Building Research Institute of Montana

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CRUMBLING CONCRETE
GARFIELD ELEMENTARY SCHOOL
REPORT AND BLUEPRINT FOR ACTION

P.O Box 20063 Billings, MT 59104 406.256.1760

TABLE OF CONTENTS

1

PRELIMINARY REPORT
AUGUST 19, 1996

b r i m™

August 19, 1996

Mr. Alan Anderson
Director of Facilities Services
Billings Public Schools
101 10th Street West
Billings, MT 59102

RE: Preliminary Report - Crumbling Concrete Walls - Basement of Garfield Elementary

Dear Alan:

This preliminary report is a summary of the initial results of a study being undertaken by Building Research Institute of Montana (**brim**). **Brim** was commissioned by you because of the crumbling concrete in the basement of Garfield Elementary School.

Our objective; find out as much as possible about the problems causing the crumbling concrete. We were to do this in a short time frame and for as little money as possible because no money was previously allocated for this emergency.

I am happy to report we have met these objectives. Working closely with you and your staff, along with your paint and plumbing departments, and the principal and custodians at Garfield, our team of experts have tracked down the most likely cause of the problem. Our team consists of an architect, a structural engineer, a geo-technical engineer, a hydrogeoligist, licensed plumbers and environmental drillers.

We have provided recommendations to stop the source of the problem and repair the building. We have also provided an estimate to give you an idea of how much it might cost.

Sincerely,

Jeffrey C. Baston, NCARB, AIA

b r i m™

PRELIMINARY REPORT - CRUMBLING CONCRETE
GARFIELD ELEMENTARY SCHOOL

PHOTOGRAPH NO. 1 - Crumbling concrete column in basement of Garfield Elementary.

Garfield Elementary School has a water problem. Its symptom is crumbling concrete. **Brim** found the basement level is encompased by moist silty clay and silty fine sand. These moist soils are very corrosive and cause a reaction with the concrete. The water "flows" through the soil and picks up alkali minerals. See photograph No. 2.

PHOTOGRAPH NO. 2
White spots indicate water percolating through soil at 6-foot level.

The sample in photograph No. 2 was taken at 6-feet deep. This is approximately the depth of the basement. The water continues to "flow" through the concrete and then evaporate on the inside of the building. Crystals grow in the concrete causing it to spall and punch out. This occurs in the foundation wall as well as the concrete floor.

The ground water is 16-1/2-feet deep causing us to search for other sources of water. Although some capillary action from the ground water is possible, it is likely the source is from the surface. Here is one scenario. There are six window wells and one stair well around the perimeter of the 1920 "original" addition and 1934 additions. Four of the window wells were installed in a 1955 remodel to allow for more classroom space in the basement.

These window wells act as catch basins for rain and snow. Some are collapsing from the pressure of the soil. See photograph No. 3. All of them have cracks where water can seep into the soil nearby.

PHOTOGRAPH NO. 3
Window well retaining wall overturning from weight of soil.

In addition, the asphalt playground around them is sloping towards the building in many places. See photograph No. 4. This allows water to pond around the base of the building and enter the ground through cracks in the asphalt and concrete.

An interesting thing happened while the drilling was taking place. The sprinklers in the hilly grass area came on. Almost immediately, the water began running onto the playground and puddling near the building. It then ran into cracks in the asphalt pavement. Once below the pavement, little evaporation can take place. This helps keep the soil moist.

PHOTOGRAPH NO. 4
Water ponds at many areas around base of building and window wells due to flat ground surface.

Also, the wind blows sand from the large play area next to the building into the window wells. See photograph No.5. This can plug the drains. If the window well drains are plugged, they can fill and leak water into the ground through the cracks in the concrete.

PHOTOGRAPH NO. 5
Wind blows sand from sandbox to window wells.

Another problem, that is associated with moisture in the ground, is the sewer lines in and around the building. A large wet spot occurs on the carpet during a heavy rain storm exactly where the sewer line exits the building below grade. See photograph No.6.

PHOTOGRAPH NO. 6
Clean-out where sewer exits basement of Garfield Elementary.

This is the music room. This room smells of sewage much of the year. Our investigation has revealed that, most likely, there is only one 6-inch line carrying the sanitary and storm water for the entire building. All the roof drains, sinks and toilets; all of the window wells and the stair well seem to be draining into this one 6-inch cast iron line.

When the sewer line leaves the building, it changes to an 8-inch clay tile line which runs to the manhole in the street. During a heavy rain, one 6-inch pipe would have difficulty carrying the water from the entire roof area and other normal building activity. This could cause the line to pressure up and leak at the weakest point - the connection with the clay tile pipe just outside the music room. It is possible the sewer is leaking below grade in other places.

Concrete deterioration is not limited to the inside. See photograph No. 7. Snow piles and standing water can cause this deterioration.

PHOTOGRAPH NO. 7
East side of Garfield Elementary School.

Brim's blueprint for action:

1. Replace concrete window wells.
2. Waterproof exterior of concrete walls around perimeter of building.
3. Slope ground surfaces away from building and remove sandbox.
4. Replace concrete floors in basement - add vapor barrier and capillary break.
5. Restore interior concrete walls.
6. Install a new storm sewer line. This will separate the roof drain lines from the sewer lines.
7. Make the rest of the building envelope watertight.
8. Implement effective exterior maintenance program.
9. Make all trades aware of building envelope waterproofing requirements.
10. Schedule inspection programs to stay on top of maintenance.

Costs:
$50,000 per year for 5-years to solve the waterproofing and concrete problems, plus an additional $20,000 per year for increased maintenance for the rest of the building envelope. This would include such things as repointing and sealing brick and terra cotta, resetting and sealing loose coping stones on the parapet, repairing slits in the EPDM roof membrane, sealing the term bars, replacing old flashings and metal drip edges, removing old unused exterior light fixtures and patching holes, and sealing window frames.

Garfield Elementary School is basically a very well constructed building with many years of service left. With the right care it can last as long as it is needed. Other things may need upgrading as well in the next few years, such as ADA requirements, but a comparable new building would cost around $5-million for a 400 student elementary school.

Not everything needs to be done immediately. For instance, some of the concrete floors are in good shape at this point. If desired, the solutions can be spread over a 4 or 5-year period. This makes it easier to pay for and we can learn more as we go, taking a step at a time. With everyone working as a team, Garfield's problems are solvable.

End of Preliminary Report.

2

CONCRETE

OCTOBER 31, 1996

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Waterproofing of the exterior below grade walls at Garfield School is needed to save the basement concrete walls from further deterioration from wet corrosive soils. Reconstruction of the window wells is also a priority.

There can be no effective waterproofing without first dealing with the window wells. All but one of the window wells is in need of reconstruction anyway. Two are over 60-years old. Three have walls that are cracking and overturning from the weight of the soil.

