KANSAS DEPARTMENT OF HEALTH & ENVIRONMENT (KDHE)

ISSUE PAPER

SINKHOLE FORMATION ASSOCIATED WITH ABANDONED BRINE WELLS AND SHAFT MINES

November 25, 2009

DEFINITIONS:

Listed here are several important definitions to assist when reviewing this issue paper.

Brine Well: A well constructed into the underlying salt formation to allow mining of the salt through injection of water into the subsurface and return of brine to the surface.

Sinkhole: A sinkhole is a surface depression caused by subsidence of rock layers into a cavern in the underlying rock.

BACKGROUND:

Brine wells have been constructed and operated in Hutchinson, Kansas since the late 1880's to present. Records also indicate there were salt solution mining operations in or near Nickerson, Sterling, Anthony, Pawnee Rock and Ellsworth, Kansas in the late 1800s and early 1900s. There were over 20 active salt plants in Hutchinson in 1890, and by 1917at least 150 brine wells had been drilled. There are no construction, operational, or plugging records for these old brine wells. These open wells can act as a conduit for contamination of the Equus Beds aquifer. The cavern, developed by the solution mining of the salt formation, creates the potential for sinkholes. To date, a total of eight sinkholes resulting from brine wells have been documented in Hutchinson. The most noteworthy are the 1974 Cargill sinkhole and the 2005 Mosaic sinkhole. Both of these sinkholes impacted main railroad lines (see photographs).

In addition to brine wells, sinkholes have also been associated with abandoned salt mine shafts. There are three salt mine shafts that have created sinkholes in Kansas located in Kanopolis, Little River, and Lyons. There is the potential for future salt mine shaft collapses as salt mining in Kansas continues in Lyons and Hutchinson and other shafts may not have been located at inactive facilities.

ISSUE:

Although KDHE and the City of Hutchinson have identified approximate locations for 15 former salt plants in Hutchinson (see attached Figure 1) and several facilities in other towns in Kansas, the actual locations and conditions of the abandoned brine wells, and their associated cavern, at these sites are not known. Many of these old facilities are located near commercial and residential areas and transportation arteries that could be impacted if a sinkhole formed. Abandoned brine wells at these locations need to be located and the well and cavern evaluated for the potential risk to endangering property and public safety, and causing contamination of the overlying aquifer so appropriate action can be taken. The well accessing the cavern also needs to be properly plugged. At this time, there is no responsible party identified for the vast majority of these former facilities. It is believed most of the salt shaft mining facility locations have been identified.

POSITION:

KDHE's UIC program currently regulates salt solution mining wells under state regulations found at KDHE Article 46 – Underground Injection Control Regulations, which references Federal regulations 40 CFR Parts 124, 136, 144, 145, 146, and 261 under the Safe Drinking Water Act (SDWA).

These regulations do not address these old abandoned pre-regulation brine wells or mine shafts. Kansas Statute 55-1,120 allows the Secretary authority to find the location of abandoned brine wells and determine the well's threat to the public health, safety, and environment. The Secretary can order a person legally responsible for causing the pollution or hazard or threat of hazard or pollution to remediate the abandoned solution mining well, including plugging of the well. In addition, if funds are available, provide for the plugging and abandonment and order assessment of the costs to the legally responsible party.

Kansas Statute 55-1,121 provides for a Salt Solution Mining Well Plugging Fund. This fund was intended to provide money to address these wells through investigation and plugging under K.S.A. 55-1,120. However, this fund by statute, relies on grants, gifts, bequests and state or federal appropriations for funding. To date, this fund has not received any money for conducting this work.

PLAN:

Attached is a spreadsheet listing all the known sites with abandoned brine wells and salt mine shafts. This spreadsheet also has a preliminary ranking of these sites based on their potential risk to public health, safety and the environment. Risk factors considered included the sites proximity to: transportation arteries, residential areas, businesses and infrastructure. Abandoned salt mine shafts were ranked at the bottom due to the general location of these facilities away from infrastructure and municipalities. Currently, the number and location of a site's abandoned brine wells is not known, but if available, would obviously be the best risk factor for ranking.

The following are KDHE costs estimates for addressing the abandoned brine well and salt mine shaft problem beginning with locating any potential brine wells/shaft mines at a priority site followed by investigation, and finally potential remediation costs.

