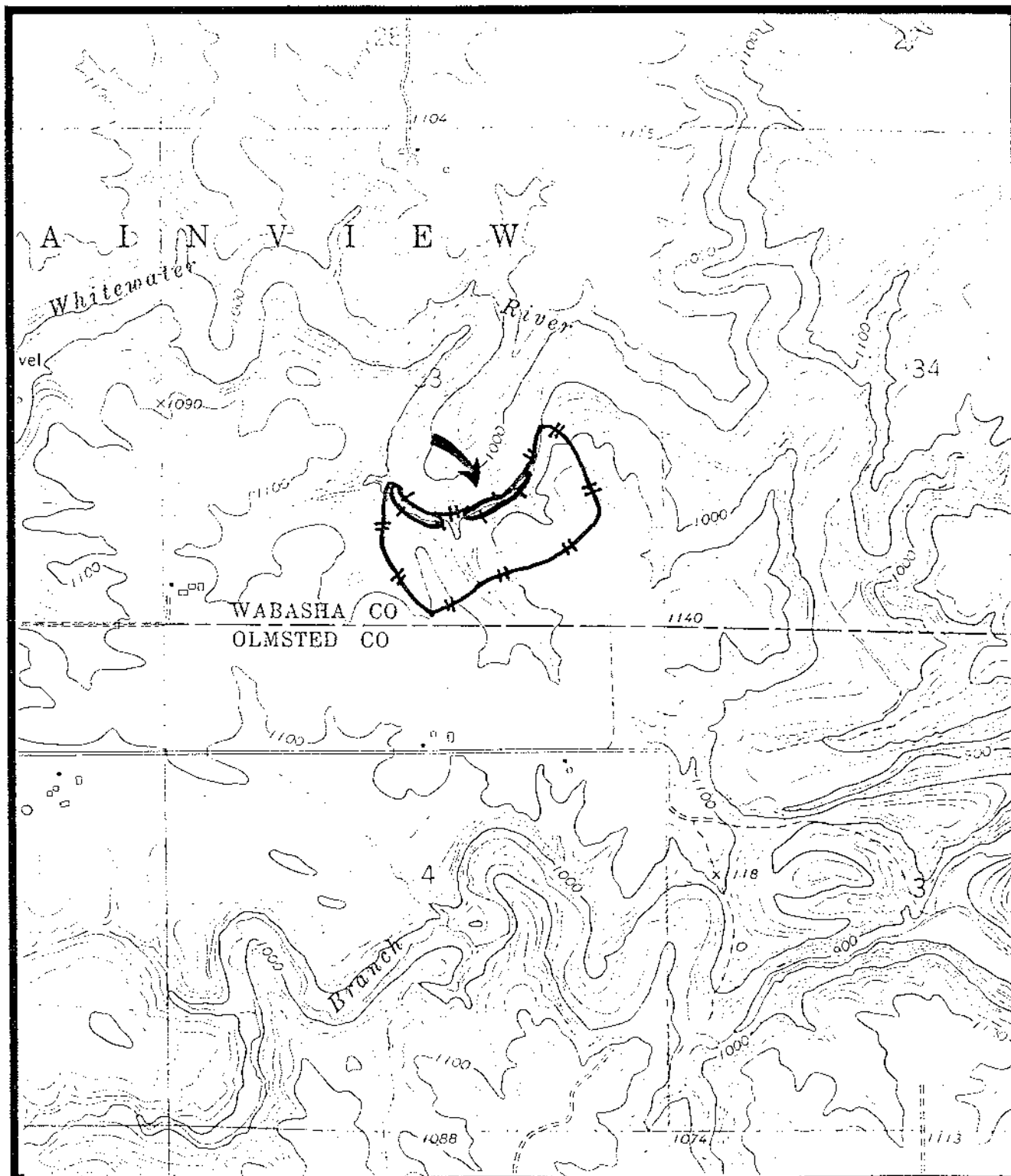
SITE NAME: Moen Bridge
QUAD NAME: Pilot Mound
LOCATION: N2, N2, Sec. 33, T104N, R10W, Pilot Mound
Township, Fillmore County, MN.



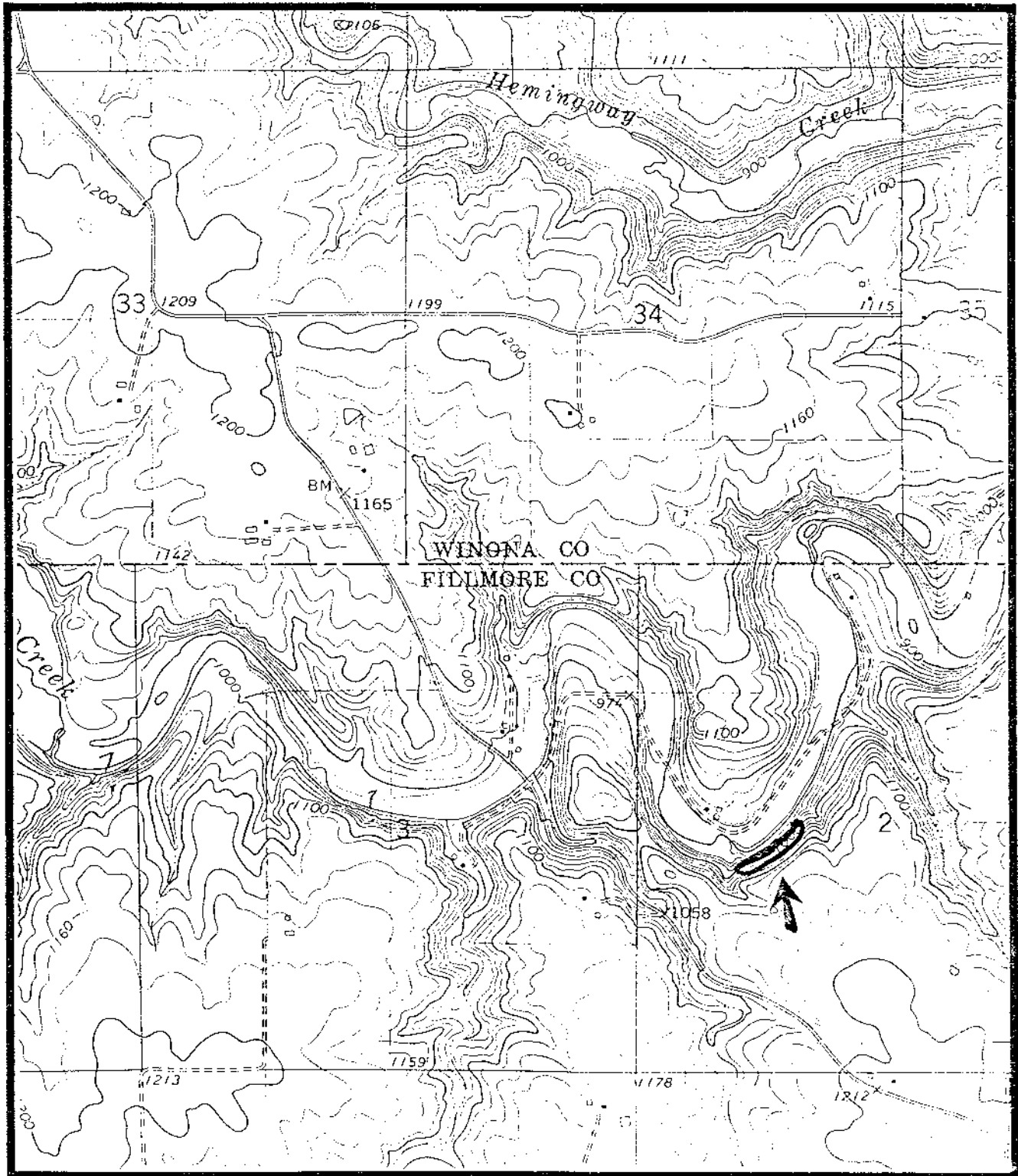
SITE NAME: North Branch Whitewater River 3
QUAD NAME: Plainview SW
LOCATION: NW4, Sec. 3, T107N, R11W, Quincy Township, Olmsted County, MN.



SITE NAME: North Branch Whitewater River 5
QUAD NAME: Plainview SW
LOCATION: SE4, Sec. 33, T108N, R11W, Plainview Township,
Wabasha County, MN.