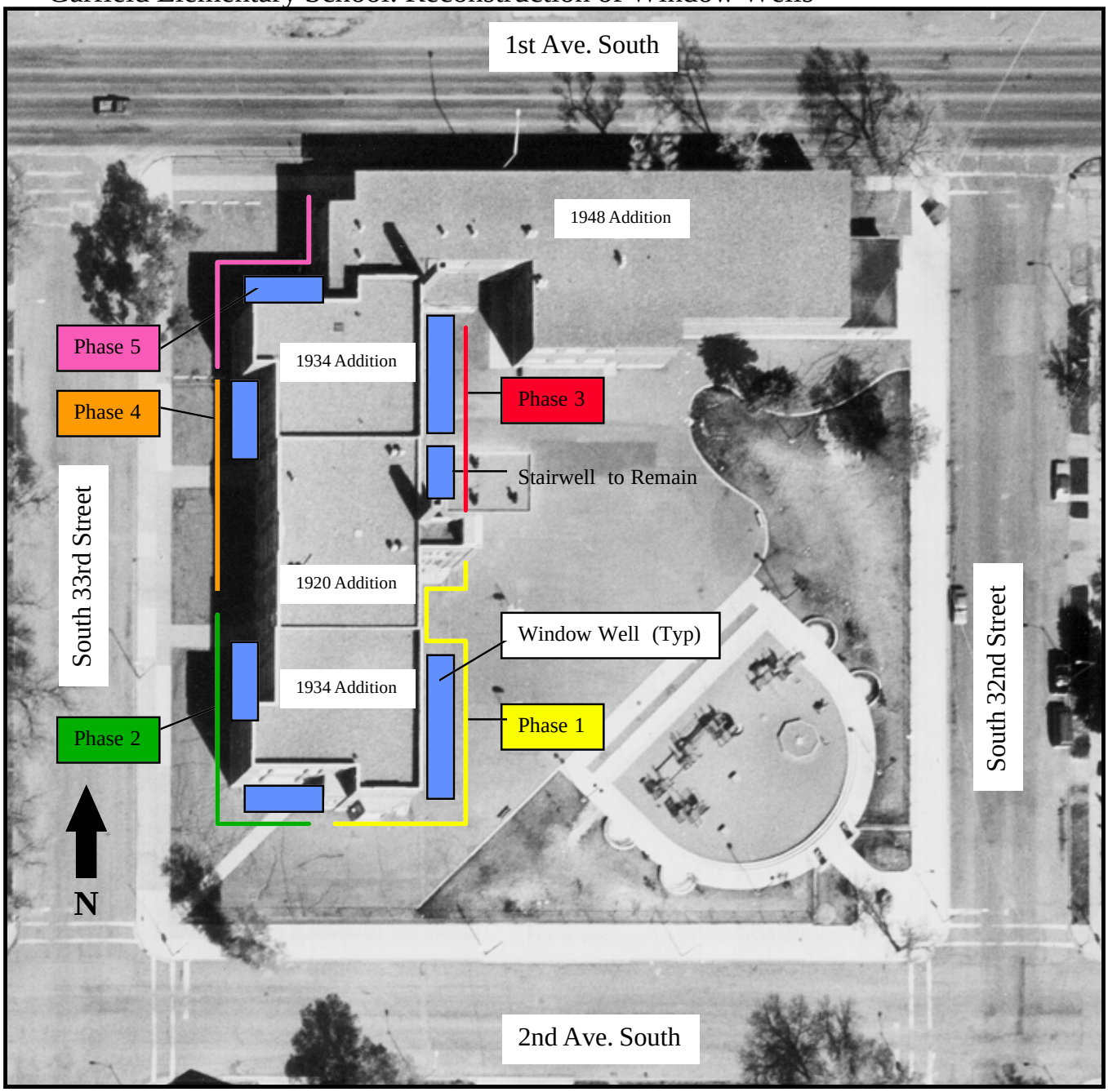
Reconstruction in a logical coordinated effort with waterproofing, sewer line repair, storm sewer construction, and basement floor restoration will be most cost effective. Consider Phase 1 on C-1 and C-2 as an example. Phase 1 should allow us to:

- Reconstruct leaking and cracked concrete window well and nearby step.
- Waterproof exterior wall of building below grade.
- Connect window well drains to sewer.
- Reconstruct concrete floor in music room and some severely damaged floor areas on the west side.
- Restore the concrete walls in those areas.
- Repair existing sewer line under floor in music room.
- Verify construction costs for future phases.
- Fine tune construction techniques and documents for future phases.

Phase 1 could cost $50,000. Each additional phase represents approximately $50,000 worth of reconstruction costs. There were five phases in the preliminary report. After further research we recommend adding two more phases to take care of the 1948 addition. See C-3. During a tunnel inspection, we saw evidence of crumbling concrete on the walls and upheaval in the floor area. It is not as serious of a problem as the older additions. However, it should be taken care of in the near future or more damage will be done to the building. The construction estimate for all seven phases total $350,000.

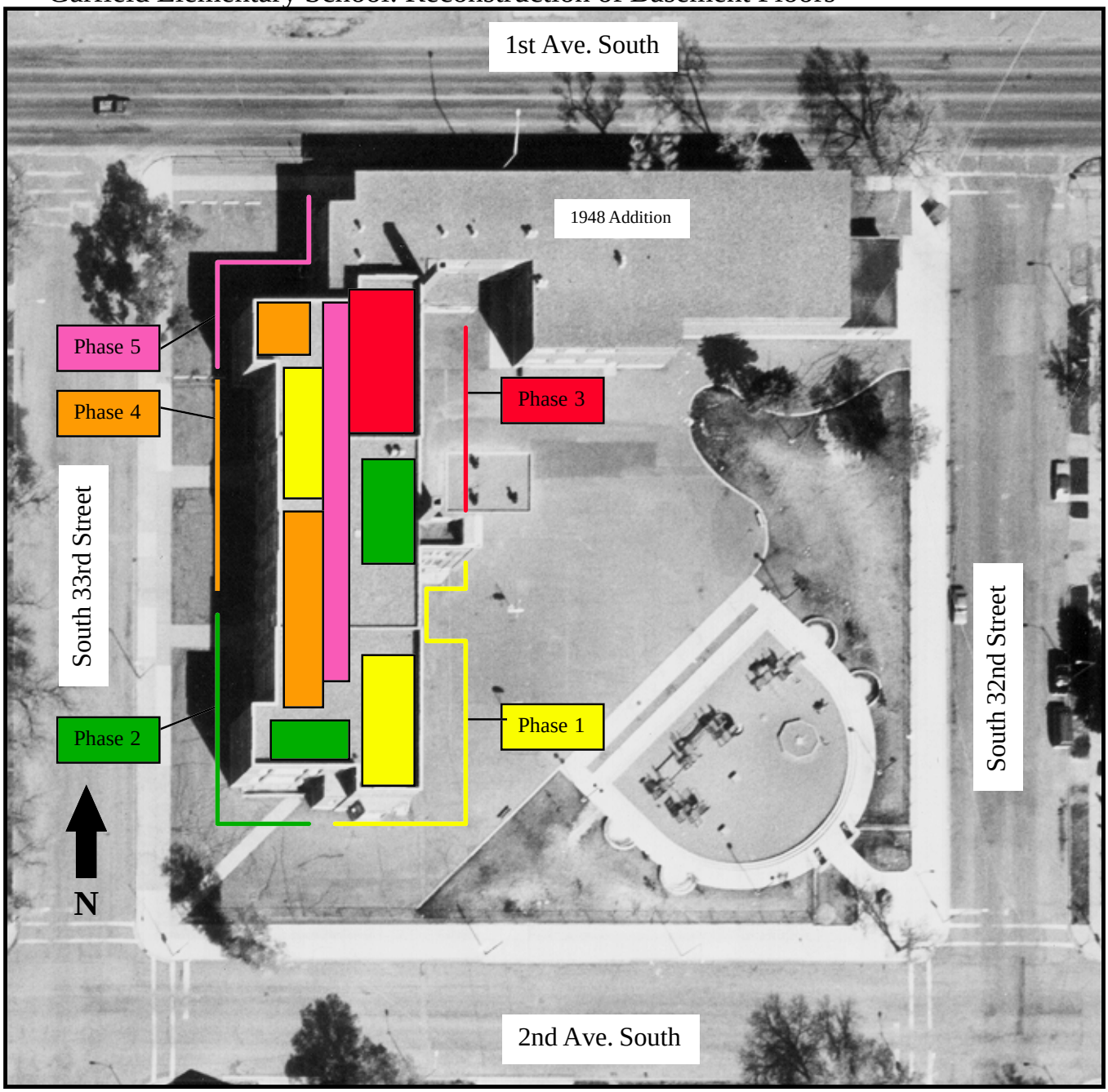
During phase 1 we could also start on the proposed new storm sewer line. We could install the new line all the way to the new manhole in 1st Ave. S. Then connect the first roof drain line from the southeast corner of the building. This would eliminate digging near the building twice and disturbing the new window well. Please see next section for costs and more details.