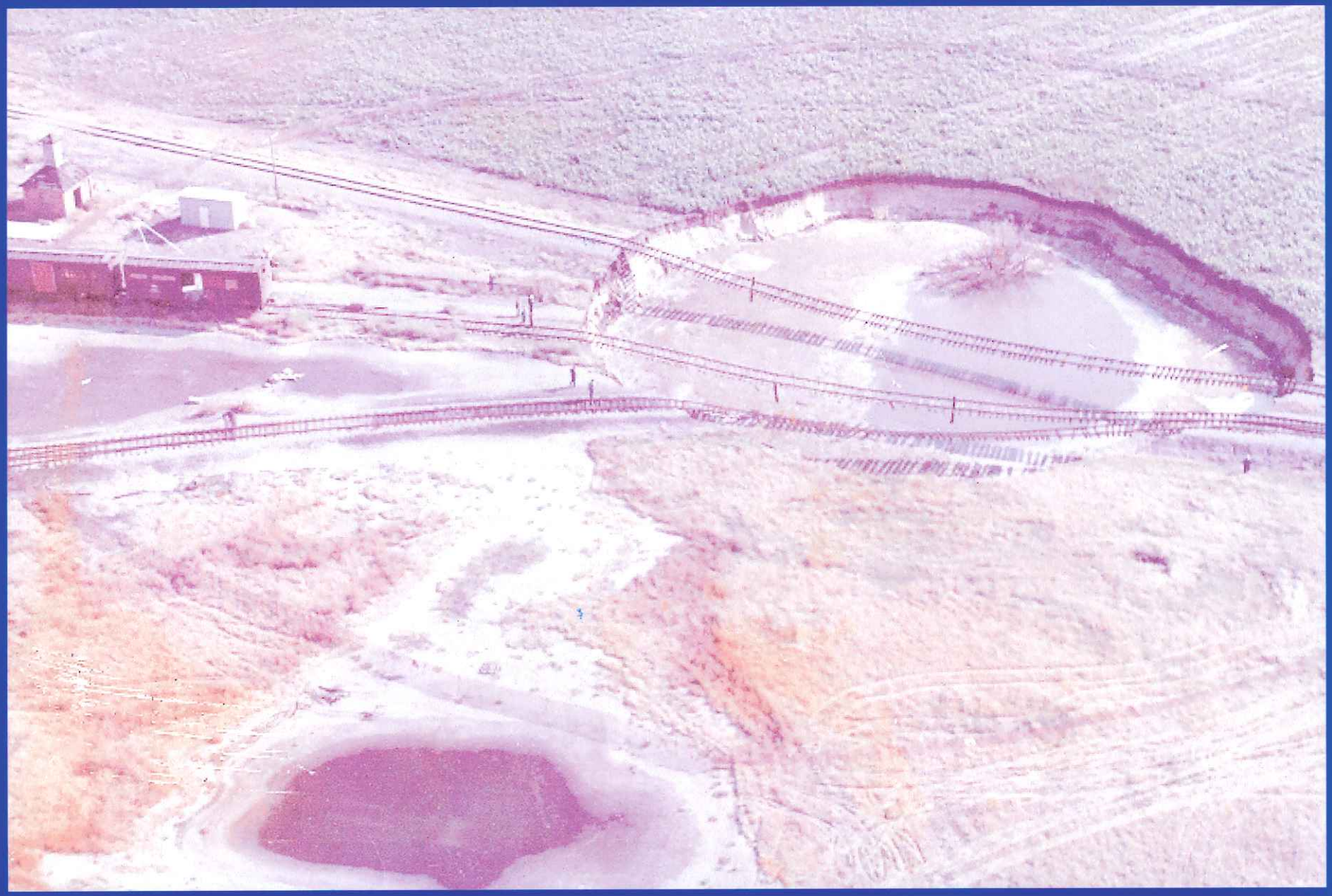
KDHE estimates it would conservatively cost $65,000 to survey a one million square foot area using electromagnetic equipment to locate wells. Additional costs would be incurred for responsible party searches and possible litigation raising the costs for locating the wells in preparation for remediation to a conservative amount of $100,000 per facility. Actual brine well/mine shaft investigation involving sonar surveys of the cavern/shaft, downhole video equipment, geophysical logging, and associated activities are estimated at $50,000 per well or mine shaft.

Remediation of the brine well or mine shaft could vary considerably based on its depth, preparation work needed, and other factors, but would range from $20,000 for plugging to over four million dollars for remediation of an active sinkhole impacting a transportation artery, business or residential area. (estimated costs for addressing 2005 Mosaic sinkhole). Typical brine well and mine shafts could conservatively be plugged and abandoned (minimal remediation activity) for $50,000 each. If each estimated old brine well (150) resulted in a sinkhole that required full remediation, the total costs could be in excess of 600 million dollars not including potential revenue losses due to transportation or businesses being affected and endangerment of public health and safety.

In order to reduce the risks and associated costs with remediation of an active sinkhole, there are several steps that can be taken to address existing abandoned brine wells and salt mine shafts. The first would be to conduct surveys at each known brine production facility to determine well/shaft locations. This would then be followed by investigation of the wells/shafts to determine the associated risks and necessary remediation. The locations of abandoned brine wells and mine shafts have already been determined at fourteen of the thirty known sites. Therefore, additional surveying at the remaining facilities for abandoned wells/shaft mines would be approximately $1.4 million. Investigation costs would vary but conservatively would be $7.5 million for 150 wells. Together, the risks posed by abandoned brine wells and shaft mines in Kansas could be reduced with an expenditure of $10 million, which is less than 2% of the potential costs for full remediation of 150 sinkholes.