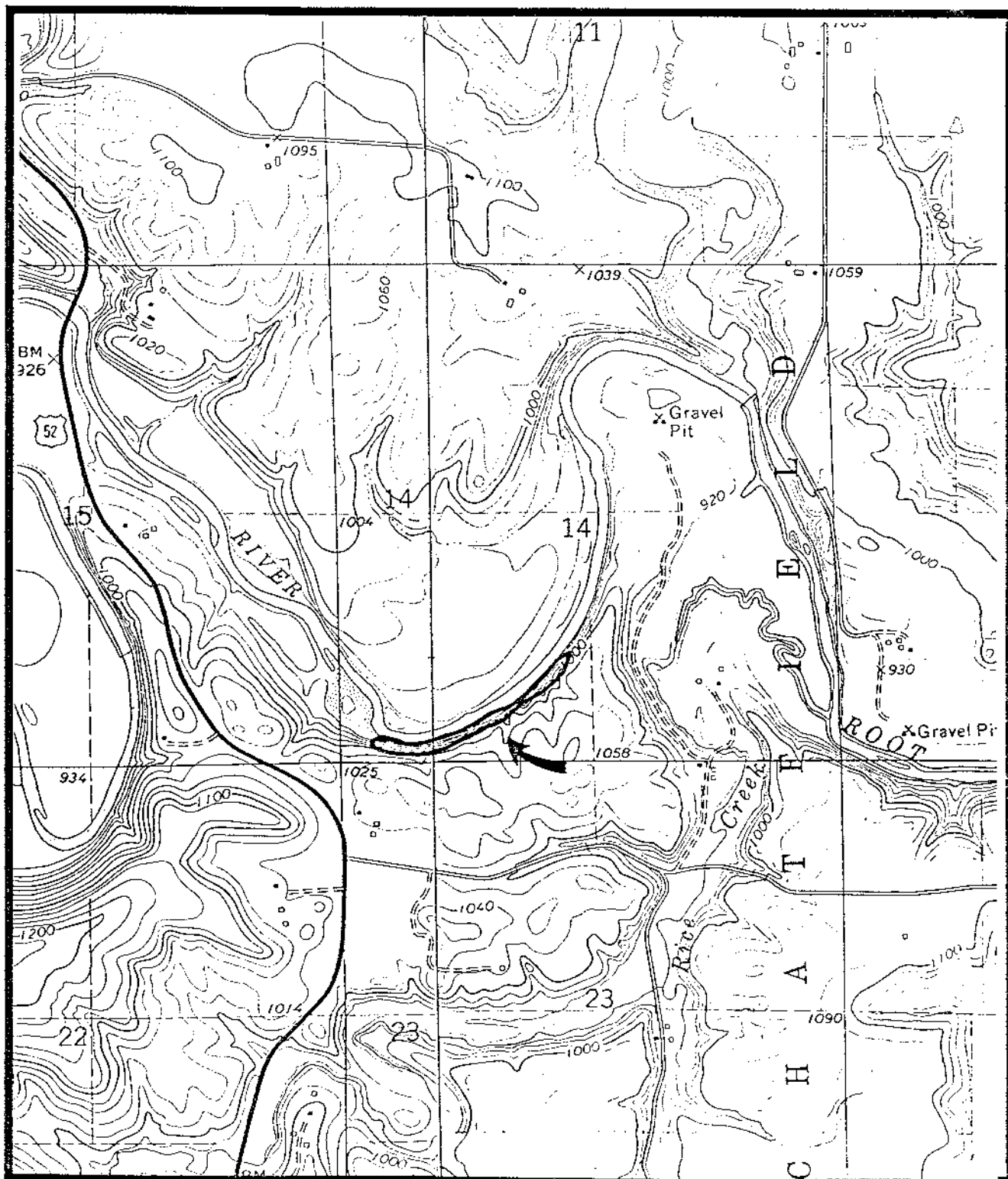


SITE NAME: Pine Creek
QUAD NAME: Arendahl
LOCATION: NW4, NE4, Sec. 2, T105N, R9W, Arendahl Township,
Fillmore County, MN.

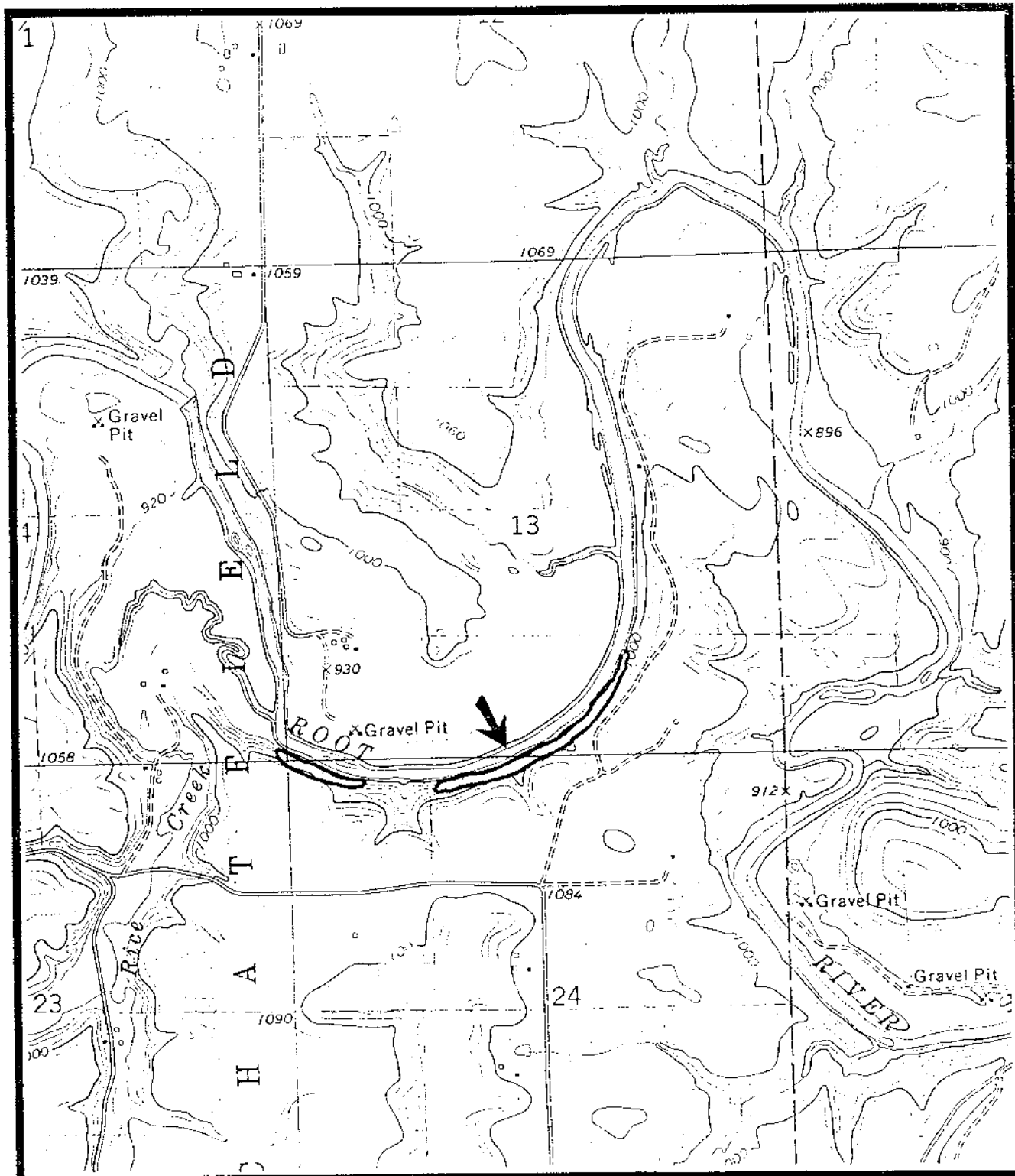


A detailed topographic map of the Charles River area. The map features numerous contour lines indicating elevation, with labels such as 1000, 1100, 1200, and 1300. A prominent river, the Charles River, flows through the center of the map. Several elevation points are marked with 'x' and numerical values: 1158, 1202, 1075, 1134, 1138, and 1140. A section of the river is highlighted with a thick black line and labeled 'Spring' with an arrow pointing to it. The word 'CHARLES' is written across the middle of the map. Grid lines are visible, with numbers 3, 6, and 12 along the top and bottom edges, and 1, 2, and 3 along the left and right edges.

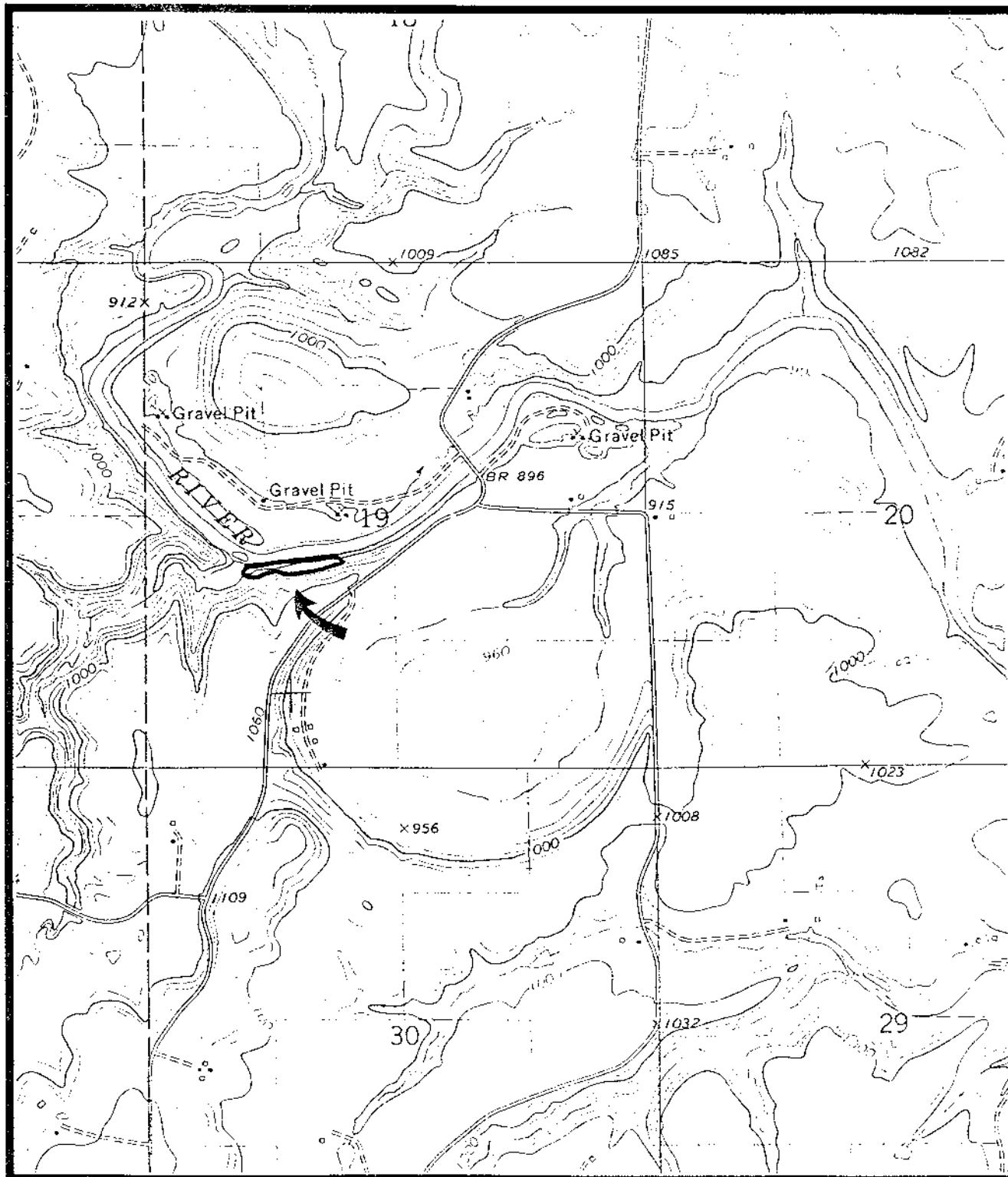
SITE NAME: Root River 1
QUAD NAME: Pilot Mound
LOCATION: SW4, Sec. 14, T104N, R11W, Chatfield Township,
Fillmore County, MN.