Garfield Elementary School: Reconstruction of Window Wells



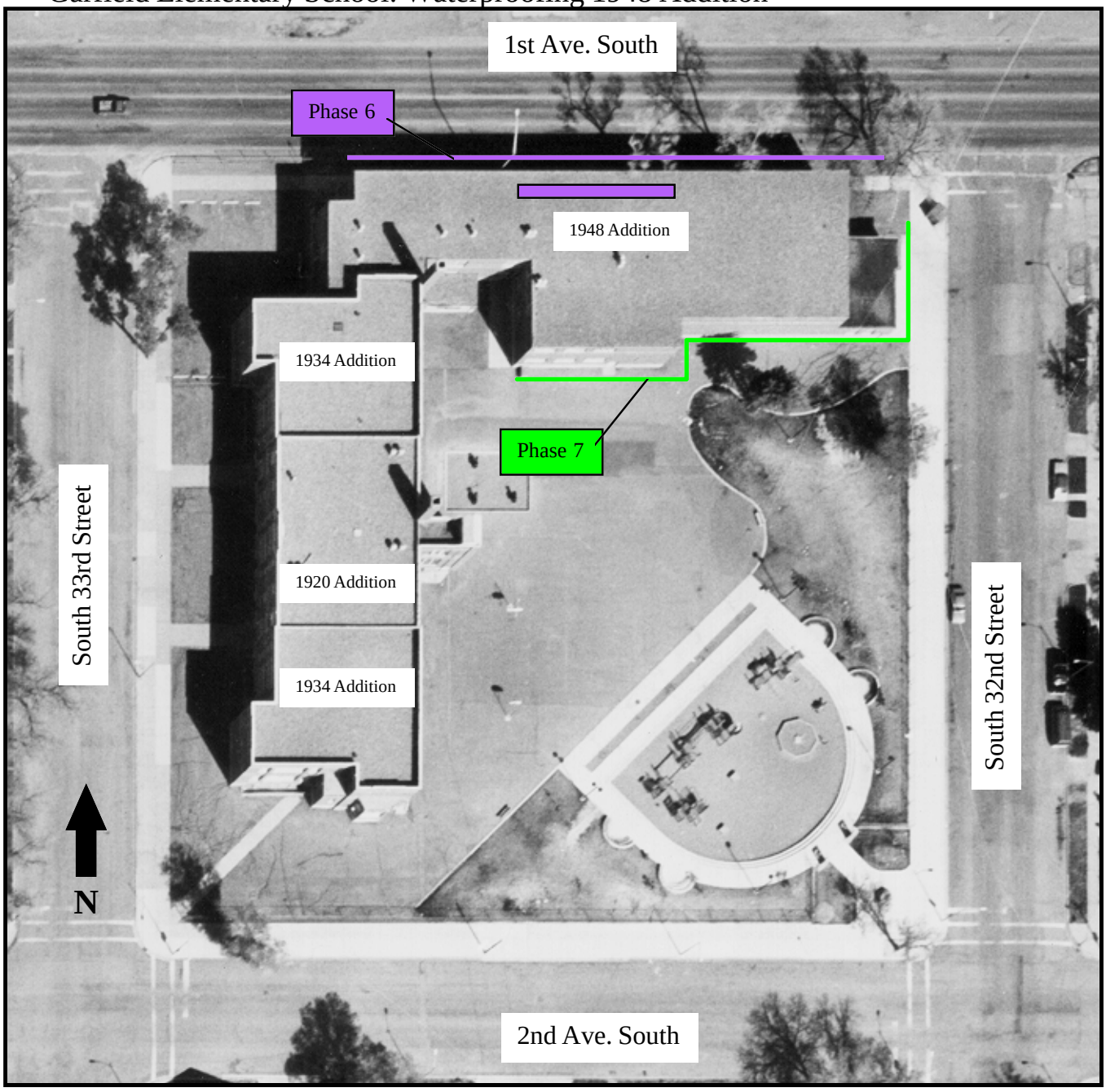
Each phase represents $50,000 of construction costs for window well reconstruction, waterproofing exterior of building wall below grade, and reconstruction of concrete basement floor. See C-2 for basement floor areas.

Garfield Elementary School: Reconstruction of Basement Floors



All concrete basement floor reconstruction costs are included in the cost of reconstruction of window well and below grade waterproofing shown on C-1.

Garfield Elementary School: Waterproofing 1948 Addition



Each phase represents $50,000 of construction costs for waterproofing below grade exterior of building wall and reconstruction of concrete sidewalk and some reconstruction of concrete floors in steam tunnels in phase 6.

3

SEWER LINES
OCTOBER 31, 1996

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The sewer investigation and sewer line jetting (cleaning) at Garfield Elementary School has been completed. Further research on the sewers was requested after the preliminary report was given. It has resulted in a number of positive steps towards solving some of Garfield's problems:

- Video taping from TV camera of existing sanitary sewer lines.
- Mapping of the existing sanitary and storm sewer lines inside and outside.
- Determining which lines the roof drains use.
- Removing obstructions in a sludged line.
- Cleaning of the window wells and their drain lines.
- Locating trouble spots.
- Making recommendations.
- Providing cost estimates.

We now know where all the lines are located and their capacities. The changes from the original drawings of the inside of the building have been marked on the plans. This investment will pay dividends now and over the years.

The main sewer line from the 1920 and 1934 additions is overloaded in times of heavy rains. This line runs southeast out of the building beneath the music room. See green line on S-1. During a heavy rain, according to my estimate, this 6-inch pipe can be at capacity from just seven roof drains and five window wells. (One window well has been disconnected and two roof drains use another line.)

All of the plumbing fixtures in the 1920 and 1934 additions use the same sanitary sewer line as the roof drains. My estimate shows these fixtures require a separate 4-inch minimum sewer line of their own to handle the load.

The manhole in Second Avenue South is probably backing up also during heavy rains. This is a city 8-inch line to which everything drains into except for the 1948 addition roof drains. They go to the storm sewer on First Avenue South.

The 6-inch line from the manhole in the yard to the manhole in 2nd Avenue was probably the sewer line for the 1902 original building (razed in 1981). See purple line on S-1. This section of sewer line needs replacing. It has many low spots and could be a source of an emergency at an inopportune time. I recommend replacing it within 5-years. This could cost $15,000.

There is another 6-inch line handling one roof drain on the east side of the 1920 addition and one roof drain on the east side of the 1934 south addition. See red line on S-1. This

pipe twists, turns, goes back under the building and back out. It has been repaired with PVC indicating a possible break when the new gas line was installed. This 6-inch line is 18-inches deep and then drops to 5 to 6-feet deep and connects to the original 6-inch (purple) sewer line between the manhole in the yard and the manhole in 2nd Avenue.

One of the problems with checking the lines are the great distances and the number of bends. It makes it very tough to push a camera or anything else through the pipe. We recommend installing two clean outs; one in the line coming from the music room and one in the line coming from the 1948 building. See S-2. This will enable periodic checking and cleaning with relative ease.

We can alleviate the pressure off of these lines during heavy rains by installing a separate storm sewer line for the roof drains. See yellow lines on S-4. This will also bring the roof drain lines up to code. Right now there are no traps between the roof drains and the sewer line as shown on the plans and required by code.

This new storm sewer could cost $65,000. This includes some regrading and resurfacing of the ground around the building. A positive slope away from the building is needed to keep surface water from entering the ground and finding its way to the base of the building. To achieve drainage without regrading the entire playground we propose installation of two new surface drains to collect the water. These would be connected to the new storm sewer and are included in the estimate.

During Phase 1 of the concrete reconstruction and waterproofing we could start on the new storm sewer line. We could install the new line all the way to the new manhole in 1st Ave. S. and connect the first roof drain line from the southeast corner of the building. This could cost $35,000. If we waited to install the new storm sewer we would have to disturb the new window well in that area when we connect to the building.