AERIAL VIEW OF SINKHOLE AT FORMER CAREY SALT FACILITY

Cargill Sinkhole 1974



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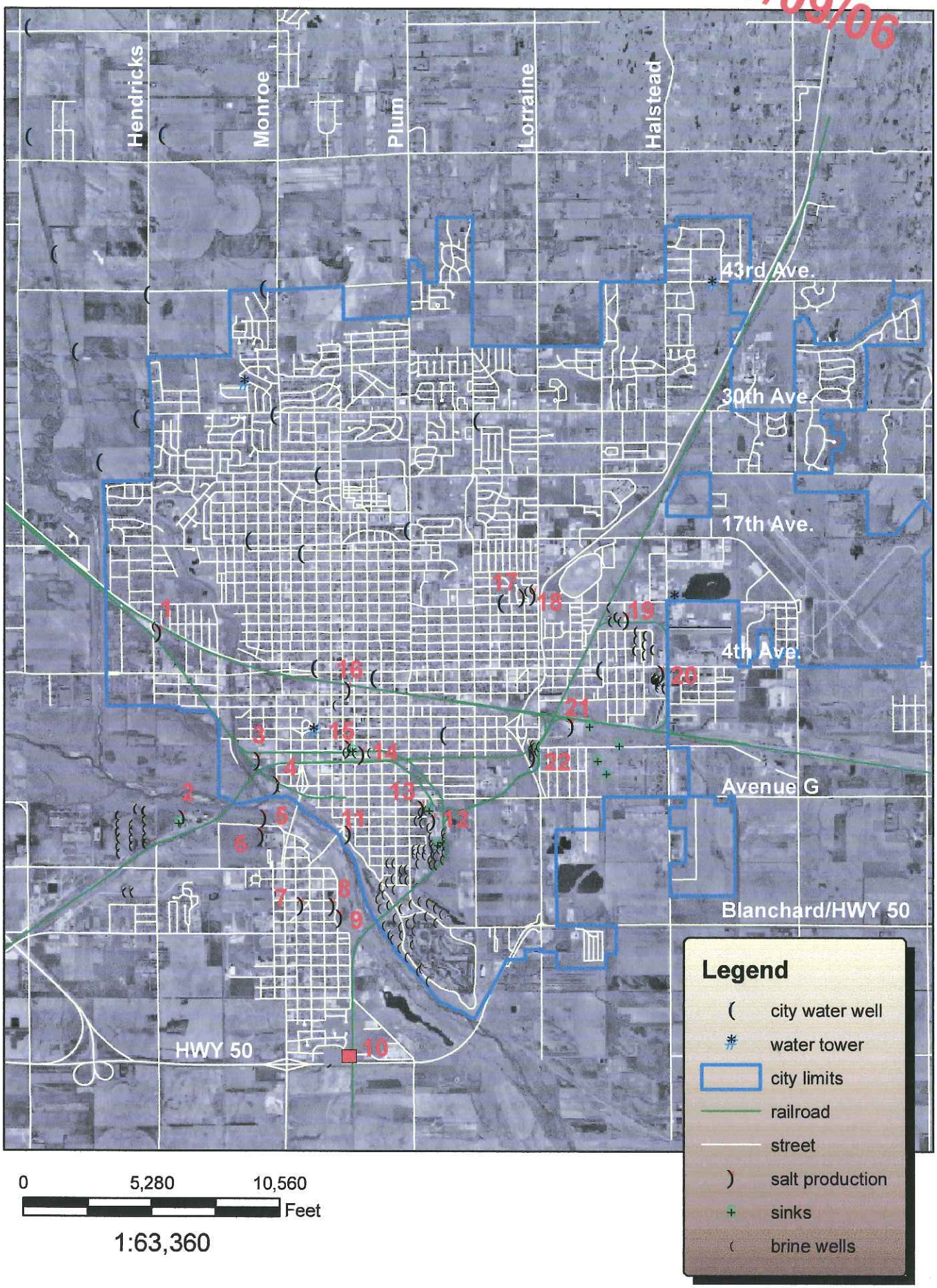
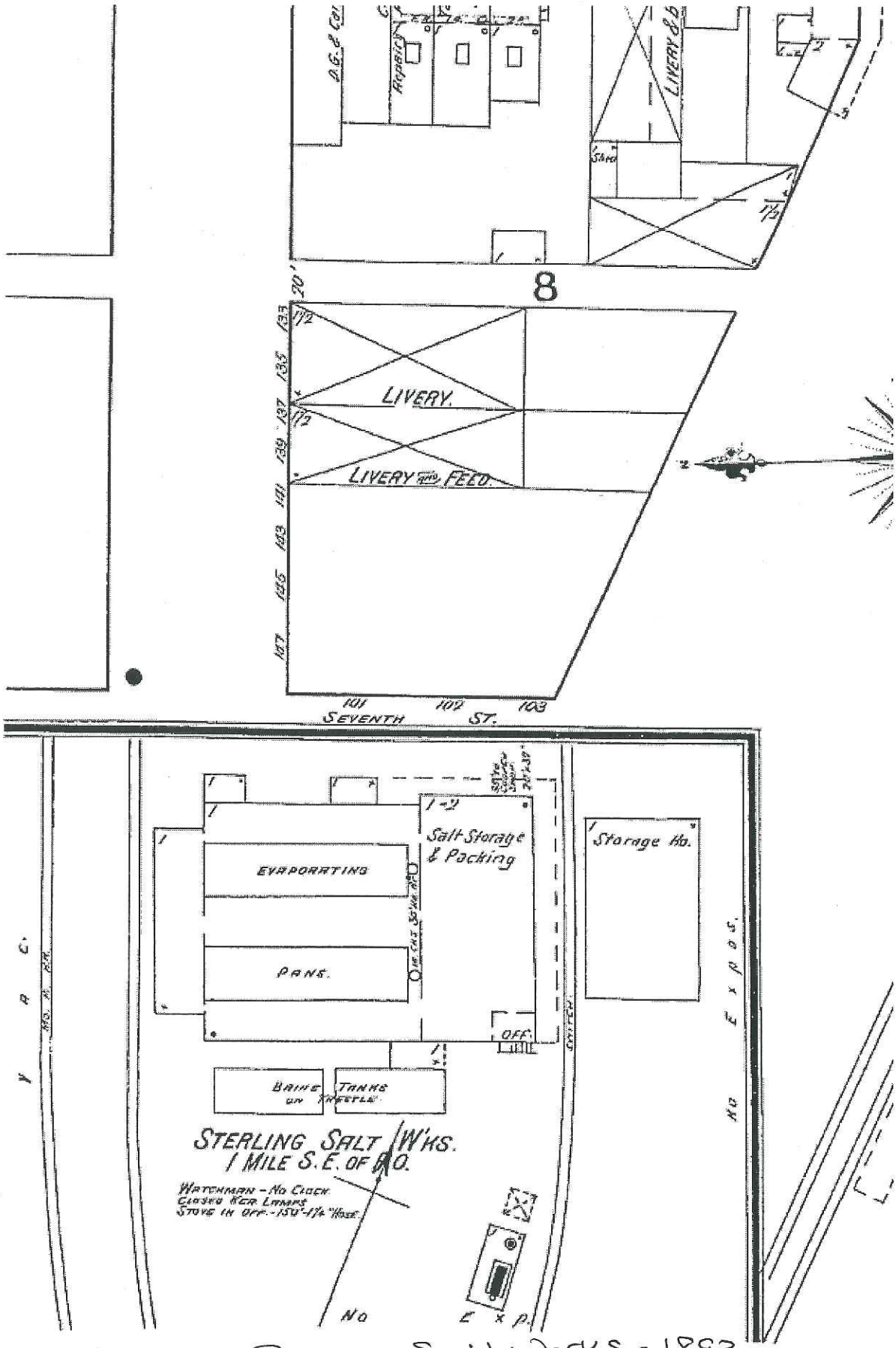
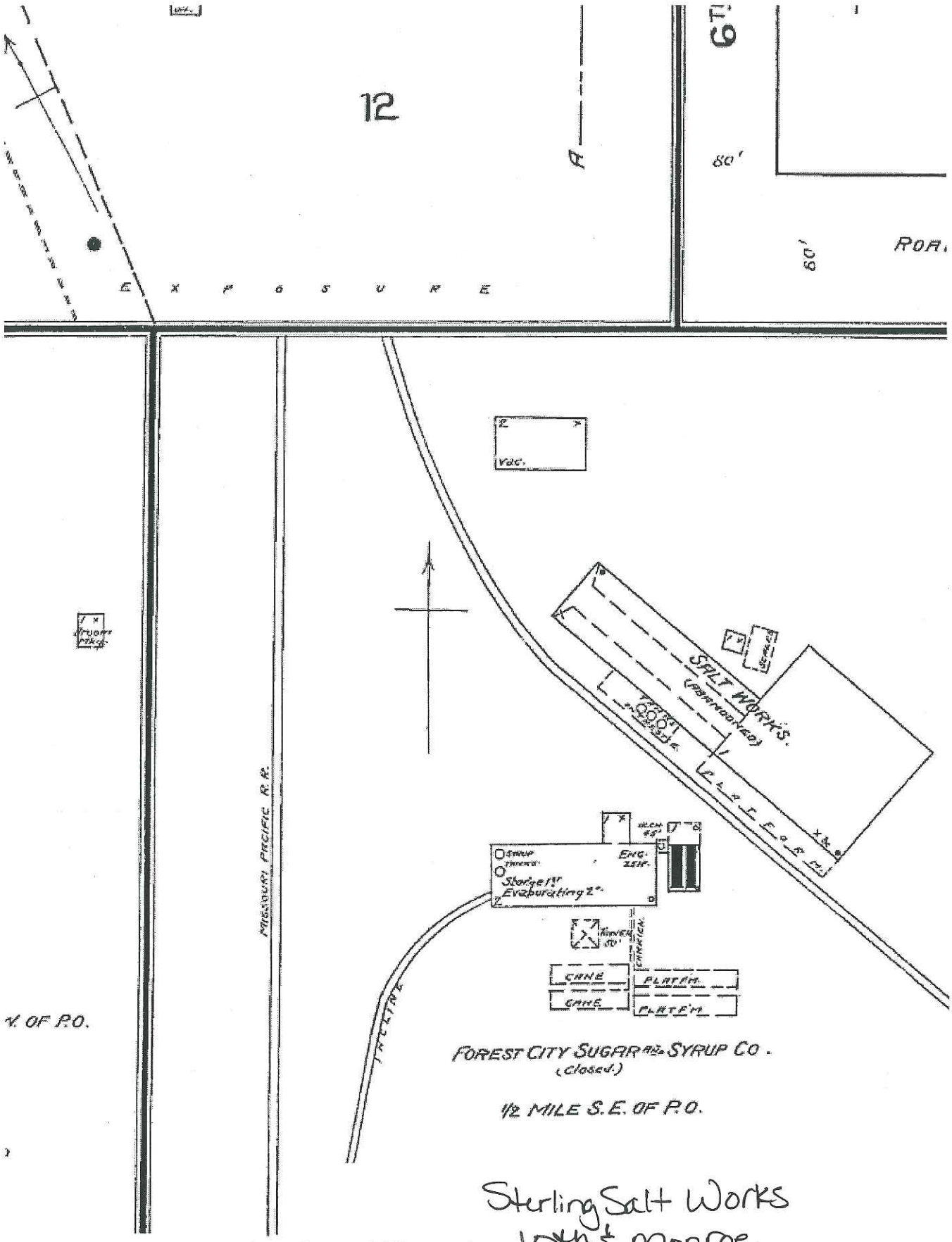
City of Hutchinson