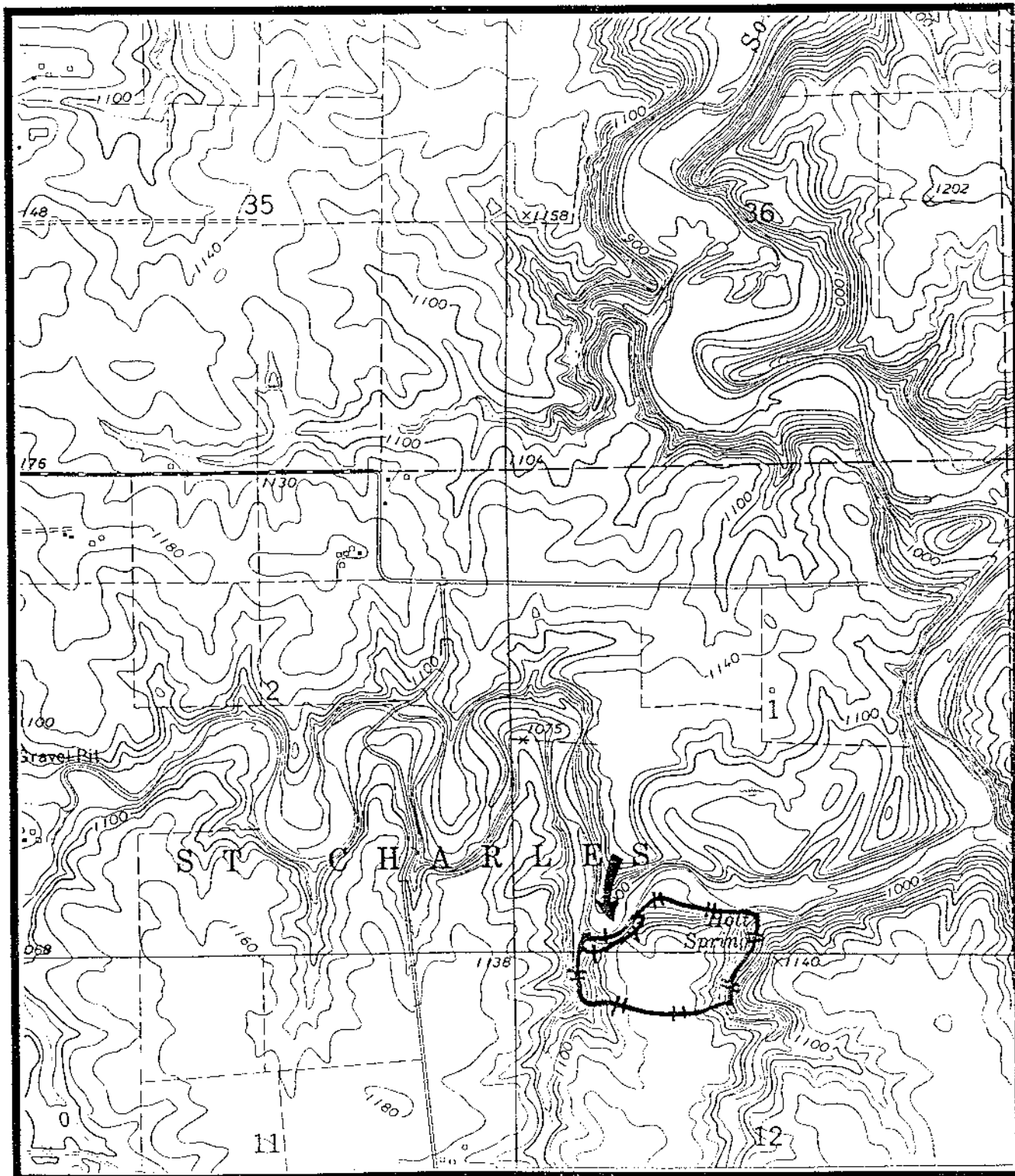
SITE NAME: Root River 2
QUAD NAME: Pilot Mound
LOCATION: SW4, SE4, Sec. 13, T104, R11W, Chatfield Township,
Fillmore County, MN.



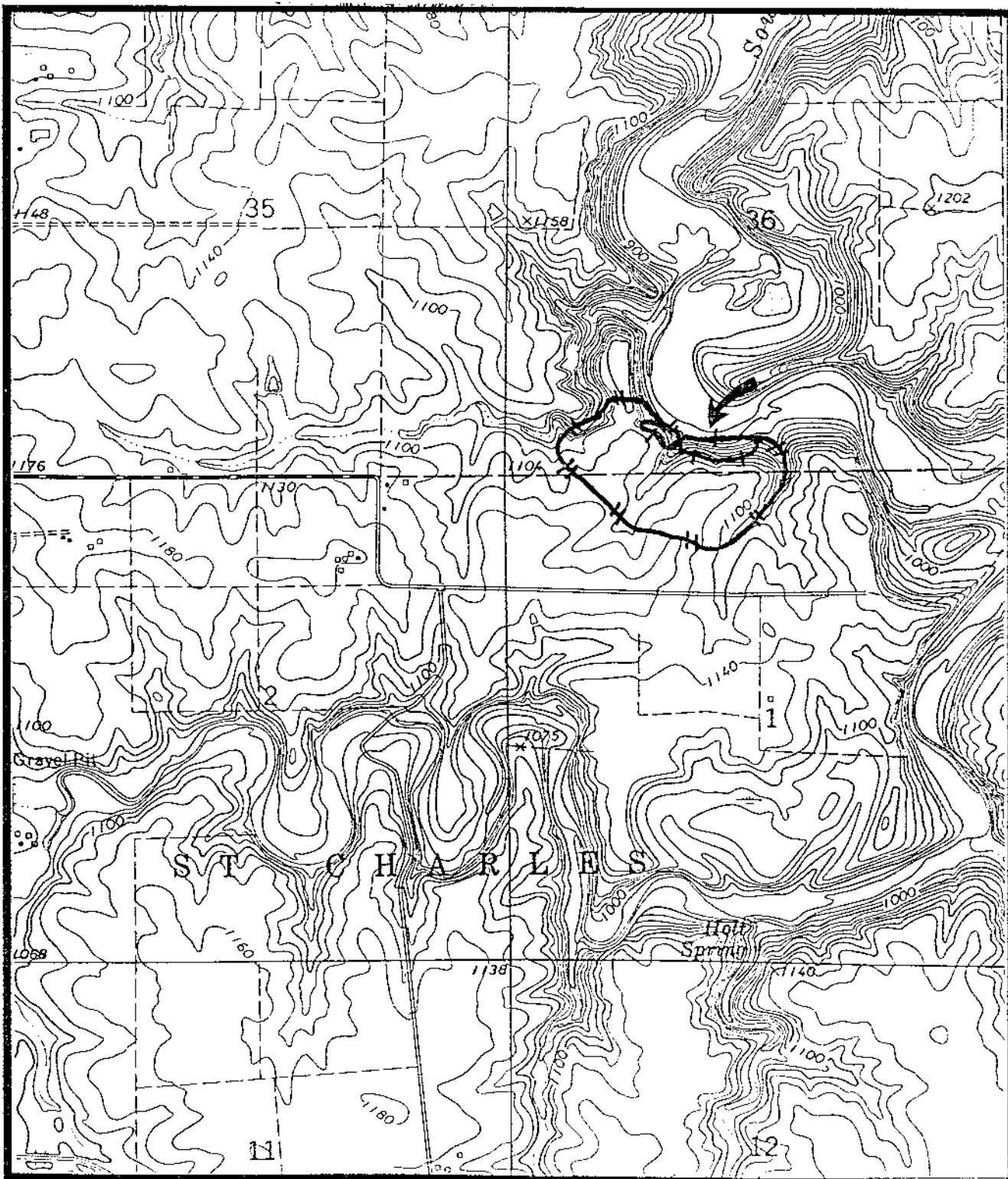
SITE NAME: Root River 3
QUAD NAME: Pilot Mound
LOCATION: N2, SW4, Sec. 19, T104N, R10W, Pilot Mound
Township, Fillmore County, MN.



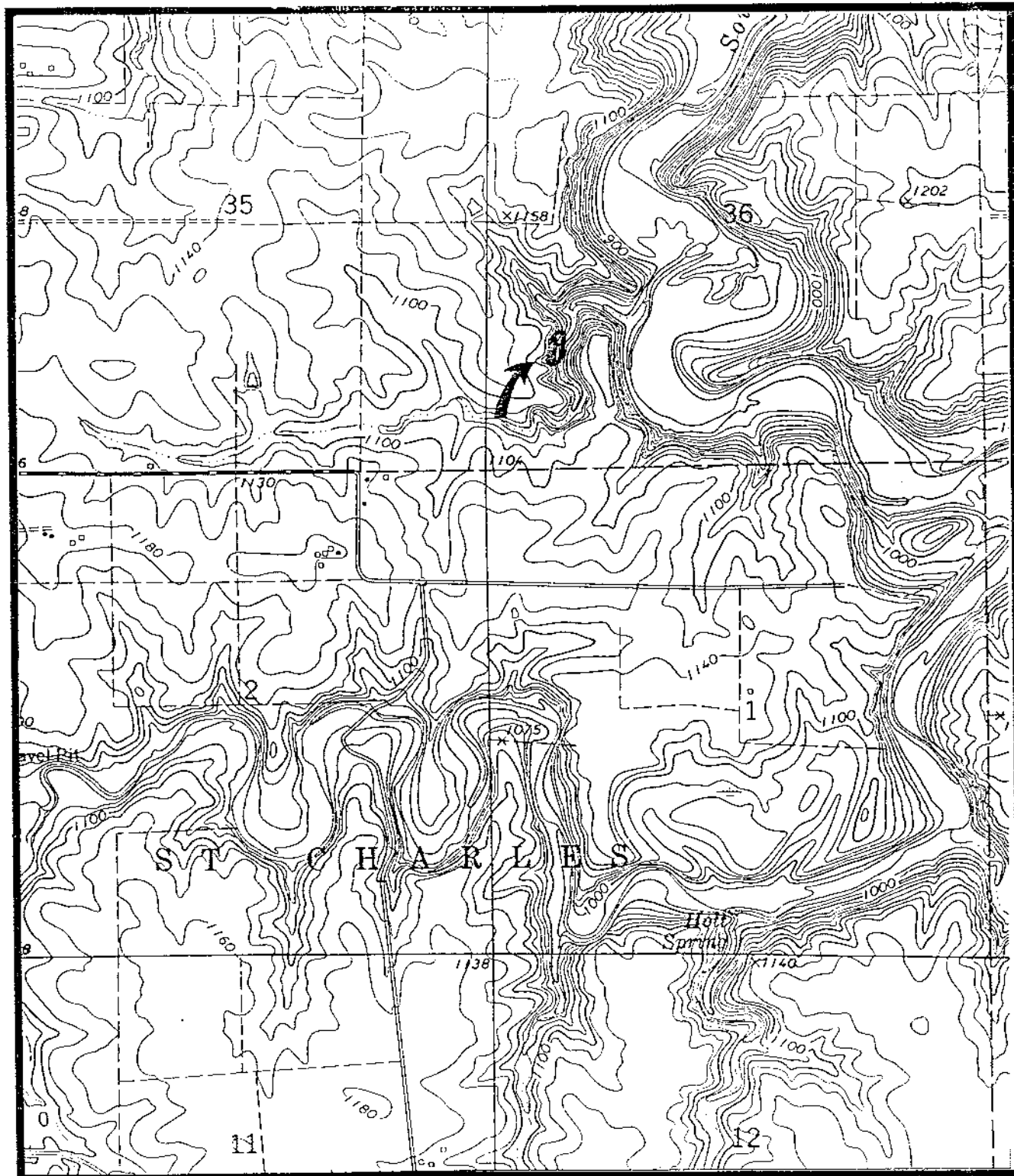
SITE NAME: South Branch Whitewater River 1
QUAD NAME: Altura
LOCATION: SW4, SW4, Sec. 1, T106N, R10W, St. Charles
Township, Winona County, MN.



