Historic Waters of the Capitol Region Watershed District
Ramsey County, Minnesota

Prepared for Emmons & Olivier Resources, Inc.

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Introduction

The Capitol Region Watershed District (CRWD), located in southwestern Ramsey County, Minnesota, has within its boundaries some of the most historic hydrological features in the Upper Midwest: Carver's Cave is the first cave to be described in the literature following Jonathan Carver's visits to it in 1766 and 1767, and nearby Fountain Cave was the first commercial show cave in the Upper Midwest, offering torchlight tours to visitors in the 1850s. Some of the pristine surface streams lovingly described by the pioneers and early visitors to our region still exist, flowing as lustily as ever, but through underground conduits. A complete inventory of these historic waters has been long overdue.

The purpose of this report is to describe the historic waters of CRWD, including its natural caves, historic springs, and former surface streams, now buried. In addition to describing physical and historical information for each feature, and how they were formed, suggestions will be offered as to possibilities for potential restoration, where appropriate.

Geology/Hydrogeology of CRWD

More than one billion years ago North America was nearly cleft in half by plate tectonic action and lava flows oozed out from the resulting rift—flows that can still be seen along the North Shore of Lake Superior and, closer to home, in the Dalles of the St. Croix River, at Taylor's Falls. This defunct rift runs like a giant scar from Minnesota south to Kansas, where it is located far underground. The rifting stopped but it left a depression that filled with sediments over time. This was the origin of the Twin Cities Basin, a thousand-square-mile geologic saucer that formed the foundation for all the rock layers to follow—including the familiar layers seen locally in the Mississippi River gorge.

After the Ice Ages, meltwaters from the great ice sheet, which ponded back to form an enormous lake, called Glacial Lake Agassiz, cut the present river gorge through the Twin Cities. This left a lowered base-level—a lower place for water to drain to. This was important for the development of natural caves.

Below the glacial deposits we encounter bedrock but there is an enormous geological time gap between these two layers. It just happens that the missing layers in between were not laid down in Minnesota to begin with, or, if they were, they were completely removed by erosion over a vast span of time. This uppermost bedrock layer we encounter was laid down in Ordovician times (505 to 438 million years ago).

In the old brickyards of Lilydale, in West St. Paul, just to the east of CRWD, the Galena Limestone is exposed at the very tops of the cliffs. No caves are found in this layer in the Twin Cities, but in southeastern Minnesota, especially Fillmore County, which has been called the heart of Minnesota cave country, all the big caves, like Mystery and Niagara, and several hundred others, are found in the Galena. This rock formation was named for exposures in Galena, Illinois; there, and in the adjacent states, it often contains lead veins.

The Decorah Shale, named for its outcrops in Decorah, Iowa, is very well exposed in the brickyards, just below the Galena Limestone. Owing to the fact that the shale provided the clay content for the former brick-making operation, the brickyards are also known as claypits. Owing to the imperviousness of this clay, there are abundant springs in the claypits, where the shale has intercepted descending groundwater, forcing it sideways to the exposed rock face. In winter, the springwater freezes, leading to the growth of gigantic ice columns, stout as oak trees, that last well into the spring season. The floors of the claypits, equally impervious, are lined with cattail marshes. Within the boundaries of CRWD, the distribution of Decorah Shale is somewhat patchy, leaving "islands" that stand up above the surface. These islands have been called Decorah Shale highlands by geologists, and by a nice coincidence, much of Highland Park itself occupies a Decorah Shale highland.

Below the Decorah Shale is the Platteville Limestone, formed in warm shallow seas about 450 million years ago, an environment frequently compared to the Bahama Islands of today. The presence of fossil green algae indicates that the Platteville seas were fairly shallow, about 150 feet deep, for the light to be able to penetrate the water column. The Platteville also contains volcanic ash layers, derived from ancient former volcanoes in what are now the Appalachians. Many species of invertebrates living in the Platteville seas become extinct when this ash fell, as if from atomic fallout. The ash layers are impervious to water and some of the most famous springs in Minneapolis, such as Chalybeate Springs, owe their existence to them. This limestone layer, named for rock exposures in Platteville, Wisconsin, frequently makes up waterfall ledges, as at Shadow Falls and Hidden Falls within CRWD. The Platteville Limestone is almost always 30 feet thick under the Twin Cities. Immediately underlying the Platteville is a 3-feet thick layer of greenish Glenwood Shale. While you might expect to see springs at this contact, only a few, scattered seeps are encountered.

The lowermost and oldest rock layer having exposures within CRWD is the St. Peter Sandstone The pioneer geologist David Dale Owen officially named this rock in 1847 for outcrops near Fort Snelling, along the St. Peter's River—now the Minnesota River. The St. Peter layer has an average thickness of about 100 feet regionally. However, it's about 150 feet thick at its type section at Fort Snelling and it ranges up to 500 feet thick at Joliet, Illinois, as determined from drilling records. The St. Peter is very extensive for a single formation, underlying nearly a quarter of a million square miles in the Midwest. The St. Peter has an almost saintly purity throughout most of this range, suggesting that it has been recycled from older sandstones, geologically winnowed of its impurities. The St. Peter is called a "sheet sand," meaning that it was laid down flat, like a sheet, over large areas, by a warm shallow sea that invaded the continent from the south. It was the last major sandstone layer to be deposited in the Upper Mississippi Valley. The St. Paul area was known to the Dakota Indians as "White Rocks" because of this glaringly white layer, exposed in its river bluffs.

Most importantly, the St. Peter Sandstone, in the Minnesota part of its range, lacks natural cementation, hence it is friable, and easily excavated. Natural caves form in the St. Peter Sandstone by a process known as "piping," a form of erosion caused by flowing groundwater. Piping forms two different kinds of cave in the St. Peter: tubular caves, best exemplified by Fountain Cave in St. Paul, and maze caves, best seen in Schieks Cave under downtown Minneapolis (Brick, 1997b). The term was borrowed from civil engineering practice in the late 1940s, where it was used originally to refer to the pipe-shaped voids formed by seepage of water around failing dams. Note that while the rocks themselves are old, the caves found in them are usually much younger, no older than the carving of the postglacial river gorge to which they presently drain.