As each phase is worked on, we could connect the roof drain in that area to the new storm drain line. The remaining $30,000 from the storm sewer estimate would be spread over Phases 2-5.

S-3 shows the existing storm drain system that is used for the roof drains of the 1948 addition. It is important to note the different jurisdictions that apply to the sewer lines around Garfield School. Storm sewers in S. 32nd and S. 33rd Streets are 6-inch pipes approximately 3-feet deep. They carry the run-off from the paved areas. They are not big enough to handle the additional water from Garfield’s roof drains.

All of the window wells and their drain lines have been cleaned and checked with water. See blue boxes on S-5. All but one drain well now. The window well next to the music room (east side) has no connection to the sewer that we can find. This must have been

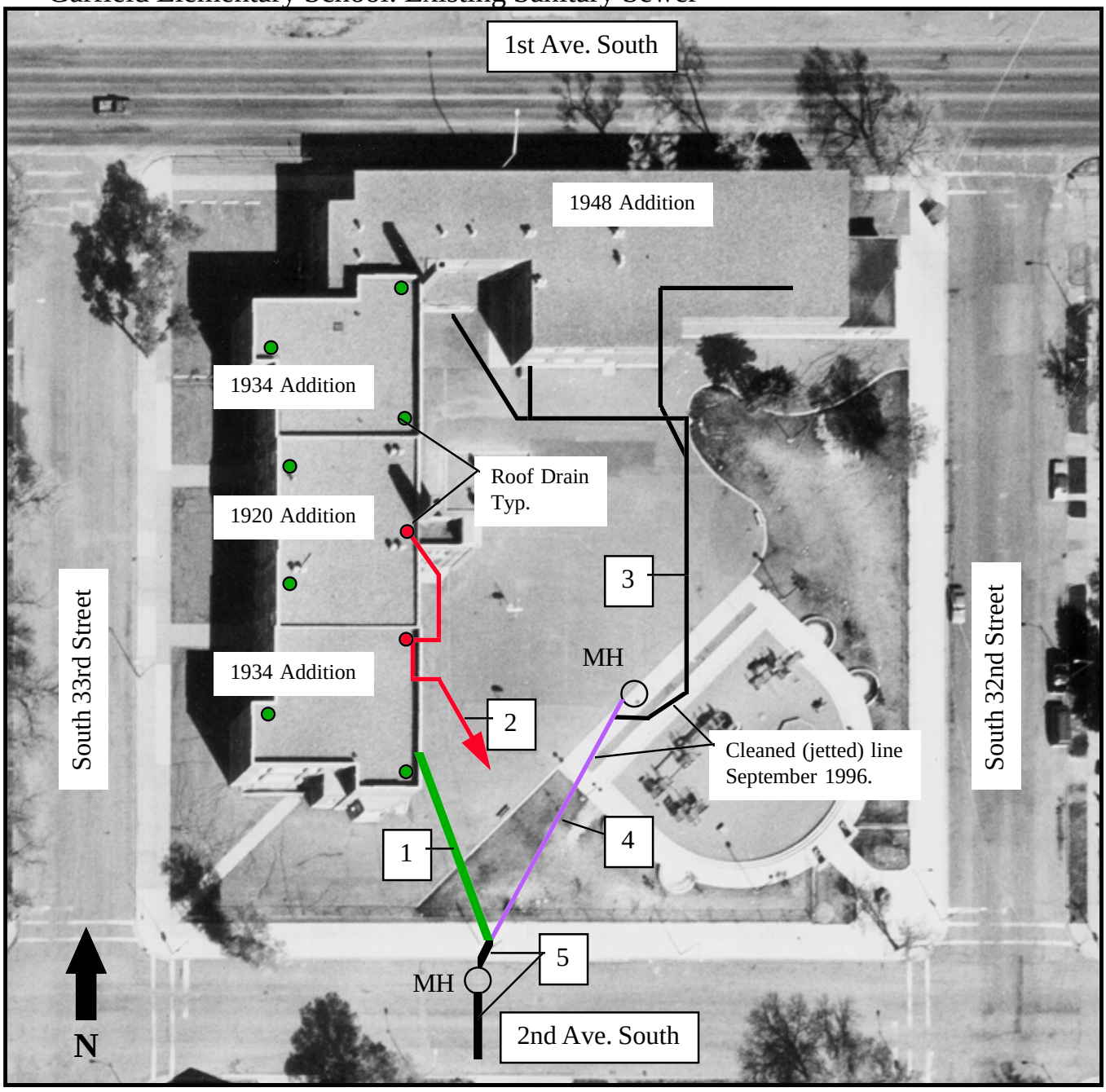
disconnected from under the music room floor and could be the source of our leak and sewer smell.

It was found that one drain line in the window well was capped and one ended in mud. There is a hole in the concrete next to the drain that water goes down readily. This hole might be the reason water is getting into the music room. The wet carpet that smells of sewer may be from a combination of the sewer line and the window well leaking.

A preventive maintenance program should be implemented at Garfield. The sewer lines, stairwell, window wells and their drains should be cleaned periodically. The sewer lines should be jetted once a year. The stairwell, window wells and their drain lines should be cleaned more often. If the sandbox is left in place, cleaning should be done monthly. If the sandbox is removed, cleaning could be done quarterly. An inspection program should be implemented to verify if cleaning is being performed adequately and to adjust the cleaning schedule to maximize effectiveness.

To be most effective, we should consider the entire building envelope during planning, repairs and preventive maintenance programs. Please see the next section for further information on this.

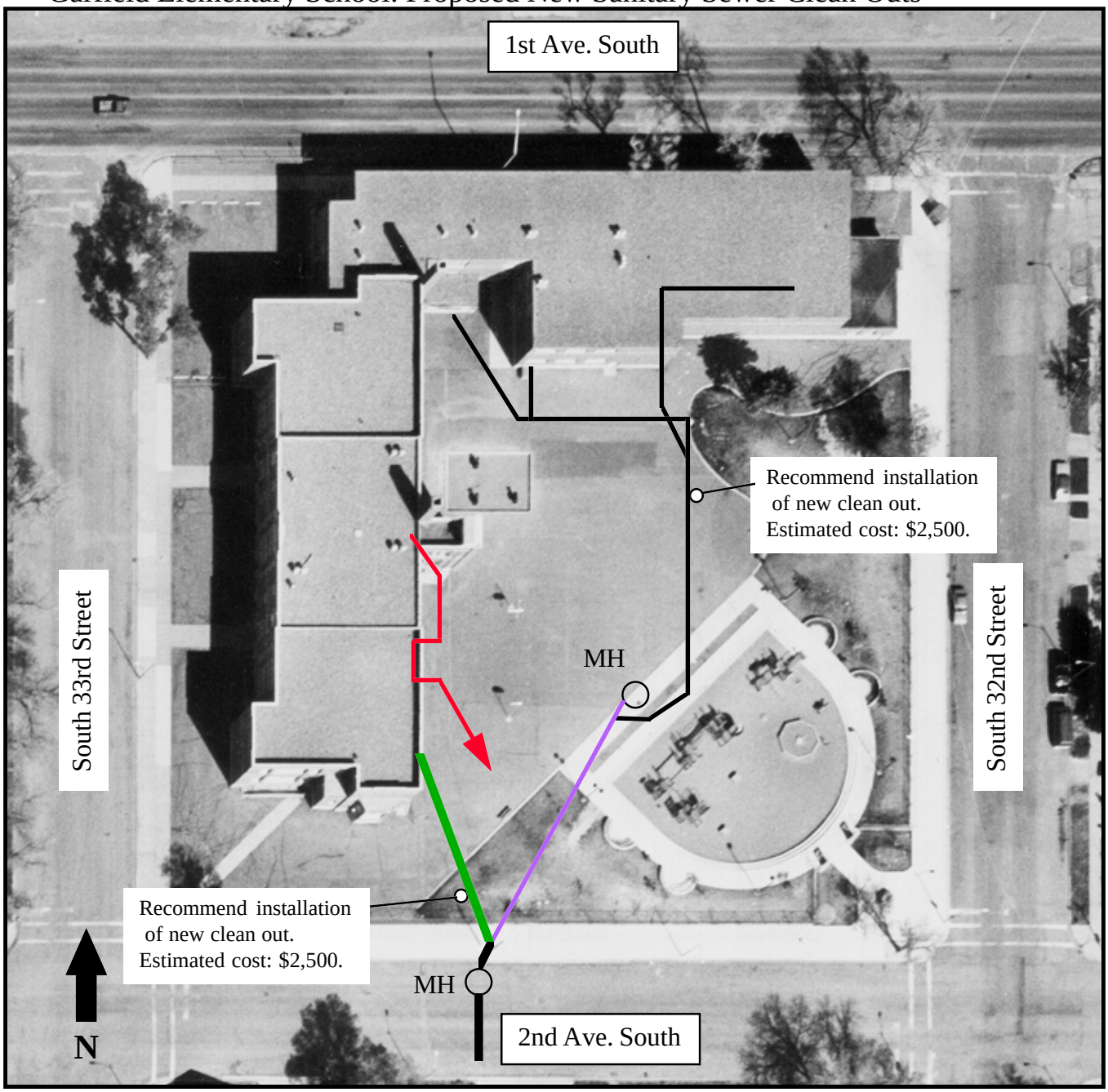
Garfield Elementary School: Existing Sanitary Sewer