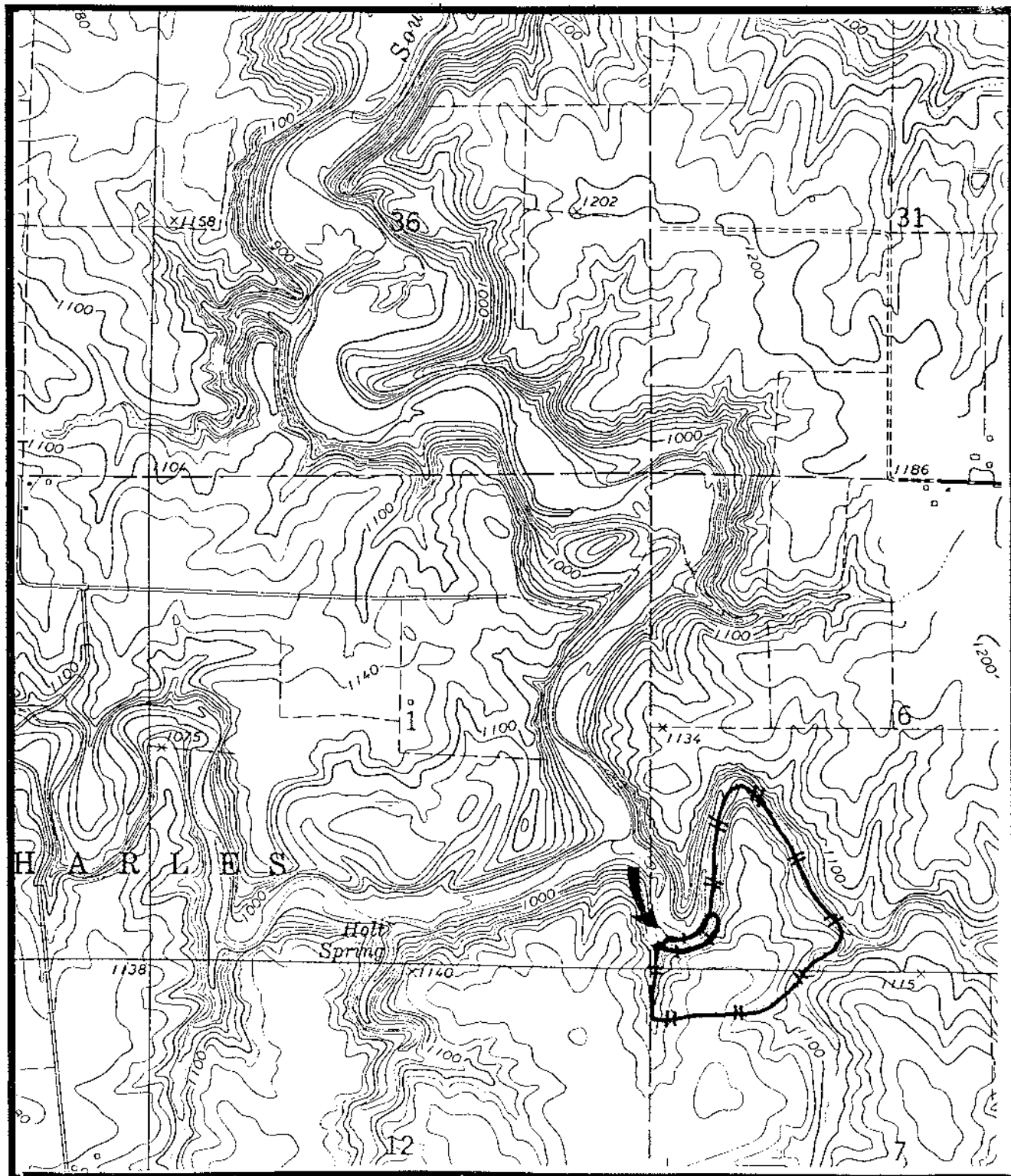
This is a topographic map of the St. Charles area. The map features contour lines indicating elevation, with labels such as 1000, 1100, 1140, 1160, 1180, 1200, and 1202. A prominent contour line is labeled 1100. The map includes a grid system with horizontal and vertical lines. A dashed line is labeled H48. A solid line is labeled N30. A small area is highlighted with a thick black outline and an arrow pointing to it. The text 'ST. CHARLES' is written across the center of the map. Other labels include 'Gravel Pit', 'Holt Spring', and '1202'. The map also shows various symbols for buildings and other features.



SITE NAME: South Branch Whitewater River 3
QUAD NAME: Altura
LOCATION: NW4, SW4, Sec. 36, T107N, R10W, Elba Township,
Winona County, MN.



SITE NAME: South Branch Whitewater Tributary
QUAD NAME: Altura
LOCATION: SW4, SW4, Sec. 6, T106N, R9W, Utica Township,
Winona County, MN.



APPENDIX 4: SITE-SPECIFIC LANDSNAIL SPECIES LISTS

Beaver Creek Valley State Park 1

Anguispira alternata
Carychium exiguum
Cochlicopa lubrica
Columella simplex
Euconulus fulvus
Gastrocopta contracta
Gastrocopta holzingeri
Hawaiiia minuscula
Helicodiscus parallelus
Hendersonia occulta
Nesovitrea indentata
Punctum minutissimum
Strobilops labyrinthica
Vallonia perspectiva
Vertigo gouldi gouldi
** Vertigo bollesiana
* Vertigo hubrichtii n. sp.
Zonitoides arboreus

Beaver Creek 1 - Whitewater WMA

Allogona profunda
Carychium exiguum
Helicodiscus parallelus
Hendersonia occulta
Gastrocopta contracta
Nesovitrea indentata
Punctum minutissimum
Strobilops labyrinthica

Beaver Creek 2 - Whitewater WMA

Allogona profunda
Carychium exiguum
Cochlicopa lubrica
Discus catskillensis
Euconulus fulvus
Gastrocopta contracta
Gastrocopta tappaniana
Hawaiiia minuscula
Helicodiscus parallelus
Hendersonia occulta
Nesovitrea indentata
Punctum minutissimum
Strobilops labyrinthica

Choice

Carychium exiguum
Discus catskillensis
Gastrocopta contracta
Helicodiscus parallelus
Punctum minutissimum
Stenotrema hirsuta
Strobilops labyrinthica
Vallonia perspectiva
Zonitoides arboreus

Hemingway Creek 1

Allogona profunda
Carychium exiguum
Cochlicopa lubrica
Discus catskillensis
Helicodiscus parallelus
Hendersonia occulta
Nesovitrea indentata
Strobilops labyrinthica
Vallonia perspectiva

Hemingway Creek 2

Anguispira alternata
Carychium exiguum
Discus catskillensis
Gastrocopta holzingeri
Hawaiiia minuscula
Hendersonia occulta
Nesovitrea indentata
Strobilops labyrinthica
Vertigo gouldi gouldi
* Vertigo hubrichtii n. ssp.
Stenotrema hirsuta
Stenotrema leai
Zonitoides arboreus

Hemingway Creek 3

Cochlicopa lubrica
Discus catskillensis
Gastrocopta contracta
Helicodiscus parallelus
Nesovitrea indentata
* Novisuccinea sp. (?)
Stenotrema sp.
Stenotrema leai

Holt Spring

Anguispira alternata
Carychium exiguum
Cochlicopa lubrica
Hawaiiia minuscula
Hendersonia occulta
Strobilops labyrinthica
Vertigo gouldi gouldi
* Vertigo hubrichti n. ssp.
* Vertigo meramecensis

Logan Branch 3

Anguispira alternata
Carychium exiguum
Columella simplex
Discus catskillensis
Gastrocopta holzingeri
Hawaiiia minuscula
Helicodiscus parallelus
Vertigo gouldi gouldi
Stenotrema barbata
Zonitoides arboreus
*** Zonitoides limatulus

Moen Bridge

Anguispira alternata
Carychium exiguum
Hendersonia occulta
Vertigo gouldi gouldi

North Branch Whitewater River 3

Discus catskillensis
Gastrocopta contracta
Helicodiscus parallelus
Nesovitrea indentata
Vallonia sp.
Vertigo gouldi gouldi

North Branch Whitewater River 5

Discus catskillensis
Hawaiiia minuscula
Hendersonia occulta
Helicodiscus parallelus
Punctum minutissimum
Strobilops labyrinthica
Vallonia sp.
Vertigo gouldi gouldi
* Vertigo meramecensis (?)

Pine Creek

Carychium exiguum
Cochlicopa lubrica
Discus catskillensis
Euconulus fulvus
Gastrocopta contracta
Helicodiscus parallelus
Hendersonia occulta
Nesovitrea indentata
Punctum minutissimum
Strobilops labyrinthica
Vallonia sp.