Caves

The three important natural caves within the boundary of CRWD are Carver's Cave, Dayton's Bluff Cave, and Fountain Cave. These three caves are often confused with each other in the historical literature but are easily distinguished upon further examination. Carver's Cave is the short cave downriver from downtown St. Paul containing a lake, whereas Fountain Cave is the long cave above the city containing a stream. Stratigraphically, the two caves differ in that Carver's Cave is located near the middle of the St Peter Sandstone, whereas Fountain Cave is located near its top. There are subtle differences in the character of the sandstone itself at both locations, which was perceptively noted by Long, who visited both caves on the same day in 1817. Dayton's Bluff Cave is a smaller twin of Carver's Cave and located a short distance upriver from the latter. (Brick, article in review.)

Carver's Cave

Carver's Cave is a spring-cut cave in the St. Peter Sandstone, formed by the eroding away of sand grains by flowing water, a process called "piping." In form, it belongs to the tubular variety of St. Peter cave (Brick, 1997b).

Native Americans have always referred to Carver's Cave as *Wakan Tibi*, the Dwelling of the Great Spirit. Jonathan Carver visited what he called the "Great Cave" in 1766 and again in 1767, and it became the earliest Minnesota cave in the published literature when the first edition of Carver's *Travels Through the Interior Parts of North America* appeared in 1778 (Carver, 1956). Major Stephen H. Long, U.S. Corps of Topographical Engineers, visited the cave and named it "Carver's Cave" on July 16, 1817. Many accounts of visits to the cave subsequently appeared in the historical travel literature. While the cave has changed little over long stretches of time, and thus approaches extreme stasis, the overall impression you get from some of these accounts is exactly the opposite (Brick, 2006).

St. Paul druggist Robert O. Sweeny drafted a map of Carver's Cave about the time of the 1867 centennial of Carver's original visit and with certain exceptions it differs little from a 1981 survey map. The 1867 map is thus important in establishing the true identity of the cave, because there are similar caves nearby, such as Dayton's Cave, with which it has been confused over the years.

Carver's Cave has undergone repeated episodes of naturally sealing itself with debris from the cliffs above and being dug open again by some enterprising individual, about once each generation. Water levels of the lake inside the cave have fluctuated considerably over the years depending on whether cliff debris has dammed back the water. While it is uncertain how extensive the subterranean spring-shed is for Carver's Cave, it is known that in 1913, when the lake inside the cave was drained, the water level in Dayton's Cave, located about 400 feet upriver, was affected.

The most famous reopening of Carver's Cave, which generated by far the most publicity, was that by John H. Colwell in 1913. Since the cave entrance was concealed by sand deposits, one of the methods used by Colwell to relocate the cave was to trace the spring water leaking from the deposits at the foot of the bluff. It was in the wake of Colwell's activity that journalist Charles T. Burnley produced a conjectural map of the cave that resembled the gut chambers of a cow, showing several rooms beyond the present back end of the cave (Brick, 2007b).

Carver's Cave sealed itself again and was relocated and dug open in 1977 by the St Paul Parks and Recreation Department as an official Bicentennial project. Afterwards, the steel doors now seen in front of the cave were constructed to restrict access, but it is still quite easy for determined individuals to crawl past them. Owing to the funnel-shaped morphology of the bluff face above the cave, which channels avalanche debris, an alluvial cone formed in front of the steel doors over time. While the outer half of this cone—outside the cave—was removed several years ago during landscaping for the newly established Bruce Vento Nature Sanctuary, the other half—inside the cave—remains. As you proceed farther into the lake inside the cave, there is a drop-off into deeper water, which marks the edge of the debris cone.

The author of this report began making regular visits to Carver's Cave in the late 1980s and in the late 1990s undertook a series of measurements in the cave lake using electronic equipment (AquaCheck™). The average water temperature was 10°C. Other values recorded included pH, electrical conductivity, and the amount of dissolved oxygen in the cave lake. Using various configurations of a flume, discharge from the cave was measured as approximately 100 liters per minute.

While a full biological survey of the cave has never been conducted, the author of this report has regularly observed the amphipod *Gammarus pseudolimnaeus* (a crustacean more commonly known as a scud, or freshwater shrimp) in the lake that fills the cave (Brick, 2000), along with white planarians (flatworms), snails, minnows, and frogs. The Carver's Cave ecosystem, lacking photosynthetic inputs, is based on organic detritus, chiefly decaying leaves that have blown in through the cave entrance, providing food for the amphipods, which in turn serve as prey for fishes. The most unusual creature observed by the author in the cave, however, was a beaver, in 1999, which had assembled a cache of sticks on the beach just inside the entrance.

It would be very difficult to bar access from Carver's Cave. However, from the author's experience, if the current water levels in the cave are maintained, that will be sufficient to deter visitors from proceeding further, owing to the depth and painfully cold temperature of the water, which acts as a strong deterrent to casual exploration.

Apart from the author's numerous publications on Carver's Cave, two other important sources are Woolworth and Woolworth (1980) and Terrell (2003).

Dayton's Bluff Cave

This natural cave is located about 400 feet upriver from Carver's Cave in the St Peter Sandstone of Dayton's Bluff but its entrance is sealed by accumulations from the bluffs above. The exact location is suggested by the spring water seeping from the colluvium. In some respects this cave seems to be a smaller version of Carver's Cave in that it contained a lake and was graced by petroglyphs. The cave may have been visited as early as Long, in 1817. In pioneer days, this cave was frequently mistaken for Carver's Cave, with which it was hydrologically connected, and it was used as a root cellar or for the storage of ale. Newspaper reports suggest that the cave was open as late as 1961. (Information from author's files; Terrell, 2003.)

Fountain Cave

Fountain Cave in St. Paul, the longest natural sandstone cave in Minnesota, is a cave of many state firsts. The first graphic depiction of a Minnesota cave, in 1850, was of Fountain Cave; it became the first show cave in Minnesota in 1852; and it was the first cave in Minnesota to have its speleogenesis thoroughly discussed by the many visitors traveling up the Mississippi River (Brick, 2004). The cave still exists but is inaccessible because the highway department sealed it during the construction of Shepard Road in 1960 (Brick, 1995).