Draft 06/09/06



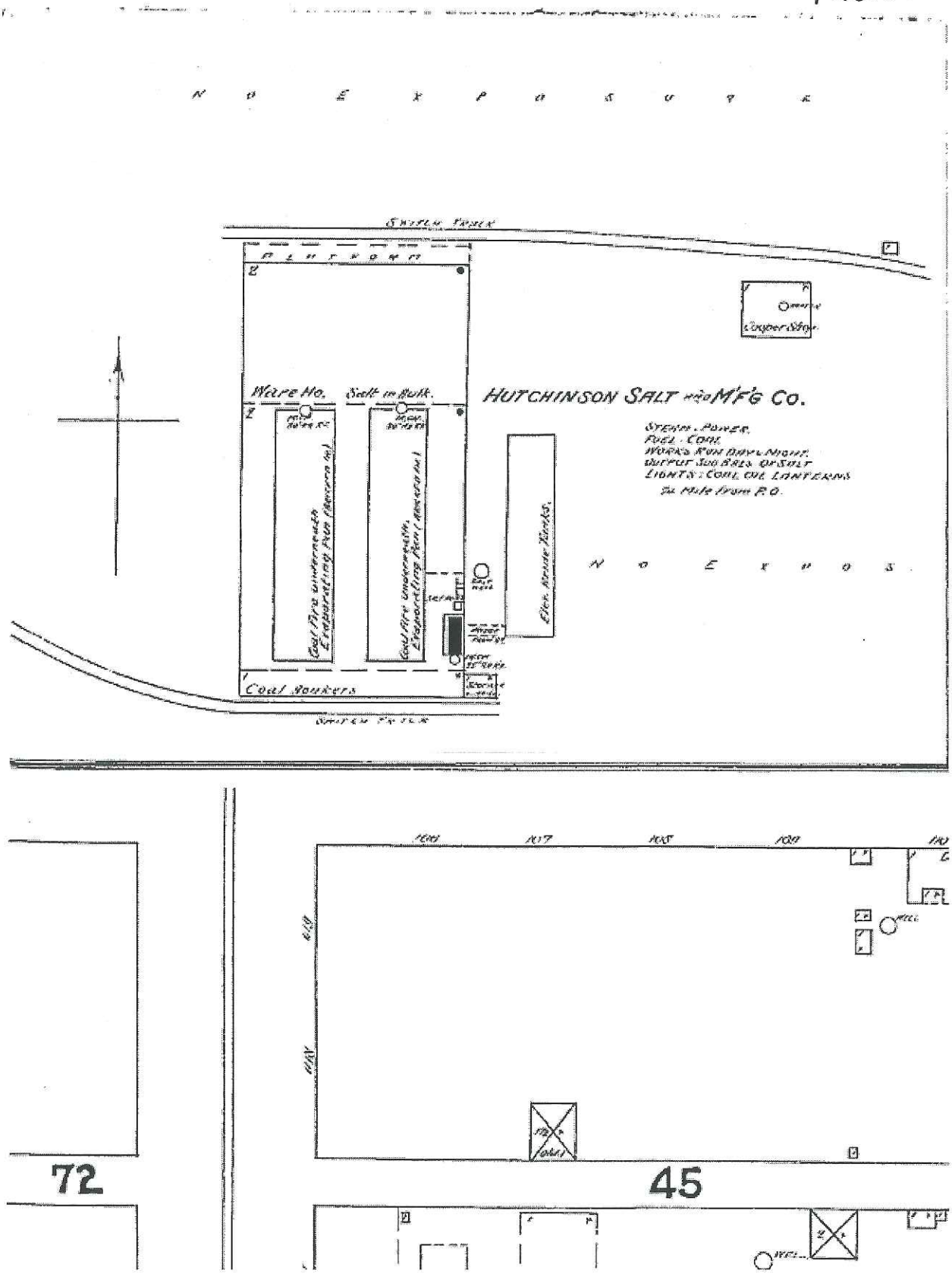


Sterling Salt Works - 1893
Sterling Kansas - Broadway & Jackson

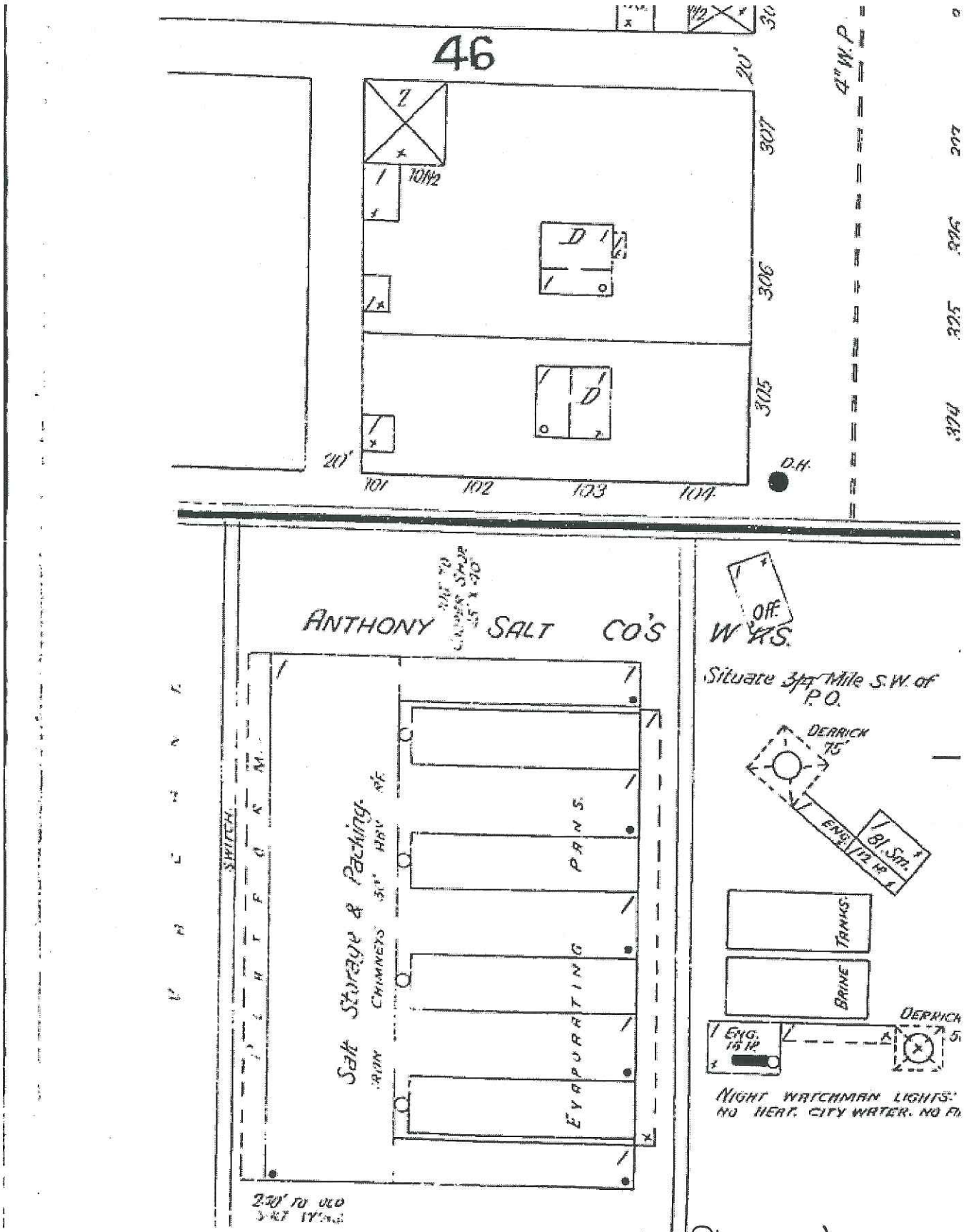


Sterling Salt Works
10th & Monroe
Sterling, Kansas - 1891

Hutchinson Salt & Mfg. Co.
Nickerson, Kansas - 1891
near Peabody and Railroad St.
or Peabody & Avenue A