Riceford 3

Allogona profunda
Carychium exiguum
Hawaiiia minuscula
Hendersonia occulta
Nesovitrea indentata
Strobilops labyrinthica
Vallonia sp.
Zonitoides arboreus

Root River 1

Carychium exiguum
Hawaiiia minuscula
Hendersonia occulta
Strobilops labyrinthica

Root River 2

Allogona profunda
Anguispira alternata
Carychium exiguum

Collumella simplex
Euconulus fulvus
Gastrocopta contracta
Gastrocopta holzingeri
Hawaiiia minuscula
Hendersonia occulta
Nesovitrea indentata
Punctum minutissimum
Strobilops labyrinthica
Stenotrema barbata
Vertigo sp.

Root River 3

Anguispira alternata
Helicodiscus parallelus
Hendersonia occulta
Stenotrema barbata
Vertigo gouldi gouldi
Zonitoides arboreus

South Branch Whitewater River 1

Anguispira alternata
Carychium exiguum
Cochlicopa lubrica
Derocerus laeve
Gastrocopta contracta
Gastrocopta holzingeri
Helicodiscus parallelus
Hendersonia occulta
Punctum minutissimum
Stenotrema barbata
Strobilops labyrinthica
Vallonia sp.
Vertigo gouldi gouldi
* Vertigo meramecensis
** Vertigo bollesiana
* Vertigo hubrichtii n. ssp.

South Branch Whitewater River 2

Carychium exiguum
Cochlicopa lubrica
Columella simplex
Discus catskillensis
Gastrocopta contracta
Gastrocopta holzingeri
Helicodiscus parallelus
Hendersonia occulta
Nesovitrea indentata

Punctum minutissimum
Strobilops labyrinthica
Stenotrema barbata
Vertigo gouldi gouldi
* Vertigo hubrichti n. ssp.
Zonitoides arboreus

South Branch Whitewater River 3

Allogona profunda
Anguispira alternata
Carychium exiguum
Cochlicopa lubrica
Discus catskillensis
Euconulus fulvus
Gastrocopta contracta
Helicodiscus parallelus
Hendersonia occulta
Nesovitrea indentata
Punctum minutissimum
Stenotrema barbata
Strobilops labyrinthica
Zonitoides arboreus

South Branch Whitewater River Tributary

Carychium exiguum
Cochlicopa lubrica
Discus cronkhitei
Gastrocopta contracta
Hawaila minuscula
Helicodiscus parallelus
Punctum minutissimum
Strobilops labyrinthica
Vertigo gouldi gouldi
* Vertigo meramecensis
** Vertigo bollesiana

-
- * Federal candidate (likely G1-G3) landsnail species.
- ** Federal candidate (likely G1-G3) landsnail species previously unknown from Minnesota.
- *** Other landsnail species of significance in Minnesota.

APPENDIX 5: SITES NEEDING ADDITIONAL RESEARCH

Unsurveyed Sites:

1) Holt Spring Tributary: NE4, NW4, Sec. 12, T106N, R10W, St. Charles Township, Winona County, MN.

2) Money Creek: S2, NE4, Sec. 21, T104N, R10W, Pilot Mound Township, Fillmore County, MN.

3) Shattuck Creek 1: SE4, NW4, Sec. 7, T102N, R8W, Preble Township, Fillmore County, MN.

A new potential site as described by Kurt Rusterholz (MN NHP), possessing Sullivantia renifolia.

4) Shattuck Creek 2: NE4, NW4, Sec. 8, T102N, R8W, Preble Township, Fillmore County, MN.

A new potential site as described by Kurt Rusterholz (MN NHP), possessing Sullivantia renifolia.

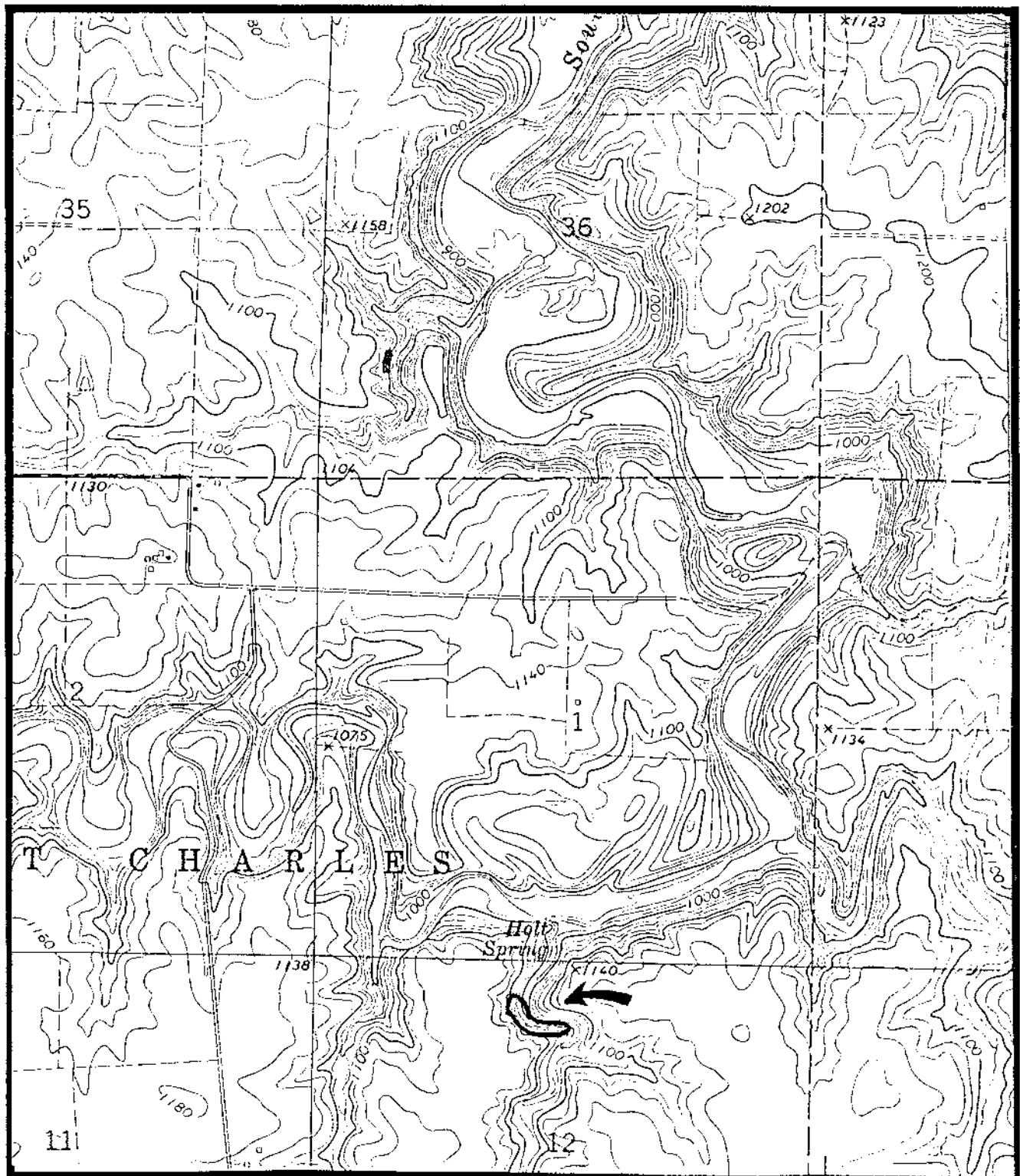
5) Silver Spring Creek: S2, NW4, Sec. 26, T109N, R13W, Zumbro Township, Wabasha County, MN.

6) South Branch Whitewater Tributary 2: SW4, NW4, Sec. 6, T106N, R9W, Utica Township, Winona County, MN.

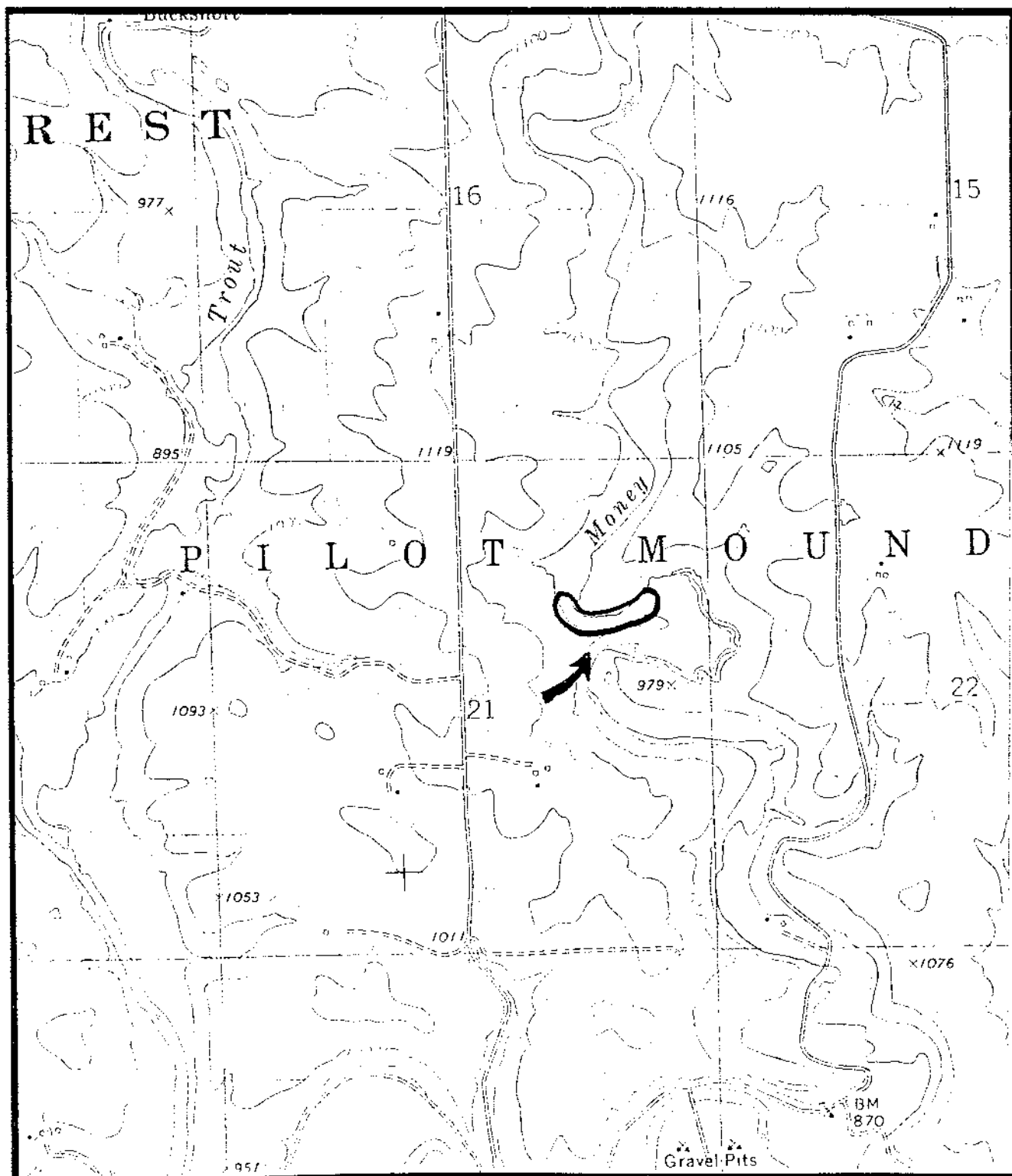
7) Sweet Ravine: SW4, SW4, Sec. 30, T109N, R7W, Norton Township, Winona County, MN.