Fountain Cave dates to the waning of the last Ice Age. The melting ice sheet to the north pooled up to form the enormous Glacial Lake Agassiz, with more water than all the present Great Lakes combined, and the spillover from this lake formed Glacial River Warren, an ancestor of the present Mississippi. A waterfall on this glacial river, thought to have been grander than Niagara Falls, chewed its way upstream from downtown St. Paul, carving the present gorge. Migrating past the site of the future cave, it exposed the St. Peter Sandstone. The sandstone aquifer, thus uncorked, drained laterally to the new gorge along pre-existing rock joints. The flowing water enlarged the joints into a cave—a process that geologists called "piping." In 1932, St. Paul landscape architect George L. Nason described how the 400-foot long ravine at the cave's entrance—"the beautiful little valley," as he lovingly called it—was "formed by the caving in of the roof at various times" (Brick, 2008).

Fountain Cave was discovered and named on July 16, 1817, by Major Stephen H. Long, U. S. Corps of Topographical Engineers. Joseph N. Nicollet, the French émigré scientist who drafted the so-called "mother map" of Minnesota, visited Fountain Cave in 1837. It is marked "New Cave" on his famous 1843 map, *Hydrographic Basin of the Upper Mississippi River*. In the report that accompanied the map, he stated that "The cave now referred to is of recent formation. The aged Sioux say that it did not exist formerly." The idea of recent formation apparently influenced the Native American name for Fountain Cave, "the new stone house." It is more likely, however, that Fountain Cave was not "new" at this time, merely newly reopened. The cave entrance had been concealed by collapse debris, it may be conjectured, and was flushed open again by Fountain Creek in 1811 (Brick, 1995).

The famous Pierre "Pig's Eye" Parrant—depicted with his eye-patch on countless beer cans in our own day—arrived on the scene in 1837. Parrant was a French Canadian voyageur who attempted sedentary habits in his old age but he did not actually live in Fountain Cave. On the contrary, much of his supposed historical importance rests in the fact that he erected a log cabin, one of the first buildings on the site of what is now St. Paul, on or about June 1st, 1838. Often loosely described as a "saloon," it was sited at the mouth of the secluded gorge so that potential customers could see it from the river. Some squatters at Camp Coldwater, near Fort Snelling, soon moved downriver to join Parrant, and cabins began to sprout like mushrooms at the cave. But since the platting of the city of St. Paul actually began in 1849 with "St. Paul Proper," in what is now the downtown area, and not at Fountain Cave, the traditional claim that Parrant founded the city is untenable.

The most elaborate account of Fountain Cave was presented in E. S. Seymour's *Sketches of Minnesota, the New England of the West*, published in 1850—a version that was to be reprinted and plagiarized more than any other in the coming years. Seymour's description establishes that the cave was basically an unbranched tube, wholly in the sandstone layer. Apart from widenings of this passage, called rooms, much of the passage was crawlway. There were four rooms successively decreasing in size upstream, of which he gave the dimensions. The third room back was the only named feature in the cave, called "Cascade Parlor" because it contained a waterfall two feet high. He

did not go beyond the fourth room, having penetrated an estimated distance of sixty rods (990 feet), but stated that he could hear a second waterfall in the distance.

In 1880, the newly formed Chicago, St. Paul, Minneapolis, and Omaha Railroad began building a roundhouse and repair shops in the triangle of land bounded by Randolph, Drake, and the river. The oldest and only complete map of Fountain Cave known to exist dates to the 1880s and shows this facility already in place. The map also shows Fountain Creek, a surface stream arising from wetlands in the Fort Road neighborhood in St. Paul, draining into a sinkhole at the upper end of the cave, flowing through the cave and out again into a ravine that led to the Mississippi River. A shaft was constructed so that sewage could drain from the shops into the cave (Brick, 2007a).

The author of this report was able to pinpoint the exact location of the sinkhole draining into Fountain Cave using old real estate plats. A railroad spur servicing the Ford Motor Company plant in Highland Park was built right over that very spot in 1923. Once the Fort Road wetlands and the sinkhole were built over, the water supply to the cave was cut off and cliff debris began to accumulate at its entrance, debris that ordinarily would have been flushed away by the cave stream itself.

Springs

Springs in CRWD tend to be found along spring lines at discrete elevations, depending on bedrock contacts, where there are perched water tables. The springs discussed below are organized by spring-line, starting with the stratigraphically most elevated one. Of course, many of these spring-lines continue into adjoining areas. Not all of these springs are perennial; some of them will only be found during wet years. Coverage for the city of St. Paul is more complete than for the northern part of CRWD, away from the Mississippi River, where scattered, depression-type springs in glacial drift may exist and are as yet unmapped; this latter area remains to be thoroughly researched.

Drift-Decorah Shale Springline

The most coherent spring-line in St. Paul is that marking the contact of the glacial drift with the underlying Decorah Shale, along the edges of the Decorah Shale highlands. In the classification presented by Schwartz (1936) this is called the “third type” of spring, which he defined as “Springs at contact of unconsolidated material with solid rock.” Water seeps down through porous material until meeting an impervious layer and is then shed laterally to the river gorge. Schwartz & Thiel (1954) published a diagram of this type of spring. Since the relevant geological contact is not directly visible in most cases, its presence was inferred based on the elevation of the top of the Decorah Shale, as determined from the bedrock topography map of Mossler (1992). This map has 50-foot contour intervals, and the author was most concerned with the 850-900 foot interval. Unless specified otherwise, the average flow rate of many of these springs is less than one gallon per minute. The following passage from Bond (1857) may be the earliest allusion to the drift-Decorah spring-line:

> There is one serious objection to the back-grounds of St. Paul, at present, though in time, it will prove to be a great blessing. A great many springs of ‘pure cold water’ are continually gushing from the base of the above-mentioned hills, forming several bad marshes, and rendering an access to

> many of the choice situations rather difficult. Good roads have been constructed over these wet places, while the water supplied by the living fountains, can easily be brought in town.

According to Brick (2007c), "When plotted on the topographic map, I fancied that the dozens of sparkling springs along the drift-Decorah contact had the outline of a necklace, eight miles long, looping around the neck of St. Paul, roughly following the Mississippi River. And while waterlogged landowners might object to using the word 'diamond' in reference to them, they are St Paul's most distinctive springs, just as the Platteville spring-line best characterizes neighboring Minneapolis."

Here are a few of the better known springs along this spring-line:

Ninth Street Springs

Formerly located in downtown St Paul, but now dried up or buried. Mentioned in historical accounts, it is not certain which spring-line they belonged to, but it is likely that they were drift-Decorah contact springs (Brick, 1997a).