1	8-inch dia., 6-foot deep (clay tile) sanitary sewer; records kept by City of Billings Public Utilities Department. Green indicates green roof drains utilize this line.
2	6-inch dia., 6-foot deep roof drain (clay tile and PVC) connected to 6-inch sanitary sewer (purple line) at some point in school yard. Red indicates red roof drains utilize this line.
3	6-inch dia., 6-foot deep (clay tile) sanitary sewer built in 1948.
4	6-inch dia., 6-foot deep (clay tile) sanitary sewer; records kept by City of Billings Public Utilities Department. Replacement needed within 5-years. Estimated cost $15,000.
5	8-inch dia., 6-foot deep (clay tile) sanitary sewer; records kept by City of Billings Public Utilities Department.

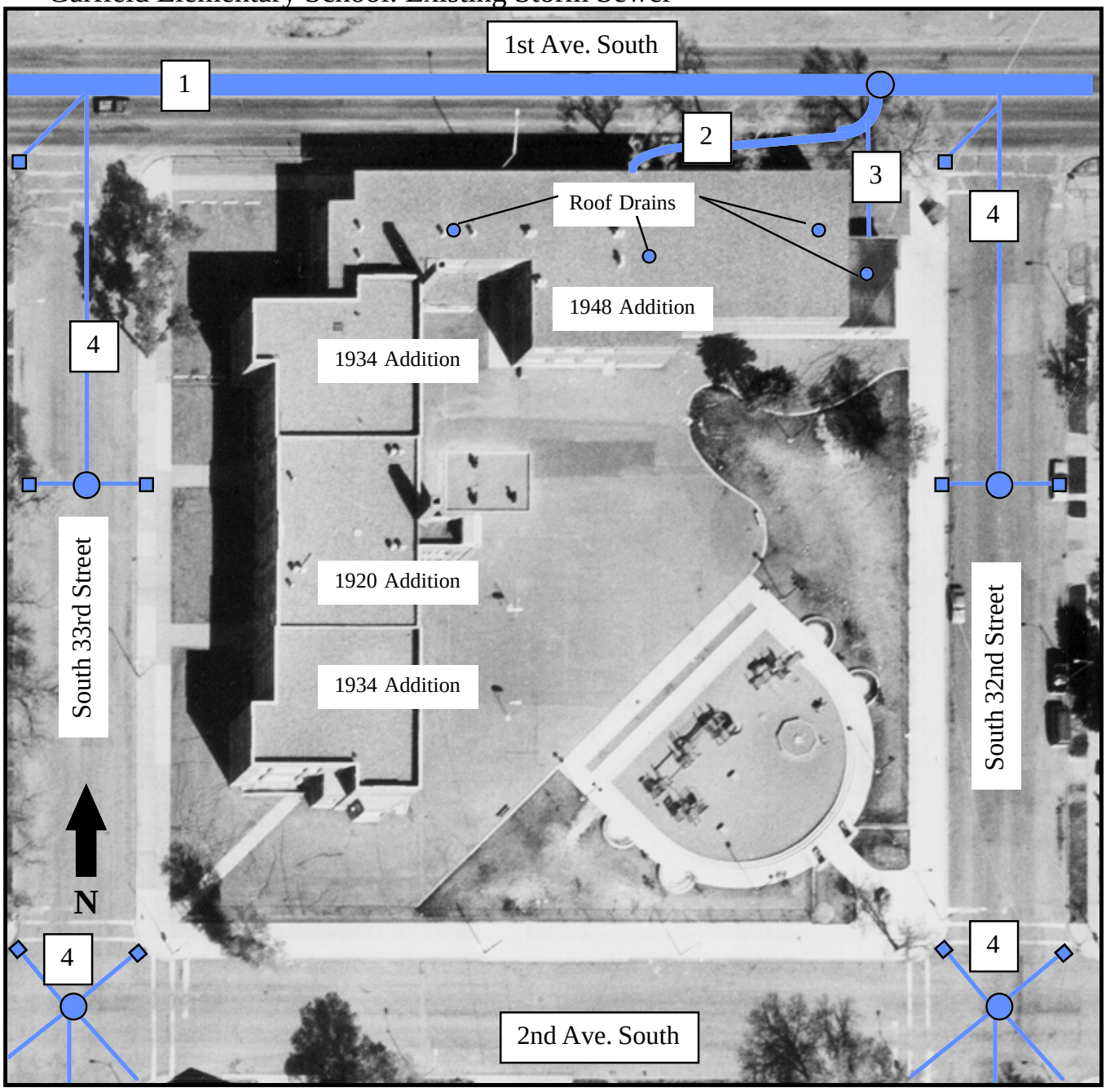
NOTE: Field verify all locations, sizes and inverts.

Garfield Elementary School: Proposed New Sanitary Sewer Clean Outs



NOTE: Field verify all locations, sizes and inverts.