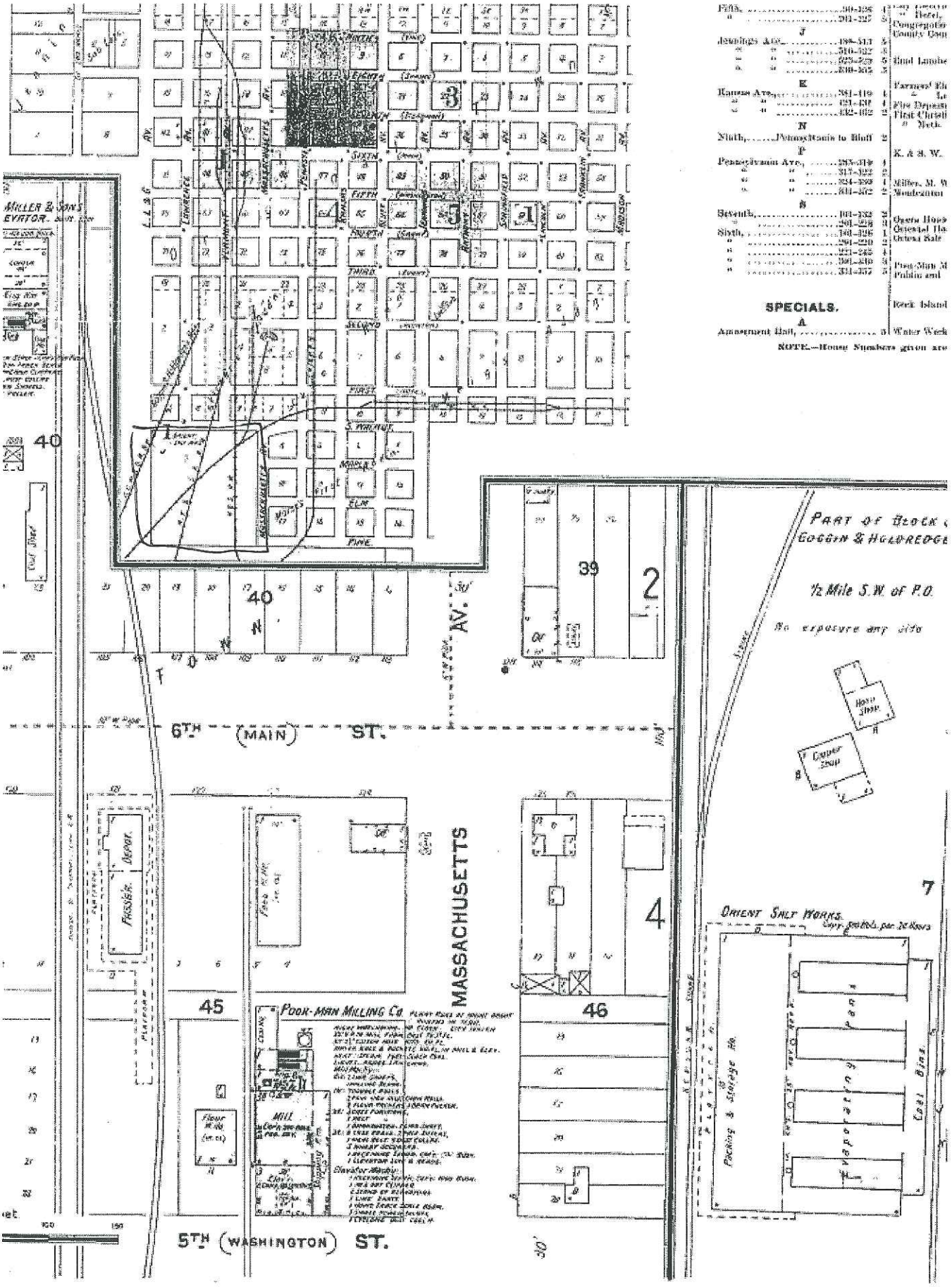


Anthony Salt Company (Orient Salt)
Anthony, Kansas - 1893



S. Walnut to Pline along Massachusetts
~~1/2 S.W. of P.O. at 6th & Bluff Ave.~~

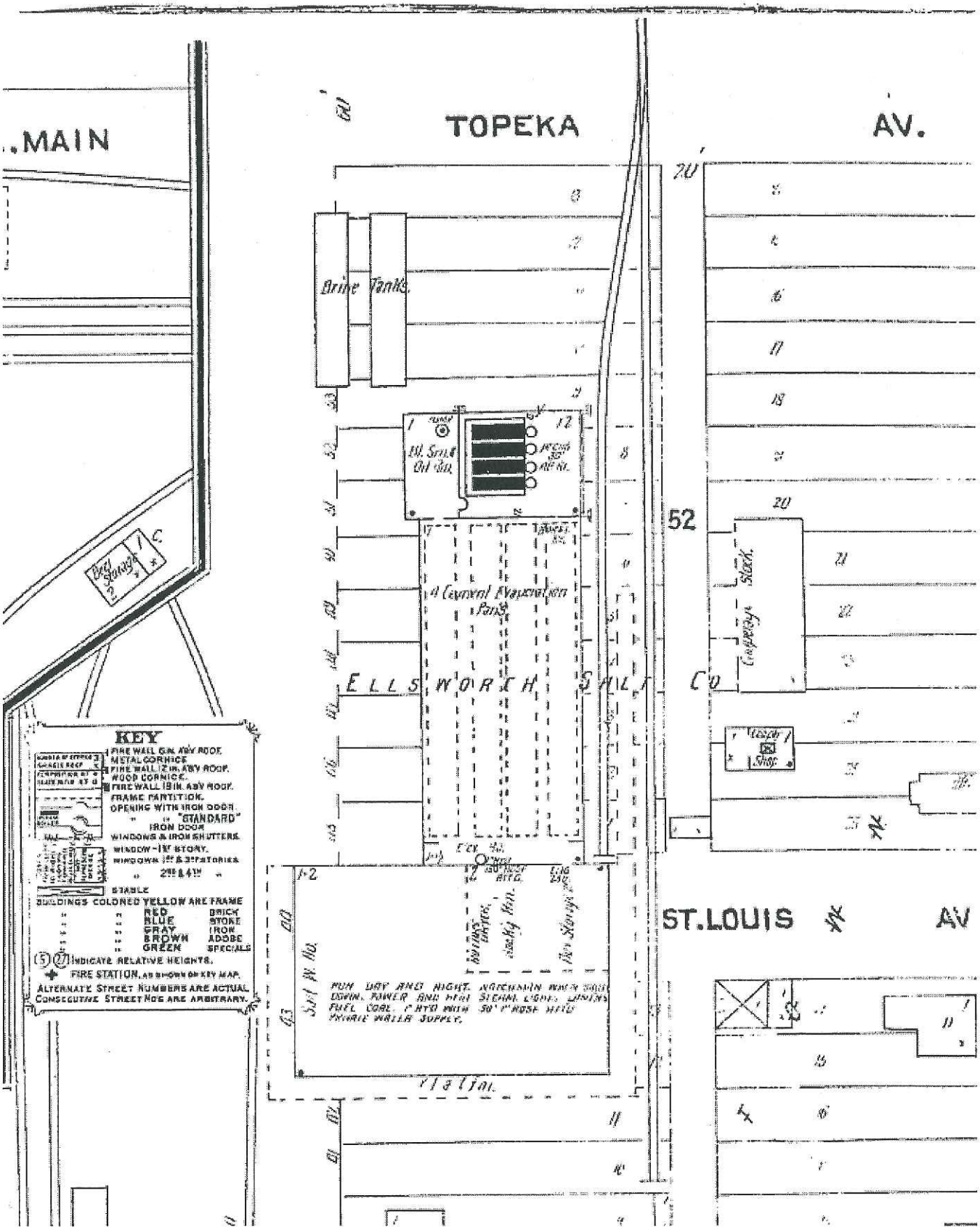
Anthony, Kansas 1905



Ellsworth Salt Co.

Ellsworth, Kansas - 1905

Area < between Topeka Ave and St. Louis Ave
between N. Main and 1st Street



ABANDONED BRINE WELL RISK ASSESSMENT					
Facility	Address	City	Active/Closed	Rank	Map Key
Mosaic (Former Carey Salt)	Carey Blvd. & Howard St.	Hutchinson	Closed	1	21
Union Salt and Ice	S. Walnut & Bennett St.	Hutchinson	Closed	2	14
Cary Salt	S. Walnut & Ave. C.	Hutchinson	Closed	3	15
G.H. Bartlett Salt Works/Matthews	Hwy 61 & E. 11th Ave.	Hutchinson	Closed	4	18
Western Salt Works	N. Lorraine St. & E. 14th Ave.	Hutchinson	Closed	5	17
Barton/Cargill Salt	609 E. Ave. G.	Hutchinson	Active	6	12
Gouin, Lock & Humphrey	Carpenter St. &	Hutchinson	Closed	7	13
Pennsylvania Salt Works	Des Moines Ave. & Elm St.	S. Hutchinson	Closed	8	10
Wyoming/Queen City Salt	N. Van Buren St. & Ave C.	Hutchinson	Closed	9	3
Great Western/McFarland Salt W	S. Monroe St. & W. Ave. E.	Hutchinson	Closed	10	4
Star Salt Plant	Hwy 96 & Hendricks St.	Hutchinson	Closed	11	1