College Avenue Springs

According to St Paul historian Don Empson (pers. comm.), the College Avenue springs were located near (or under) the present Minnesota History Center, but the author of this report could not find any trace of them, except perhaps for a persistent sound of rushing water in one of the storm drains below the building (Brick, 2007c).

Walnut Street Spring

The Walnut Street stairway runs alongside the James J. Hill House, and about half way down there is seepage on the stairs. No historical or other information is available. **(**Brick, 2007c)

Irvine Avenue Springs

According to Brick (2007c), "I continued mapping this spring-line through the Irvine Avenue neighborhood of St Paul, below Summit Avenue, certainly the most scenic part of the project. Historic houses cling to the steep slopes, and I found myself spring-hunting midst the gables. At a residence whose address plate said, 'Rue Eugene-Dupont,' water poured from a crack across the driveway, streaming downhill along the switchbacks before vanishing into a storm drain. The Irvine springs, though charming, bring trouble for residents, causing slick winter pavements, slope movements, and wet basements, as reported in a recent newspaper article (Agha, 2003)."

Grand Avenue Springs

"Where the spring-line crossed Grand Avenue, I found [in 1993] ornate lampposts with water gushing from their bases, which were swathed with filamentous green algae, suggesting an on-going, rather than merely temporary, situation." (Brick, 2007c)

Pleasant Avenue Springs

"Along Pleasant Avenue (as at its intersection with St Albans, and with St Clair) I found retaining walls of limestone rubble masonry, at the foot of which there were springs. A local resident told me that his parents used to drink water from the Pleasant Avenue springs. Indeed, the 'Pleasant avenue and St. Clair street' location was officially listed in the *Annual Report of the City Engineer for the City of St. Paul* (1895) under the heading 'Street Fountains,' along with the clarification, 'water from spring.' The 1901 report, however, strikes a different tone, describing 'the success that has been achieved in the doing away of numerous springs at various parts of the city that in the past have been a considerable source of annoyance, danger and expense during the winter months. These springs have been properly intercepted, and we are not annoyed during the winter months by ice creeping all over the street, forming regular icebergs.'" (Brick, 2007c)

Linwood Park Springs

"Along greenish outcroppings of Decorah Shale in Linwood Park, I found a place where one of the springs could be observed issuing directly from the ground, supporting a growth of cattails, and measured the flow as 1 gpm." (Brick, 2007c)

Highland Springs

The following account of Highland Springs has been heavily abridged from Empson (1975).

Between 1871 and 1885, William Nettleton owned a 130-acre dairy farm in the area around St. Paul's Randolph Avenue and Lexington Parkway. His house and property were subsequently purchased by the Wardell family who, for three generations, lived in the Nettleton house and supplied the city with pure drinking water from a bountiful spring on the property. The spring that was to supply a livelihood to the Wardell family for 65 years, delivered a constant flow, summer and winter, of 27 gallons per minute. The temperature was a constant 42 degrees Fahrenheit, no matter what the season. The water had 25 grains of hardness (13 calcium, 12 magnesia) and was said to derive from drainage bounded by Montreal, Saratoga, Summit, and Syndicate streets, percolating down 20 feet before flowing to the spring.

The company supplied drinking water to businesses and private homes. Weekday mornings, a wagon loaded with bottles of spring water, plus a generous helping of crushed ice, made its way down the Randolph hill to downtown St. Paul. Following a regular route, Wardell carried bottles into office buildings, setting them up in a cooler, and surrounding them with crushed ice. Afternoons, the wagon's route extended out into residential areas, where the weekly 6½ gallon containers were delivered. Sundays, the wagon made a long trip to White Bear to supply that area.

Since providing water also meant providing ice, the Wardells created a pond on their property by letting the spring overflow into a depression. The pond, as much as 9 feet deep, had dimensions of 100 by 200 feet. The annual ice harvest amounted to 300,000 tons, all neatly cut with a rotary saw into foot-thick blocks, 11 by 22 inches. The blocks were drawn by horse pulley up a track into the three story icehouse built into the hillside.

The company grew over the years, and trucks began to replace wagons. By 1920, the company employed about 25 people, but that same year, Prohibition dealt a blow to the firm. The soda pop business, carried forward from the years on the West Side, had to be discontinued. Saloons, where soda pop was consumed at that time, were largely controlled by the breweries who, with the advent of Prohibition, switched to manufacturing their own soda pop. Henceforth, the Wardells had to depend solely on the spring water business.

By 1965, the old Nettleton farm, home of the Highland Spring Water Company, had become a choice piece of real estate with a commanding view. At the same time, the business of deriving a livelihood from a spring in an urbanized area had become problematical. An excavation in the wrong place, a break in the sewer, pollution in any form, and the company would be out of business overnight. The Wardells sold their property to a developer, and their equipment to the Chippewa Spring Water Company. The old Nettleton house was torn down and Montcalm Estates was constructed on the hillside.

Today, Highland Spring is routed into the storm drains, but behind Montcalm Estates, peering down through the manhole grating, you can still see the flow of the spring from the hillside above, running at its constant 27 gallons per minute.

Additional information on Highland Spring, including a chemical analysis, can be found in Schwartz (1936), who, however, states that there are two springs, with flows of 800 and 1,000 gallons per hour (which adds up to 30 gpm).

Fountain Park Spring

“Just beyond [Randolph and Lexington], the spring-line passed through the eponymous Fountain Park, a small, unmarked city park wedged between two residential properties on Lexington Avenue.” (Brick, 2007c) This spring probably only flows during very wet weather.