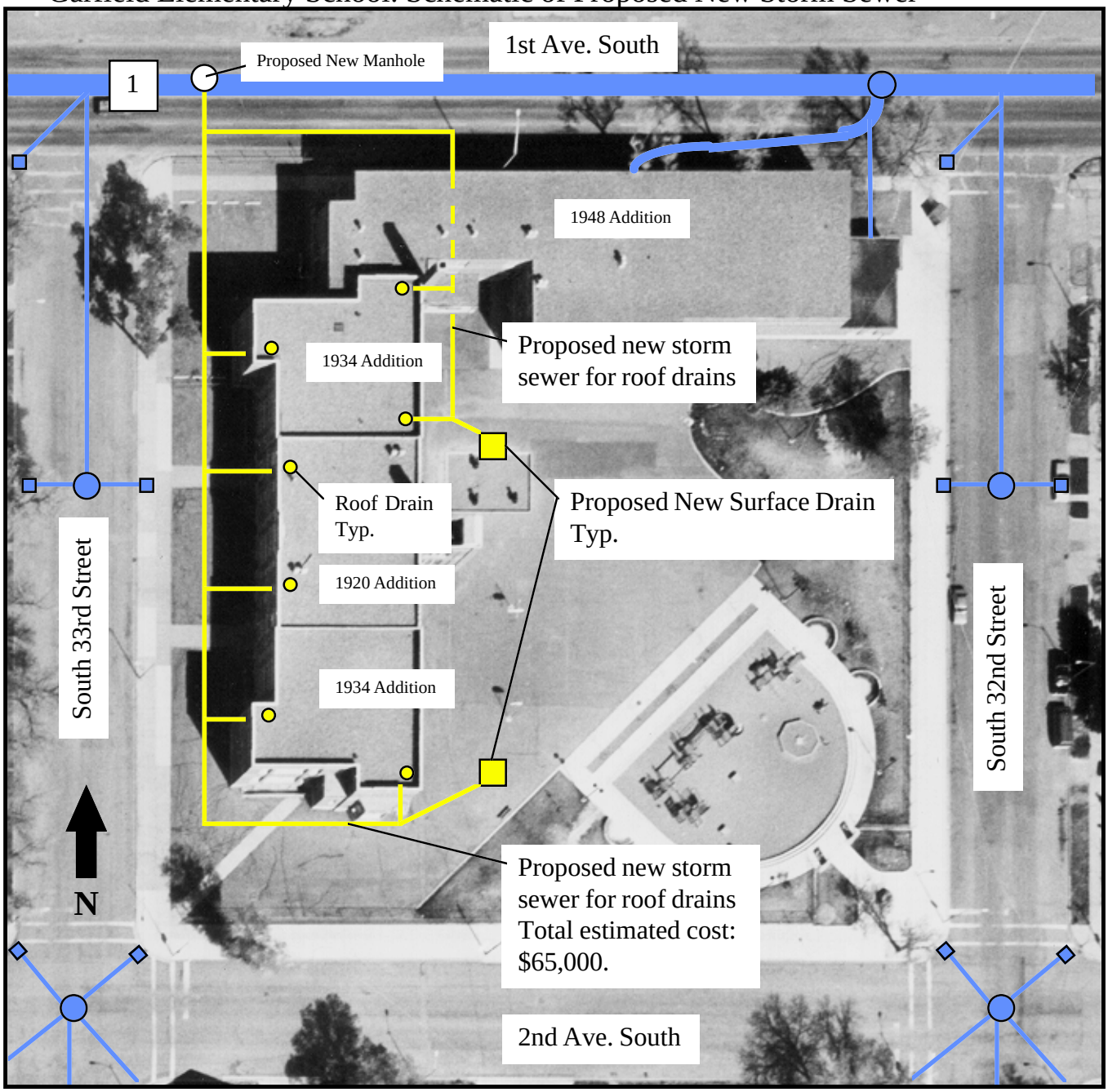
Garfield Elementary School: Existing Storm Sewer



1	36-inch dia., 5-foot deep storm sewer built by MT Transportation Dept., maintained by City of Billings Public Works Department.
2	8-inch dia. into 10-inch dia., 5-foot deep storm sewer built in 1948 to handle roof drains of 1948 addition.
3	6-inch dia. into 10-inch dia, 5-foot deep storm sewer built in 1948 to handle roof drains of 1948 addition.
4	6-inch dia., 3-foot deep storm sewer built in 1932, maintained by City of Billings Public Works Department.

NOTE: Field verify all locations, sizes and inverts.

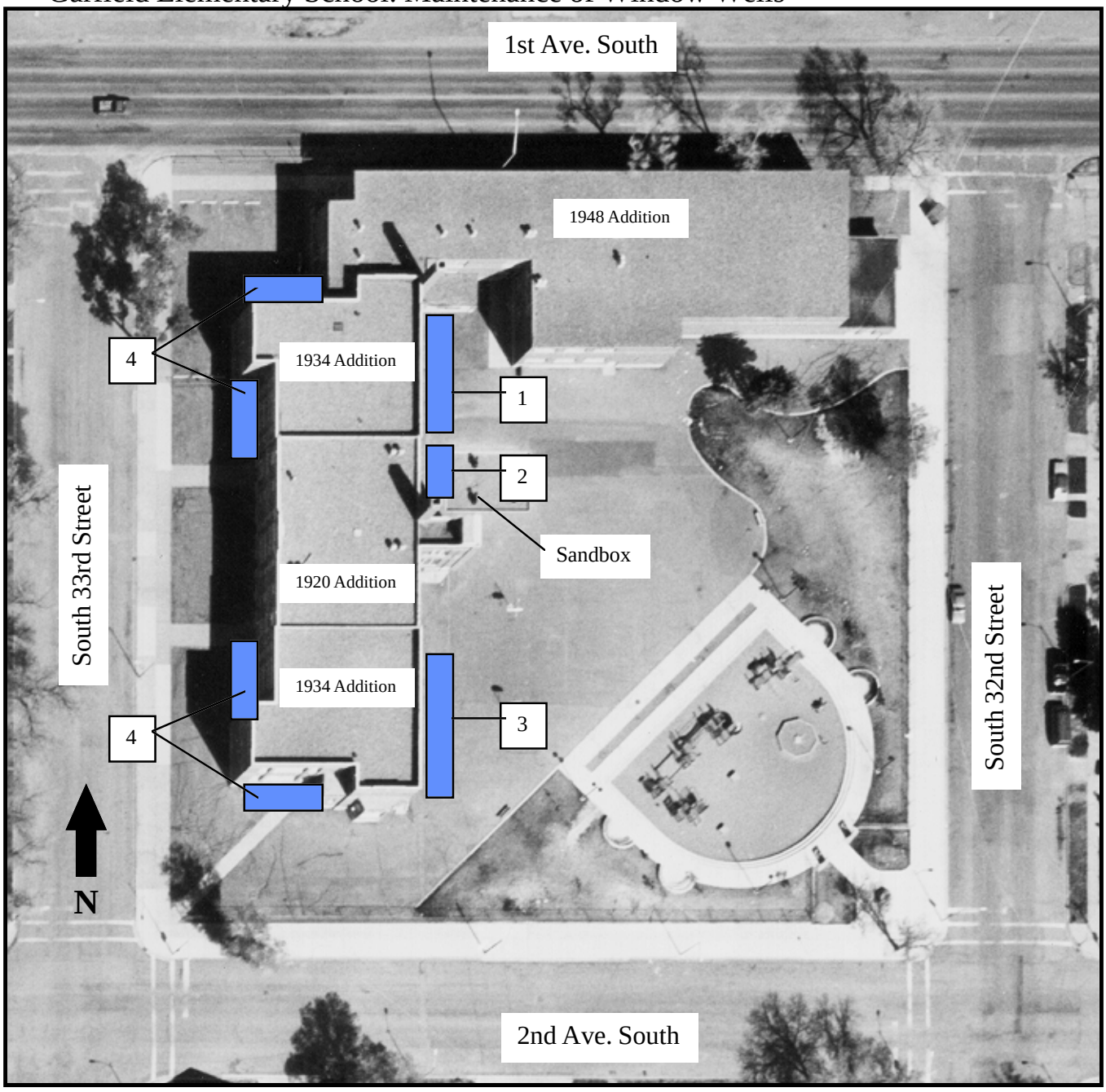
Garfield Elementary School: Schematic of Proposed New Storm Sewer



1 36-inch dia., 5-foot deep storm sewer built by MT Transportation Dept., maintained by City of Billings Public Works Department.

NOTE: Field verify all locations, sizes and inverts.

Garfield Elementary School: Maintenance of Window Wells



1	4’ x 60’ x 3’-6” deep window well (1934). Concrete bottom and drains reconstructed unknown date. Shovels full of sand cleaned out Oct. 22, 1996. Drains cleaned and work well.
2	4’ x 25’ x 6’-0” deep stairwell (1934). Concrete walls and bottom reconstructed in 1989. Full of trash and sand. Cleaned Oct. 22, 1996.
3	4’ x 70’ x 3’-6” deep window well (1934). Not connected to any sewer. Cleaned Oct. 22, 1996. North drain hits mud after 2’. South drain dead ends after 2’. Water runs into small hole in concrete next to drain into the soil.
4	Four 4’ x 28’ x 3’-6” deep window wells (1955 remodel). Cleaned Oct. 22, 1996. Drains work well. All but north well needs reconstruction due to cracking concrete and overturning walls.