Hutchinson Salt and Manufacturin	Carey Blvd. & S. Lorraine St.	Hutchinson	Closed	12	22
Solvay Process Co.	E. 8th St. & N. Chemical St.	Hutchinson	Closed	13	19
Conn & Carey	E. 3rd Ave. & N. Walnut St.	Hutchinson	Closed	14	16
Hutchinson Packing Co.	E. 4th Ave & N. Halstead St.	Hutchinson	Closed	15	20
Independent Salt	W. 3rd. Ave. & Walnut St.	S. Hutchinson	Closed	16	7
Diamond Salt	E. 2nd Ave. & N. Elm St.	S. Hutchinson	Closed	17	8
Crystal City Salt Works	N. Elm St. & Blanchard Ave.	S. Hutchinson	Closed	18	9
Sunflower	E. Park St. & S. Walnut St.	Hutchinson	Closed	19	11
New York Salt	N. Main & Morton Dr.	S. Hutchinson	Closed	20	6
Morton Salt	1000 S. Morton Drive	S. Hutchinson	Active	21	2
Riverside Salt Works	Monroe St. & Morton Drive	S. Hutchinson	Closed	22	5
Sterling Salt Works	Broadway & Jackson	Sterling	Closed 1893	23	NA
Sterling Salt Works	10th & Monroe	Sterling	Closed 1891	24	NA
Hutchinson Salt and Manufacturin	Peabody and Railroad St.	Nickerson	Closed	25	NA
Anthony Salt Company(Orient Sal	S. Walnut & Massachusetts A	Anthony	Closed	26	NA
Ellsworth Salt Company	Topeka Ave. and 1st St.	Ellsworth	Closed	27	NA
Pawnee Rock	Unknown	Pawnee Rock	Closed	28	NA
Kanopolis Salt Mine		Kanopolis	Closed	29	NA
Little River Salt Mine		Little River	Closed	30	NA
Lyons Salt Mine		Lyons	Closed	31	NA