Dawson Park Spring

“The spring-line then ran through Dawson Park, also unmarked, where I encountered a healthy flow in the ravine.” (Brick, 2007c)

McDonough Park Springs

“In McDonough Park, also unmarked, along the north side of St. Paul Avenue, I mapped several more springs. Empson (2006) charmingly refers to these unmarked, neglected city parks as ‘ghost parks,’ and gives a list of them. The association between ghost parks and springs is hardly accidental, because these frequently rugged little lots were donated to the city by individuals who found them useless for building purposes and the city probably did not formally develop them for

the same reason. But that happens to be exactly the sort of hillside situation in which the drift-Decorah spring is lurking." (Brick, 2007c)

Sunny Slope Lane Spring

"At Sunny Slope Lane, I encountered a rivulet flowing in the street [in 1993], and traced it back to a private residence (No. 1760). Had I not been walking the spring-line I would have missed this one, because it looked merely as if a garden hose had been left running in the front yard. Contacting the owner, I learned that there was a trapdoor in the basement that could be lifted to view the spring." (Brick, 2007c)

Dew Drop Pond

"Dew Drop [is] a pond at the foot of 'Chapel Hill' (as it's known locally) on the campus of the University of St. Catherine. The pond's elevation suggested to me that it was fed by these springs, and just recently I found an old postcard depicting the spring itself. When I spoke with the college archivist, Sister Margery Smith, she informed me that she had never seen an image of the spring anywhere, and asked me if I would donate the postcard to their archives. Postmarked 1909, this artistic rendering—one of the earliest depictions of Highland Park scenery—shows the Dew Drop in the background, before it was landscaped in the 1920s, with the addition of an island. Even though the spring pool is quite shallow (several feet at most), I recall having read in the newspapers years ago of students drowning in it, giving it a melancholy distinction among the springs of St. Paul.

"Bruce Erickson, campus engineer, gave me a tour of the Dew Drop this past summer [2007] and informed me that St. Catherine's Library has a sump pump that used to run 24 hours a day owing to the shallow water-table. In 2002, during a major reconstruction project, it was decided to deal conclusively with the ground water problem, and a concrete pipe, 24 inches in diameter, was laid under the site, draining into the pond. Erickson says that the discharge from the pipe is 18 gallons per minute, keeping the pond ice-free in winter. The library's sump pump rarely activates nowadays." (Brick, 2007c)

St. Paul Seminary Grotto

"At…St. Paul Seminary…there's a smaller ravine running back from the Mississippi River, at the head of which is a grotto, dated 1919, which displays a sculpture called 'Tongues of Fire.' The dry-weather flow in this ravine is entirely from ground water seepage and on the particular day that I measured its cumulative flow, at the little waterfall in the lower ravine, it was 10 gpm. Ironically, no spring-water arises within the grotto itself, calling to mind the old adage about how springs often refuse to bubble up into the marble basins we build for them. I noticed that there were several other small spring-cut ravines of this type along the Mississippi River Boulevard, usually containing visible outcrops of greenish Decorah Shale." (Brick, 2007c)

Shadow Falls

Shadow Falls is formed where a stream pours over a ledge of Platteville Limestone near the west end of Summit Avenue. The waterfall is frequently attributed to a spring, because when you trace the stream uphill through the Decorah Shale ravine, the water is seen to be vigorously emerging

from the ground at one point. However, upon digging about with a shovel, the author of this report encountered a storm drain and a strong odor of hydrogen sulfide, so it appears that the "spring" is in fact the buried exit point of a storm drain (Brick, 1997a).

Nonetheless, the evidence is somewhat ambiguous. Nason (1932), a reliable source, asserts that there is a spring here. Likewise, the earliest record of Shadow Falls is identified as "Spring Leap" on Plympton's 1839 map of the Fort Snelling Military Reserve. Moreover, in April, 1933, there was newspaper coverage of children succumbing to typhoid after drinking from a "spring" at this location. It could be that the storm drain leads back to an authentic spring, now buried.

Town & Country Club Spring

"The final spring that I dealt with was at the Town & Country Club along Marshall Avenue, where there's a spring in the golf course rough. The ground was so waterlogged that it was like walking on a bog mat. Surrounded by giant willow trees, the scenery here probably best recreates the appearance of this type of spring back in the early days of St. Paul; a sign on the gatepost indicated that the club was established in 1888." (Brick, 2007c)

Les Bolstad Golf Course Springs

The Decorah Shale tends to form isolated "islands" around the Twin Cities area. The headwaters of Bridal Veil Creek (see below) are found in springs in ravines on the wooded slopes below the University of Minnesota's golf course. In 1994, the author of this report cultured filamentous algae from water samples collected at these springs for a class in cryptogamic botany.

Drift-Platteville Limestone Springline

This spring-line follows the glacial drift-Platteville Limestone contact. It is most noticeable along the Mississippi River Boulevard, where the springs, eroding headward, have carved ravines, necessitating a series of bridges and bends in the road. Most of these springs appear to be minor, such as the one at the former Stonebridge estate.

Platteville Limestone Springline

This spring-line, very pronounced in Minneapolis, is characterized by countless minor seepages along the outcrop of the Platteville Limestone in CRWD, and examples can be seen in the outcrops below the western end of Eustis Avenue. No named or historical springs are found here, however, unless the former Rum Town Spring (exact location uncertain, but it was in St. Paul, across from Fort Snelling) fell into this category.

Platteville-Glenwood Springline

This spring-line is very minor in CRWD. No named or historical springs are found here.

St. Peter Sandstone Springline

Where the water-table in the St Peter Sandstone intersects the Mississippi River gorge, springs can sometimes be found. However, apart from Carver's Cave and Fountain Cave, described above, this spring-line is very minor in CRWD.

Other Springs

Midway Springs is located in a closed glacial depression where Fairview Avenue passes under Interstate 94 in St. Paul. The water, probably derived from the glacial drift, is diverted into storm drains in a small fenced off area along the east side of Fairview Avenue.

North Star Spring. The North Star Brewery dug lagering caves in the St. Peter Sandstone of Dayton's Bluff in 1855. Abandoned by 1900, the largest of the caves has a powerful spring in its floor, flooding the cave with several feet of water. The spring water drains from the cave and has been channeled through a stone-lined canal into a landscaped pond in the Bruce Vento Nature Sanctuary. A thick growth of watercress can often be found near the mouth of the cave.

Skonard's Spring is located near the intersection of State Highway 280 and Energy Park Drive in St. Paul and the water probably derives from glacial drift. Historically, this spring was used as a water supply by the local residents and today it drains to the nearby Kasota Pond (Dr. Karlyn Eckman, pers. comm.).

Swede Hollow Spring was used as a water supply by the residents of this former St. Paul neighborhood. The author of this report found it difficult to locate former residents who could tell him its exact location but the impression he received was that the spring was located in the valley bottom, rather than among the outcrops. In that case, the spring water could have derived from alluvial materials. Given the abundance of outhouses along Phalen Creek, which ran through the ravine, the water could not have been wholesome to drink (Brick, 1997a).