4

BUILDING ENVELOPE

OCTOBER 31, 1996

TOTAL COST ESTIMATE

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Solving the crumbling concrete, surface drainage, and sewer problems at Garfield School are very important steps in the restoration of the building. However, we must consider all sources of water and the resulting damage it can cause to have an effective protection program. We must waterproof the entire building envelope to safeguard the building from further deterioration. The areas that need attention include:

- Roofing.
- Coping stones.
- Brick and stone exterior walls.
- Windows.
- Flashings.
- Exterior lighting.
- Termination and transition detailing (where different materials meet).

Increased maintenance for these areas could cost $20,000 minimum per year for 10-years. American with Disabilities Act upgrade could cost an additional $250,000; the most expensive item being an elevator. Additional expenses on the inside for such things as repairing ceilings and stairs could cost $100,000.

The exterior of Garfield School is in need of maintenance. This photo shows brick that needs repointing.

We recommend starting with some of the easiest and least expensive maintenance:

- Repair the slits in the EPDM roof flashing and apply sealant to the term bars.
- Replace and rebuild roof drain screens on some drains.
- Apply metal flashing over deteriorating concrete coping on interior parapet walls of the 1920 addition.

Then move on to more challenging work:

- Secure loose coping stones on the perimeter of the parapet walls by resetting the stones.
- Remove old exterior lighting and conduit and patch holes in the coping stones and face brick.
- Repoint the coping stones around the entire perimeter of the 1920 and 1934 additions.

At the same time start on the worst areas of brick deterioration:

- Clean brick, stone and terra cotta.
- Repoint brick.
- Apply sealant to joints.
- Apply clear waterproofing to face brick.

Solve other potential sources of water infiltration and deterioration:

- Apply sealant to window frames
- Replace two metal roofs on south side of building.
- Apply sealant to exterior light fixtures.
- Detail all metal signs attached to building.

Make all trades aware of the new building envelope waterproofing requirements. This will help ensure future problems are reduced to a minimum. Schedule inspection programs to follow up on maintenance work. The decisions made everyday in the field will determine the costs of future maintenance problems and the longevity of the structure. Everyone should be aware that the work they perform has important ramifications for keeping a building weathertight over the years.

See next page for compilation of estimated costs.

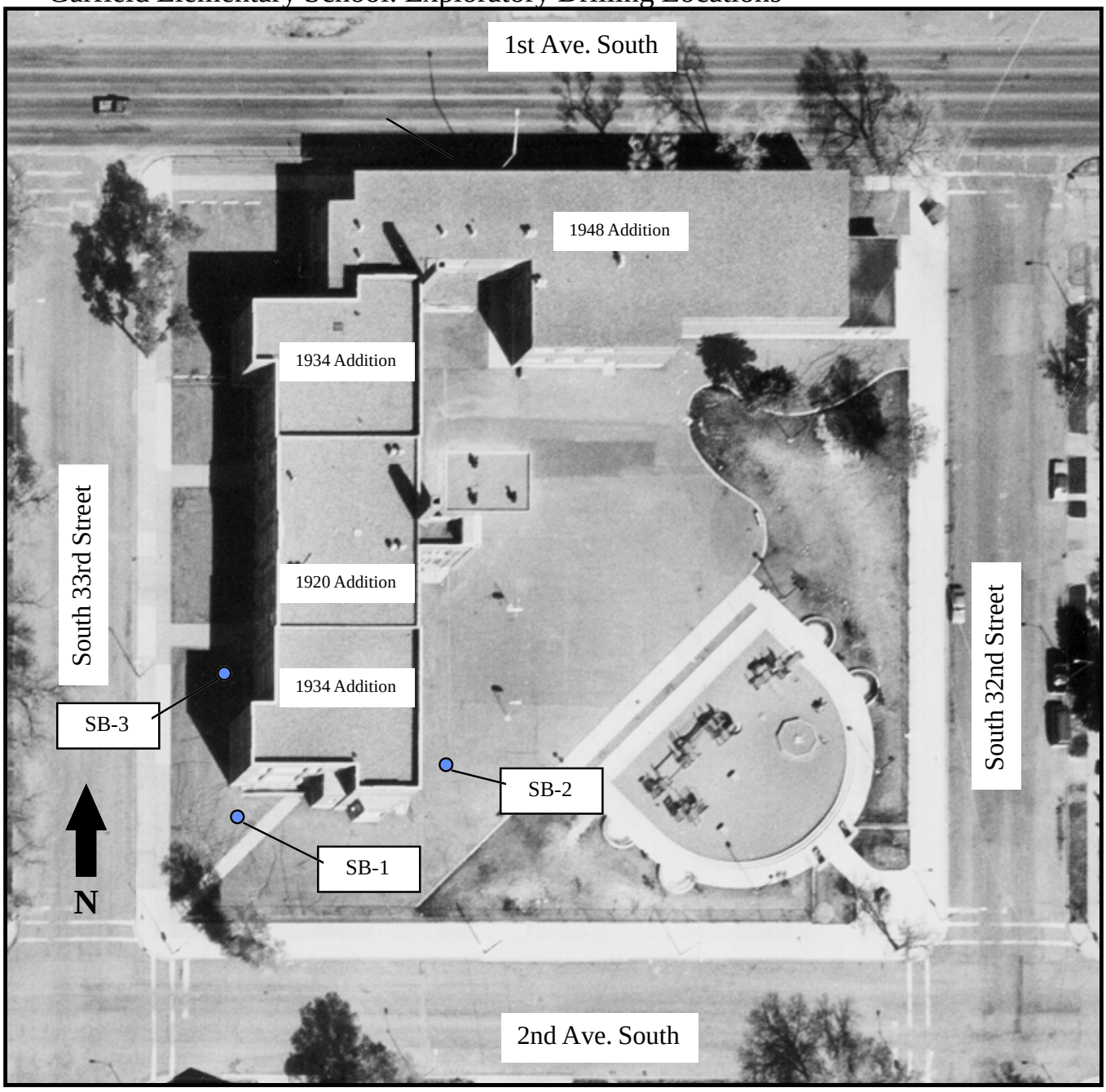
Estimated Costs:

Seven Phases of Concrete Restoration and Waterproofing	**$350,000**
New Storm Sewer	**65,000**
Repair Existing Sewer Line	**15,000**
Install New Clean Outs	**5,000**
Ten Phases of Building Envelope Maintenance	**200,000**
Total Estimated Costs	**$635,000**
ADA Upgrade (elevator)	**250,000**
Interior Maintenance (stairs, ceilings)	**100,000**
Combined Estimated Costs	**$985,000**

5

APPENDIX

Garfield Elementary School: Exploratory Drilling Locations



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LOG OF EXPLORATION HOLE SB-1

FIGURE 1

Project No. : 8B516.101
Project : GARFIELD SCHOOL
Location : BILLINGS, MT
Drill Date : 8/8/96
Drill Method : MOBILE B-47

Top of Casing Elev. :
Drill Hole Location : NA
Total Depth : 20.0
Water Level (Date) : 16.0 (8/8/96)
Field Logged by : C. PETERSON

SAMPLES	PID (ppm)	M (%)	N	DEPTH (feet)	LITHOLOGY	GEOLOGIC DESCRIPTION
				.17		ASPHALT
SS-1			3	.50		BASE COURSE; black, moist, sandy gravel
			3			
			3			SILTY CLAY, (CL); some fine sand, brown, moist
			3			
SS-2			2			
			2			
			3			
			6			
SS-3			3			
			5			
			6	5.5		SILTY FINE SAND, (SM); brown, moist, medium dense
			8			
SS-4			3			
			5			
			7			
			8			
SS-5			4			
			5	9.0		SANDY GRAVEL, (GM); brown, moist, very dense
			16			
			50			
SS-6			22			
			50/2"			
						water level at 16.0
						water level at completion and after 2 hrs at 16.9 feet
						easier drilling at 17.0 feet
SS-7			15			
			45			
			39			
			22			
				20.0		BORING TERMINATED AT 20.0 FEET