8) Torkleson Creek: E2, SW4, Sec. 24, T104N, R10W, Pilot Mound Township, Fillmore County, MN.

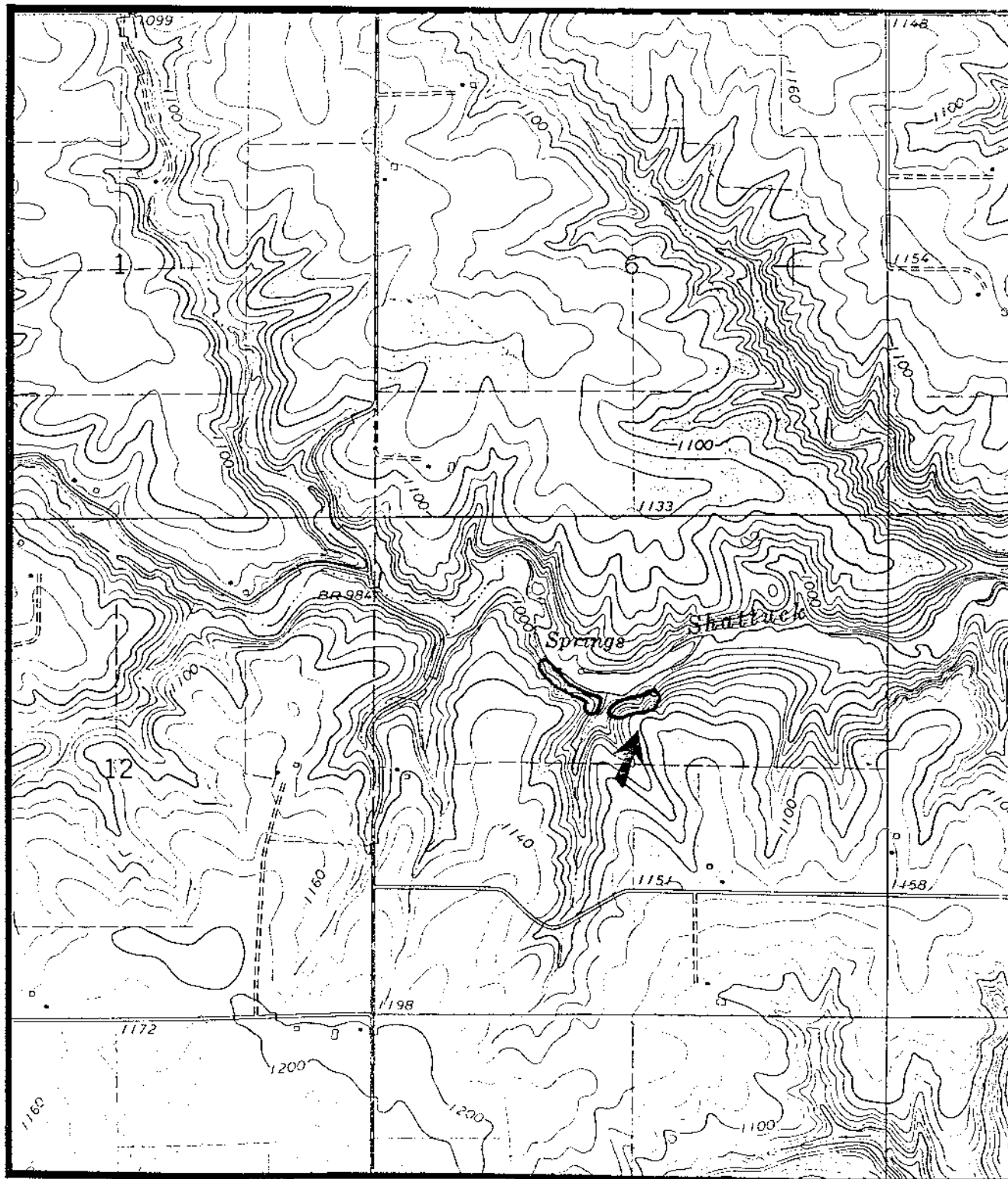
SITE NAME: Holt Spring Tributary
QUAD NAME: Altura
LOCATION: NE4, NW4, Sec. 12, T106N, R10W, St. Charles
Township, Winona County, MN.



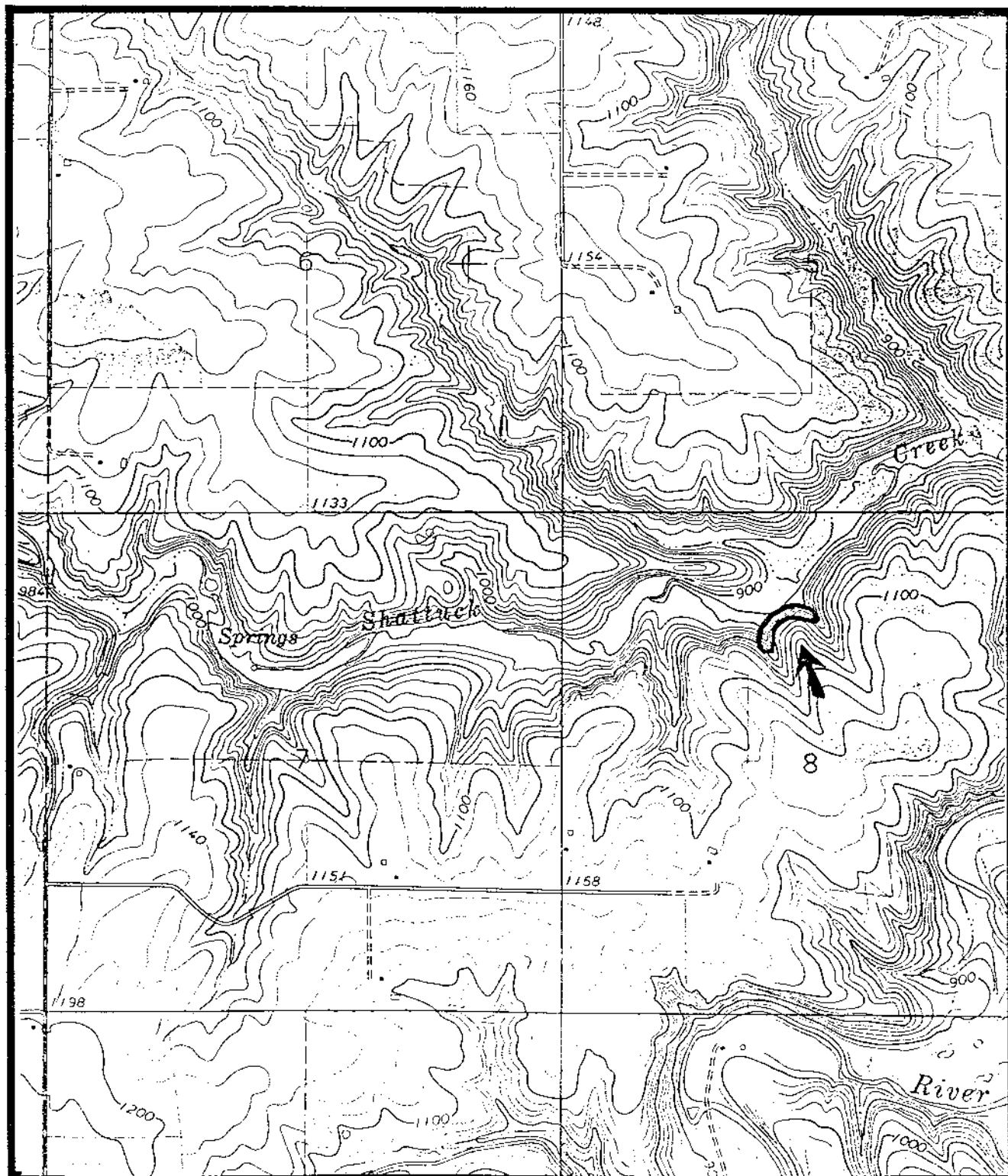
SITE NAME: Money Creek
QUAD NAME: Pilot Mound
LOCATION: S2, NE4, Sec. 21, T104N, R10W, Pilot Mound
Township, Fillmore County, MN.