Streams

Surface streams get buried and "lost" for a variety of reasons. Sometimes the motive is to hide what has become an eyesore, or to alleviate flooding. Sometimes the land on which the stream flows is needed for other purposes. Or sometimes, as in the case of Trout Brook, the streams were not buried *per se*, so much as that the adjacent street grade just grew upwards around them over the years.

In a very real sense, of course, the former surface streams are not "lost" since they are still flowing as lustily as ever. Indeed it would take a very expensive feat of engineering to get rid of them completely. To truly eliminate a stream you would have to fill the drainage basin, eliminating the topographic focus of the drainage. That could involve shifting many cubic miles of soil. These Twin Cities streams are most comprehensively described by Brick (book in review). The subject of daylighting, or re-excavating buried streams, is covered by Pinkham (2000).

The Trout Brook-Phalen Creek System. One of the most salient topographic features of downtown St. Paul is the mile-wide gap in the white crescent of sandstone cliffs along the Mississippi River. City Hall stands on a full thickness of bedrock, but the sandstone thins out where Kellogg Boulevard goes downhill, finally to vanish from sight altogether before reappearing in all its glory at Dayton's Bluff. Lowertown occupies the resulting gap. Geologists long ago surmised that this gap was carved by a preglacial precursor of the Mississippi, flowing down from the north. The Mississippi has changed course several times in the past million years or so and has only lately carved its present gorge. The topographic depression left by its precursor became the focus of postglacial drainage, and the stream that now runs through the gap is called Phalen Creek—together with its largest tributary, Trout Brook.

In pioneer days, just trying to throw a road across the Trout Brook-Phalen Creek lowland was a Herculean task, as may be gleaned from the old City Council minutes. It was first proposed to grade East 7th Street across the "bottomless bog" in 1860 but it wasn't until 1873 that the job actually got done. These streams are reflected in early, but now defunct, street names. Culvert Street was named after Phalen Creek, Brook Street after Trout Brook, and Canal Street for the combined stream below the confluence.

But something had to be done about the Lowertown wetland as a whole. In one of the most dramatic cut-and-fill jobs in municipal history, Baptist Hill, a mound of glacial debris 50 feet high, formerly located where Mears Park is today, was carted eastwards after the Civil War under the direction of city engineer David L. Curtice and dumped into the wetland. In the process, Phalen Creek and Trout Brook were left at their original, lower level—already well on their way to becoming subterranean. But while the Trout Brook-Phalen Creek valley was a curse to roads, it was a blessing for the railroads. Railroads have so dominated this valley ever since that the land between Phalen Creek and Trout Brook came to be known as "Railroad Island."

In 1893, city engineer George Wilson undertook the task of formally burying the lower reaches of the two streams, though several short segments had been roofed over years earlier. It was officially dubbed the Canal Street Sewer. Wilson's magnum opus still exists, and is easily distinguished by its innovative steel beam ceiling, Platteville Limestone rubble masonry walls, and granite floor. Wilson was so proud of his handiwork that he published an article about it in *Engineering News* in 1894, and one of the accompanying figures became incorporated into sewer textbooks (though at least one of the textbooks misattributes it to Minneapolis). Wilson's annual reports for these years contain classic photos of the project.

Trout Brook

Edmund Rice built a mansion, called "Trout Brook," which gave the stream its name. Back then, the stream was not only good enough to support trout, it was good enough to drink, even being piped into the house, as described by a descendant of Rice, Maria Dawson, in her *Letter About Trout Brook*, in 1953. The mansion was purchased in 1883 by the Northern Pacific Railroad and demolished to make way for railroad tracks.

In 1926-27, city engineer George Shepard (for whom Shepard Road is named) extended the Trout Brook Tunnel. Later, the tunnel was extended again, running under Maryland Avenue all the way to Lake Como, reducing the original Trout Brook, which began at Lake McCarron and today plunges

underground near Arlington and Jackson, to a mere side-passage. The most distinctive features of Shepard's handiwork are the square "cleanouts" which jut from the ground like the conning towers of a land-going submarine. You can see the cleanouts today along the various railroad tracks which thread the Trout Brook valley.

During especially heavy rains, Lowertown used to flood very badly. The problem was focused at the meeting of the waters, the junction of Trout Brook with Phalen Creek. Water couldn't get through the tunnels fast enough and backed up into the adjacent streets. To further alleviate flooding in Lowertown, Trout Brook was decoupled from the Phalen Creek Tunnel in the 1980s, giving them separate outfalls, thus increasing the discharge capacity of the system. The new Trout Brook outfall, a double-box section, is located 500 feet upriver from the old Canal Street outfall.

Without question, Trout Brook, as St Paul's major historical subterranean stream, is the largest potential scale daylighting/restoration project in CRWD. But this statement applies only to the segment of the stream upstream from the downtown area: roughly what was described above as having been buried by city engineer Shepard in the late 1920s, and subsequent upstream extensions. The advantages here are, firstly, that Trout Brook, upstream from the downtown area, is out in the middle of railroad right-of-ways rather than under buildings, so there would be adequate room for a riparian corridor, with integrated detention ponds or wetlands. Secondly, Trout Brook is close to the surface in much of this area, such that the crown of the tunnel projects above grade level. On the downside, it must be noted that such a project will almost certainly encounter heavily contaminated railroad soils, and these will be expensive to deal with.

Phalen Creek

Phalen Creek was named after Edward Phelan. Discharged from Fort Snelling, the former soldier built a cabin near downtown St. Paul, circa 1840. We first read of Phalen's Creek in an early deed, dated September 2, 1844, from Edward Phelan to William Dugas, of "160 acres on Faylin's Creek and Falls." Dugas built St. Paul's first sawmill here. But the creek also went by other names back then. On one of the earliest maps of St. Paul it is shown as McCloud Creek. It was also called Mill Creek. The geologist Newton H. Winchell gave a list of the mills on Phalen Creek in 1877, adding that "since the railroads have encroached on the natural course of Phalen's creek and the city water works have diminished its volume, some of them have been abandoned." Winchell's remark refers to St. Paul's first water works, built by Charles Gilfillan, which drew water from Lake Phalen through a 16-inch pipe. Originally, the plan had been to draw water from the creek itself, but mill owners objected.