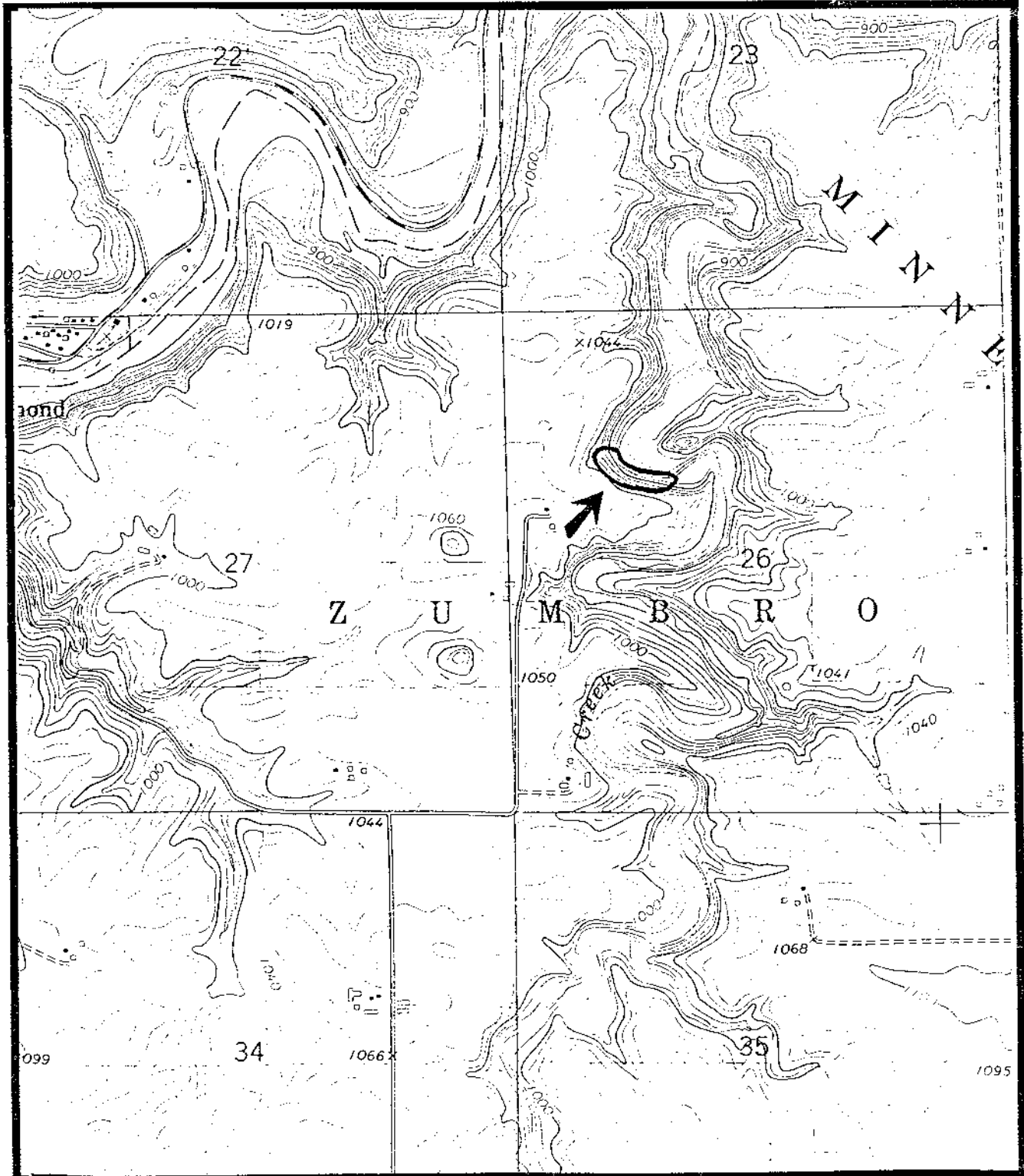
SITE NAME: Shattuck Creek 1
QUAD NAME: Bratsberg
LOCATION: SE4, NW4, Sec. 7, T102N, R8W, Preble Township,
Fillmore County, MN.



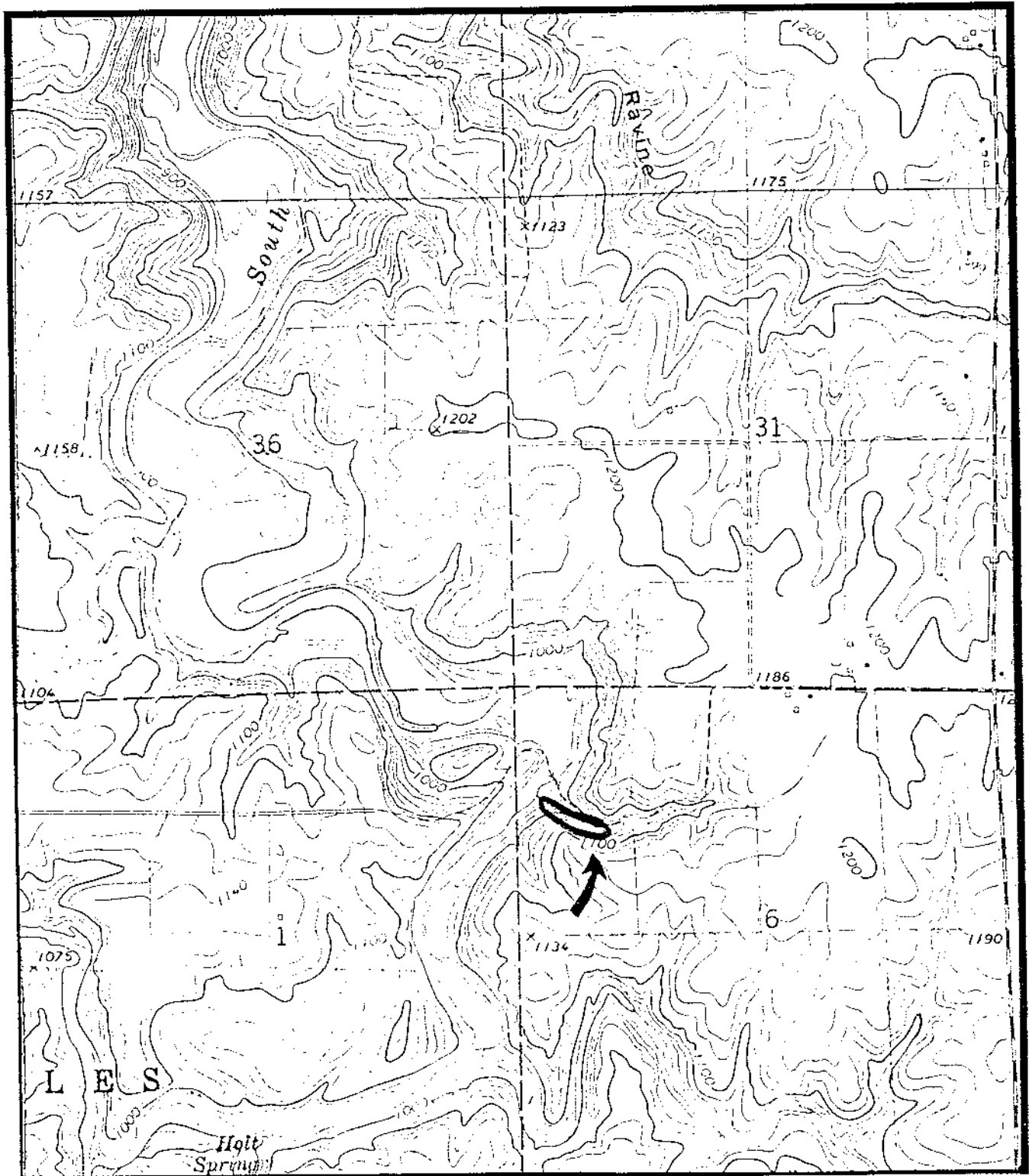
SITE NAME: Shattuck Creek 2
QUAD NAME: Bratsberg
LOCATION: NE4, NW4, Sec. 8, T102N, R8W, Preble Township,
Fillmore County, MN.



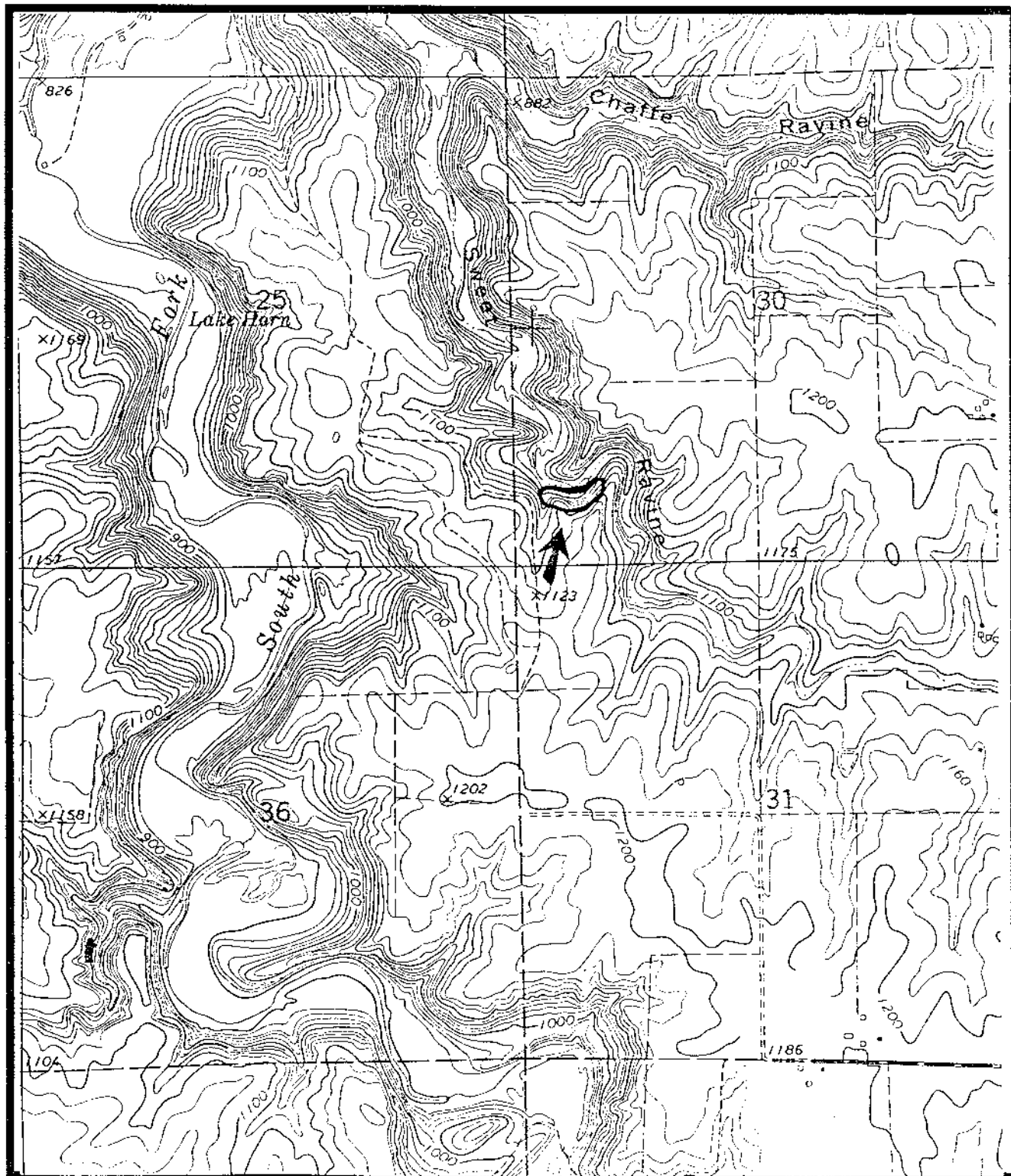
SITE NAME: Silver Spring Creek
QUAD NAME: Millville
LOCATION: S2, NW4, Sec. 26, T109N, R13W, Zumbro Township,
Wabasha County, MN.



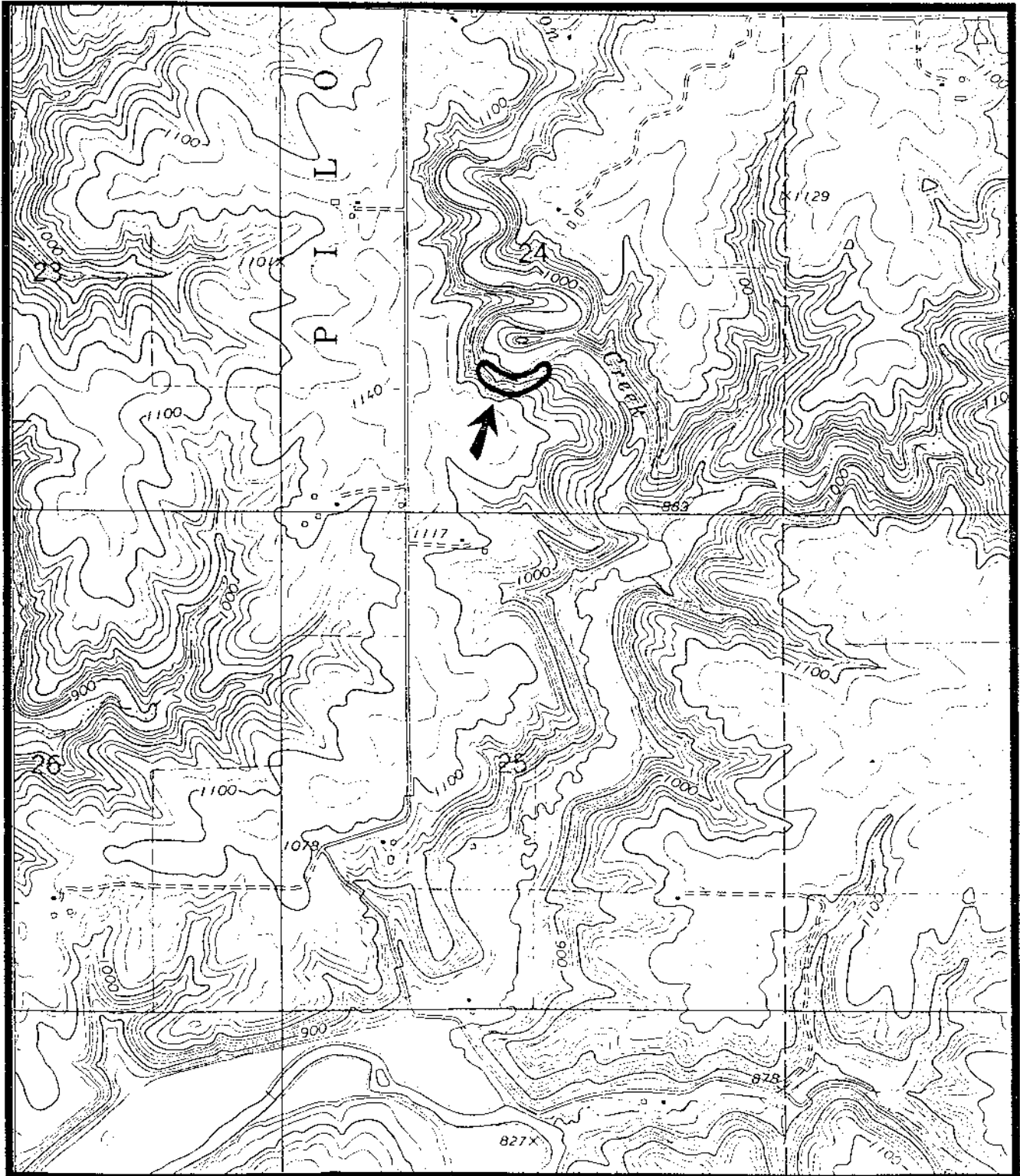
SITE NAME: South Branch Whitewater Tributary 2
QUAD NAME: Altura
LOCATION: SW4, NW4, Sec. 6, T106N, R9W, Utica Township,
Winona County, MN.



SITE NAME: Sweet Ravine
QUAD NAME: Altura
LOCATION: SW4, SW4, Sec. 30, T109N, R7W, Norton Township,
Winona County, MN.



SITE NAME: Torkelson Creek
QUAD NAME: Arendahl
LOCATION: E2, SW4, Sec. 24, T104N, R10W, Pilot Mound
Township, Fillmore County, MN.



Additional Survey Work:

- 1) Beaver Creek South 1: SW4, SW4, Sec. 16, T102N, R6W, Caledonia Township, Houston County, MN.

Site visited in 1989, but was not sampled for landsnails.

- 2) Hemingway Creek 3:

Determine the status and identification of a Succineid snail species that was collected from this site, but represented as a single specimen in fragmentary condition.

- 3) Hemingway Creek 2:

Determine the status of Vertigo hubrichtii n. sp. that was collected at this site, but was represented by a single specimen.

- 4) Logan Branch 1:

Resurvey needed to determine if Vertigo bollesiana occurs at this site. Tentative identification of the species from this site was made by Frest (pers. comm.) in 1989.

- 5) Logan Branch 3:

Recollect to identify a Succineid snail species that was collected from this site, but later lost.

- 6) North Branch Whitewater 5:

Determine the status of Vertigo meramecensis that was collected from this site, but was represented by a single specimen.

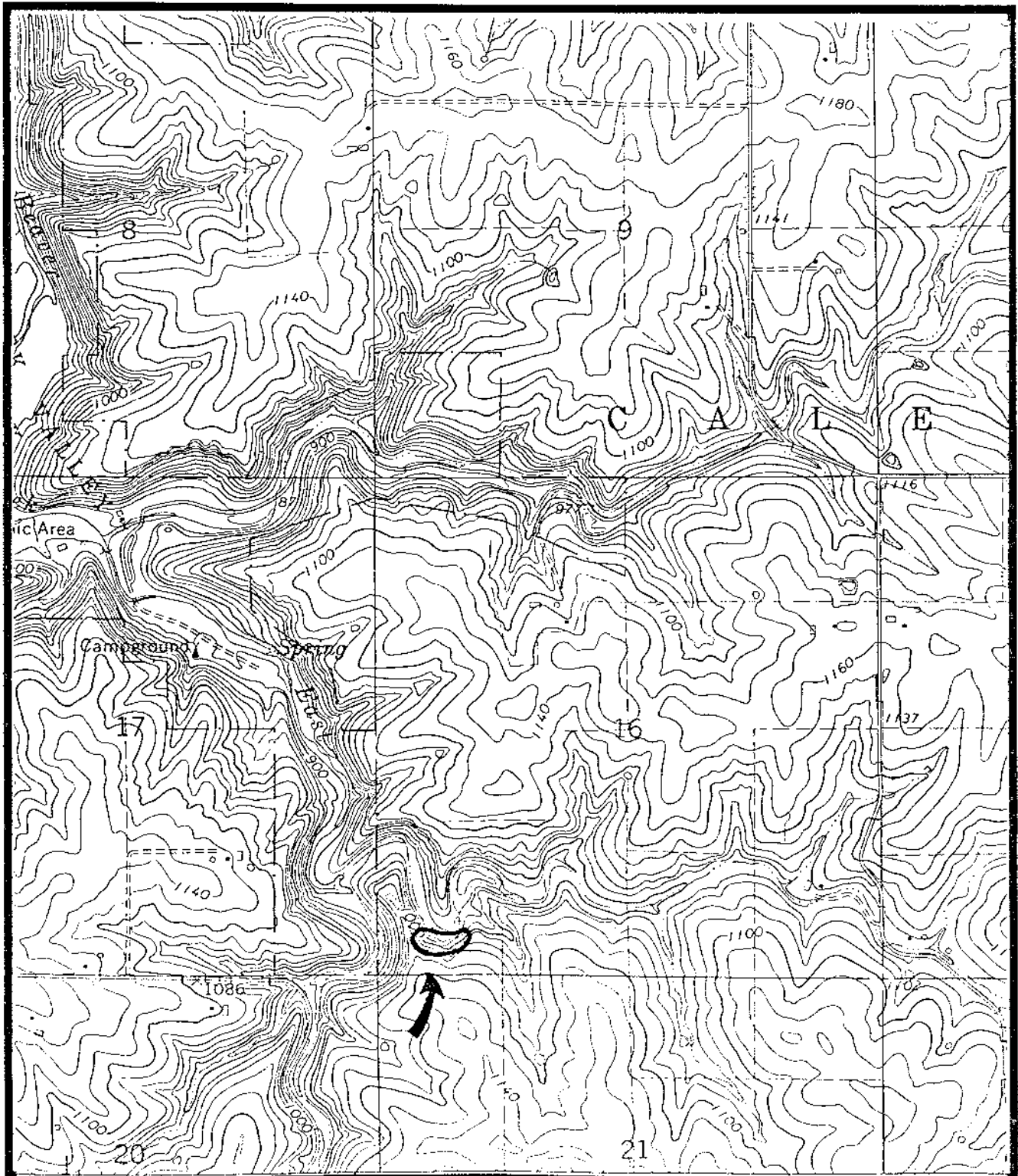
- 7) Riceford Creek 1: W2, SW4, Sec. 32, T102N, R7W, Black Hammer Township, Houston County, MN.

Site visited in 1989, but was not adequately sampled for landsnails.

- 8) South Branch Whitewater Tributary:

Determine the status of Vertigo bollesiana that was located at this site, but was represented by a single specimen.

SITE NAME: Beaver Creek South 1
QUAD NAME: Sheldon
LOCATION: SW4, SW4, Sec. 16, T102N, R6W, Caledonia Township,
Houston County, MN.



SITE NAME: Riceford Creek 1
QUAD NAME: Spring Grove
LOCATION: W2, SW4, Sec. 32, T102N, R7W, Black Hammer
Township, Houston County, MN.