Above the junction with Trout Brook, Phalen Creek flowed through the famous Swede Hollow. This deep ravine protected residents from the blasts of winter and kept them cool in summer. Originally taking its name from the Swedes, the hollow became a focal point for subsequent immigrant groups, such as Irish, Italians, Poles, and finally Mexicans. Many of them worked for the St. Paul & Duluth Railroad, whose tracks ran alongside the ravine. Living conditions were often unsanitary, with outhouses built on stilts over Phalen Creek. In 1956, the St. Paul Health Department ordered the residents to vacate, after which the fire department torched the hollow in a mighty conflagration.

Above Swede Hollow, and upstream from the historical Hamm's (and later Stroh's) Brewery, now vacant, through which it flowed, Phalen Creek was encased in the finest example of a large circular brick sewer under the Twin Cities. Upstream from this point, it would be expected that Phalen Creek should connect with Lake Phalen, where it originated. At Ocean Street, however, the Phalen Creek Tunnel ends abruptly at a brick wall. Nowadays, Lake Phalen drains to the Mississippi River by way of the Belt Line Tunnel, which runs roughly under Johnson Parkway and discharges to the Mississippi River near the former St. Paul Fish Hatchery, within the Ramsey-Washington-Metro Watershed District. Because of this, Phalen Creek does not present the same sort of daylighting opportunity as Trout Brook. But local water already has been made to flow through the Swede Hollow portion of the former Phalen Creek valley, now a regional park.

Rice's Brook

Edmund Rice, already mentioned in connection with Trout Brook, together with his brother, Henry, owned a considerable amount of prime real estate in early St. Paul (Rice Park and Rice Street, for example, are named after them). An 1849 plat of St. Paul, reproduced in Berthel (1948), shows Rice's Brook running through downtown St. Paul along what is now Exchange and Chestnut streets. Empson (2006) has the most extensive discussion of this stream, which apparently drained two now defunct lakes within the present Downtown Subwatershed. Because the stream no longer exists, there is no potential for daylighting/restoration.

Cascade Creek

Modern maps no longer show Cascade Creek, which was located in the West 7th Street neighborhood of St. Paul. One of the few historical maps that did was the map accompanying Winchell's 1877 report on the *Geology of Ramsey County*. Originating in a wetland near what is today Cretin-Derham Hall, the stream flowed eastwards and down the ravine now occupied by Ayd Mill Road, continued along the line of Jefferson Avenue, and joined the Mississippi River near the foot of Western Avenue.
In the early days, Cascade Creek was famous as a millstream. In 1860, John Ayd built the first and only gristmill in Reserve Township along its course. The creek was dammed to form a millpond, which a subsequent owner stocked with trout. The Milwaukee Road later ran its "Shortline," connecting Minneapolis and St. Paul, through the ravine, obliterating these early features (Brick, 1998).

The name "Cascade Creek" first appears on a real estate plat dated 1856. There was a Cascade Street (now part of Palace Avenue) in the vicinity as early as 1854. The name fascinated me, as it suggested the presence of a defunct waterfall (cascade) somewhere. There are references to the waterfall in the old literature. E. S. Seymour's *Sketches of Minnesota, the New England of the West*, published in 1850, stated that "A short distance below [Fountain] cave there is a little creek or rivulet, that leaps over a succession of cascades, making, in all a fall of about eighty feet." The most elaborate description, however, was by Elizabeth Ellet, who wrote, in 1853, that "A miniature waterfall flashes through the depths of a narrow dell, making thirteen successive shoots in a winding course, each falling into a lovely basin several feet in depth, which serves for a bathing place, curtained by a drapery of woods. This little cascade is closely embowered in foliage of vivid green, and its picturesque beauty makes up for the want of grandeur. It is a lovely spot to spend a summer morning or afternoon." This may be the waterfall that local residents knew in later years as

"Buttermilk Falls." The 1885 *Sanborn Insurance Atlas* showed a pronounced indentation in the river bluffs near Cascade Street—perhaps the waterfall itself.

In the late 1920s and early 1930s the large-bore "Kittsondale tunnels" as they are called in Public Works documents, were built under the Midway district of St Paul. Basically, two mirror-image tunnels, draining sewage in opposite directions, were dug. Kittsondale East drained sewage from Midway toward the east, with an outfall on the Mississippi at Bay Street, while Kittsondale West drained to the west, with an outfall in the shadow of the Lake Street Bridge.

The Kittsondale tunnels are distinguished from all other tunnels under the Twin Cities by their curious architecture. They contain vast subterranean stairways along their course, stairways that descend more than a hundred feet into the earth. Stairways, or "flight sewers," as engineers call them, are occasionally used where a sharp drop is necessary. Ordinary shafts can also serve this function but are plagued with problems of waterfall erosion at the bottom. The Kittsondale stairways served to convey large volumes of water from the highlands of St. Paul down to the level of the Mississippi.

While flight sewers are not uncommon, even in the Twin Cities, what makes the Kittsondales so special is that they contain *spiral* stairways. A spiral stairway—a man-made cascade of sorts—had replaced the old, natural waterfall at the river bluffs. The diverted Cascade Creek now joins the Mississippi at the Bay Street outfall. The West Kittsondale tunnel, built in 1931, on the opposite side of St. Paul, is not associated with any known historical stream.

Because of its depth of burial, and the fact that it has been rerouted from its historical course, the downstream stretch of Cascade Creek could not be daylighted/restored. The possibility remains of daylighting the portion that runs under the Ayd Mill ravine, but this could only be done if the railroad tracks were removed, and they remain in active use at the present time.

Fountain Creek

Fountain Creek, a surface stream arising from former wetlands in the West Seventh Subwatershed, drained into a sinkhole at the upper end of Fountain Cave, flowing through the cave and out again into a ravine that led to the Mississippi River. The source wetland, located west of Fort Road, was paved over by the late nineteenth century, when it became a residential area. Because the stream no longer exists, there is no potential for daylighting/restoration.

When studying the historical streams of the Fort Road area, note that the drainage of the wetlands appears to have been anastomosing. That is, one stream could capture another or change course over the years. This appears to have happened in the case of Fountain Creek in its relation with neighboring Cascade Creek, judging from my study of historical maps.

Bridal Veil Creek

The stream gets its name from Bridal Veil Falls, where it pours out of its concrete pipe and plunges over a ledge in the shadow of the Franklin Avenue Bridge, on the east side of the Mississippi River, in Minneapolis (and thus outside the borders of CRWD). Waterfalls with the "bridal veil" moniker (as for example the more famous one in Yosemite National Park) fall from such great heights as to

dissipate their waters as a “veil” of mist before reaching the bottom. An odd historical fact about Bridal Veil Falls is that it was once a mineral spa of sorts. Famous under the alternative name of Meeker’s Creek, it had iron and sulfur springs, and in 1869 was actually described in the newspapers as a “new watering place.” Another fact: groundwater seepage often resembles oil slicks, and another old newspaper clipping actually referred to the stream as “Oil Creek.” By 1911, however, it was decided to “box” the creek, putting it underground.

Farther upstream, near the Minneapolis-St. Paul border, Bridal Veil Creek runs through several Superfund sites contaminated with coal-tar products, before emptying into Bridal Veil Pond, along Energy Park Drive, which has been entirely reconstructed as of 2008. The stream has been made to run through a culvert that isolates it from the underlying soil, which should improve water quality in the pond, where wild fowl died from mass poisonings in the early 1990s.

The headwaters of Bridal Veil Creek, however, are within CRWD. Originally, before human interference, the stream probably began at springs on what is now the Les Bolstad Golf Course (see above), whose collected waters flow under the adjoining St. Paul Campus of the University of Minnesota, following the boundary with the State Fairgrounds, until emptying into the Sarita Wetland along Como Avenue. In 1909, the state fair board, seeking a new attraction, excavated the wetland in their efforts to create a lagoon and canal that would carry passenger boats, but gave up on the plan (Empson, 2006). Overflow from the Sarita Wetland now drains to the Eustis Street tunnel, which empties into the Mississippi River just above the Lake Street Bridge.

The author of this report, while employed as an environmental consultant, became quite familiar with the wealth of contaminated properties along the course of Bridal Veil Creek near the Minneapolis-St. Paul border. Given the issues of contaminated soils, which are expensive to deal with, and the industrial character of the land through which the stream still flows, it is questionable whether it would be a wise investment at the present time, to attempt any daylighting projects, despite the stream’s nearness to the surface. In any case, the exact course of the stream in its headwaters (i.e., east of Highway 280) is obscure and requires further investigation. Restoration efforts are best focused on the series of detention ponds (e.g., Burlington Pond, Kasota Pond) historically associated with this stream, which provide a true amenity to wildlife in a heavily industrialized area.

Shadow Falls / Finn’s Glenn Stream

Bennett’s *Map of Ramsey County* (1867) shows a stream originating in a wetland near what are now Randolph and Snelling avenues, flowing west to the Shadow Falls ravine, formerly known as Finn’s Glenn. (The author of this report respectfully disagrees with Empson (2006), who states that Finn’s Glenn is the ravine at the St Paul Seminary; the Bennett map does not seem to support this interpretation.) This is probably also the stream whose waters were dammed to form an artificial lake on the grounds of the University of St Thomas, called Lake Mennith, which drained away in 1902 with the installation of the city sewers (Empson, 2006). Because the stream no longer exists, there is no potential for daylighting/restoration.

Stonebridge Creek

Bennett's *Map of Ramsey County* (1867) shows a stream originating near what is now Groveland Park, flowing west through a shallow ravine on what had been Stonebridge, the former Oliver Crosby estate along Mississippi River Boulevard (near its intersection with what is now Stanford Court). During the Crosby years, before the Great Depression, there was a concrete-lined lake (Lake Elizabeth) and a "frog pond" along the course of a stream that ran through the estate, but these features were apparently supplied with water by a well on the grounds (Pfaender, 2005). Because the stream no longer exists, there is no potential for daylighting/restoration.

Hidden Falls Creek

Bennett's *Map of Ramsey County* (1867) shows a stream originating near what is now Cleveland Avenue and Ford Parkway, flowing southwest to Hidden Falls, a waterfall formed by a ledge of Platteville Limestone located at the head of a postglacial retreatal gorge. Ever since the Work Projects Administration created Hidden Falls Park in the late 1930s, the stream has flowed through a culvert that runs under a bend in Mississippi River Boulevard, before plunging over the waterfall and flowing down through the narrow glen, over the floodplain, and finally into the Mississippi River. Several years ago, the author of this report explored the culvert with a flashlight, following the stream as far as possible to where it runs under the Ford Motor Company property, but the culvert soon became too small for comfort.

Considering the stream's long-standing association with an existing park, and how shallowly buried the culvert is, Hidden Falls Creek is the best candidate for daylighting/restoration of any stream in this report, should the Ford Motor Company property ever be redeveloped. Seemingly, it could also be done at minimal expense.

St. Paul Avenue Stream

Bennett's *Map of Ramsey County* (1867) shows a stream that roughly parallels the course of modern-day St. Paul Avenue, flowing southeast, where that road runs along the base of the Decorah Shale Highlands, within the present Davern Subwatershed. It is very likely that this stream collected drainage from the drift-Decorah spring-line, which it appears to follow. Because the stream no longer exists, there is no potential for daylighting/restoration.

Highland Golf Course Stream

Bennett's *Map of Ramsey County* (1867) shows a stream originating on what is now the Highland Golf Course, flowing southeast down through a ravine near Montreal Avenue, thence to the Mississippi River near Crosby Lake, within the present Crosby Subwatershed. Because the stream no longer exists, there is no potential for daylighting/restoration.

Former Lakes

There were numerous lakes within CRWD in pioneer days that have become wetlands or dried up completely. It is not the purpose of this report to describe these features, about which little is known anyway. The best sources for this topic are old maps , especially the General Land Office surveys, Nicollet's *Hydrographic Basin of the Upper Mississippi River* (1843), Duffy's *Map of Ramsey County* (1859), Bennett's *Map of Ramsey County* (1867), and of course the Surficial Geology plate in the *Geologic Atlas of Ramsey County, Minnesota* by Patterson (1992). Also consult Josiah B. Chaney's classic essay, *Early Bridges and Changes of the Land and Water Surface in the City of St. Paul*, published in 1908. Chaney is a wonderful reference for the vanished streams and lakes of old St. Paul. Empson (2006) has brought the story up to date with a wealth of additional information.

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