WELL

grout
bentonite seal
10/20 Silica Sand (CSSI)
4" Sch. 40 PVC Casing
4" Slotted PVC Screen

10-20 Sand
15' - 20 slot screen
5 ' - Casing
Flush mount with lock plug

Depth to water 8/14/96 - 16.47'

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ENGINEERING

LOG OF EXPLORATION HOLE SB-2

FIGURE 2

Project No. : 8B516.101
Project : GARFIELD SCHOOL
Location : BILLINGS, MT
Drill Date : 8/8/96
Drill Method : MOBILE B-47

Surface Elev. :
Drill Hole Location : NA
Total Depth : 10.0
Water Level (Date) : DRY (8/8/96)
Field Logged by : C. PETERSON

SAMPLES	PID (ppm)	M (%)	N	DEPTH (feet)	LITHOLOGY	GEOLOGIC DESCRIPTION
				0		
				.33		ASPHALT
SS-1			3			BASE COURSE
			3	.67		SILTY CLAY, (CL); brown, moist, medium stiff
			5			
			6			
SS-2			2			
			2			
			3	3.5		CLAYEY SILT, (ML); brown, moist, soft
			2			
SS-3			1			
			2	5.0	5	SILTY FINE SAND, (SM): brown, very moist, loose
			3			
			5			
SS-4			4			
			4			
			5			
			11	8.0		SANDY GRAVEL, (GM); brown, moist, very dense
SS-5			22			
			44			
			50/3"			
				10.0	10	BORING TERMINATED AT 10.0 FEET

Dry on completion

MSE-HKM
ENGINEERING

LOG OF EXPLORATION HOLE SB-3

FIGURE 3

Project No. : 8B516.101
Project : GARFIELD SCHOOL
Location : BILLINGS, MT
Drill Date : 8/8/96
Drill Method : MOBILE B-47

Surface Elev. :
Drill Hole Location : NA
Total Depth : 10.0
Water Level (Date) : DRY (8/8/96)
Field Logged by : C. PETERSON

SAMPLES	PID (ppm)	M (%)	N	DEPTH (feet)	LITHOLOGY	GEOLOGIC DESCRIPTION
				0		
				.17		ASPHALT
SS-1			1			SILTY CLAY, (CL); brown, moist to very moist, very soft, brick fragments (fill)
			1			
			2			
			3			
SS-2			1			
			1			
			3			
			3			
SS-3			1			
			1	5.0		FINE SANDY SILT, (ML); brown, moist to very moist, very soft
			3	5		
			3			
SS-4			3			
			3	7.0		SILTY FINE SAND, (SM): brown, moist to very moist
			4			
			6			
SS-5			4			
			7			
			37	9.5		SANDY GRAVEL, (GM); brown, moist, very dense
			40	10.0		BORING TERMINATED AT 10.0 FEET
				10		

Dry on completion
Driller notes easy drilling "pretty moist"

Form No. 603(R 2-89) **WELL LOG REPORT** File No. 6309
State law requires that the Bureau's copy be filed by the water well driller within 60 days after completion of the well.

1. WELL OWNER
Name Garfield School

2. CURRENT MAILING ADDRESS

3212 - 1 Ave. S.
Billings, MT 59101

3. WELL LOCATION
NW 1/4 NE 1/4 SW 1/4 Section 3

Township 1 S Range 26 E County Yellowstone Govn't. Lot

or Lot Block
Subdivision Name
Tract Number

4. PROPOSED USE:
Monitor Well X

5. TYPE OF WORK:
New Well X Deepened Reconditioned

Method: (Dug, Cable Tool, Rotary, Bored, Hollow Stem Auger) Hollow Stem Auger

6. DIMENSIONS: Diameter of Hole 8"
Diam. from: 0 to 21'
Diam. from: to
Diam. from: to

7. CONSTRUCTION DETAILS:
Casing; PVC flush joint threaded
Diameter 2"
Weight Sch. 40
Diam. from: 0 to 4'
Diam. from: to
SCREENS:
Yes X No
Manufactur's Name Laibe Env. Products
Type threaded flush joint
Diam. 2" Slot Size 0.02 from 4' to 19'
Diam. Slot Size from to
SAND PACKED
Yes X No Size of sand 10/20
Sand packed from 3' to 19'
GROUTED:
To what depth? 3'
Material used in grouting 3/8" Bentonite chips

RECEIVED AUG 2 0 1996

8. WELL HEAD COMPLETION: File No. 6309

Pitless Adaptor Yes No X

9. PUMP (IF INSTALLED) N/A

10. WELL TEST DATA N/A

11. Was Well Plugged or Abandoned?

Yes No X

If yes, how?

12. WELL LOG MW - 1

Depth (ft.)

From	To	Formation
0	6	Brown, moist clay
6	9	Brown, silt
9	21	Sand & coarse gravel

13. DATE COMPLETED 8/8/96

14. DRILLER/CONTRACTOR'S CERTIFICATION

This well was drilled under my jurisdiction and this report is true to the best of my knowledge.

Date 8/12/96

Firm Name Hansen Environmental Drilling

Address HC 71-1030

Glasgow, MT 59230

Signature

License # MWC - 230

Montana Department of Natural Resources & Conservation (DNRC)
1520 East 6th Ave. Helena, MT 59620-2301 #444-6610

JOB: GARFIELD ELEMENTARY SCHOOL
TV SEWER LINE ON AUGUST 14 1996

FROM CITY MAN HOLE IN 2nd AVE. SOUTH:
8" TILE LINE NORTH 41", 8" WYE TO THE LEFT.
AS THE LINE CONTINUED NORTH IT REDUCES TO 6" TILE RIGHT AFTER THE WYE.
THIS LINE IS VERY SLUGGY LINE. IT RUNS TO THE EXISTING MAN HOLE IN THE YARD.

FROM CLEAN OUTS IN BASEMENT. 1st ONE IS FROM C.O. ON SOUTH SIDE IN ABOUT THE MIDDLE. 2nd ONE IS FROM C.O. IN THE BOYS RESTROOM.
1st: THIS LINE IS A 4" CAST IRON. LINE GOES N.E. 14" THEN 45's TO THE EAST, AT 22'6" IT HAS A 90 DEGREE TURN TO THE NORTH, RIGHT AFTER THE 90 IT WYES INTO ANOTHER LINE AND RUNS N.W., THEN AT 36'6" IT WYES INTO THE 6" CAST IRON LINE THAT IS RUNNING S.E. THAT IS AS FAR AS WE COULD GO WITH THE TV CAMERA.
2nd: THIS LINE IS A 4" CAST IRON. LINE GOES EAST STRAIGHT UNDER THE TOILETS, AT 20'6" IT TURNS 45 TO THE RIGHT, S.E., THEN AT 26' IT WYES INTO ANOTHER 4" LINE AND RUNS SOUTH, THEN AT 56' IT 45's AND WYES INTO A 6" CAST IRON LINE,EAST. AT 64' LINE TURN 45 TO THE RIGHT,S.E., AT 83' THE LINE FROM THE 1st WYE INTO THIS LINE. AT 85' ANOTHER LINE WYES INTO THIS LINE ON THE TOP, THEN AT 95' THE LINE TIES INTO A 8" CLAY TILE LINE. (THIS LINE IS STILL RUNNING S.E.) AT 176' THERE IS A 45 DEGREE TURN TO THE RIGHT. THAT IS AS FAR AS WE COULD GO WITH THE TV CAMERA.

ROTO-ROOTER SEWER SERVICE
724 DUNHAM AVENUE · BILLINGS, MONTANA 59101
BOX 20295 · 59104
FAX (406) 252-2557
TOLL FREE 1-800-696-4008
COAST TO COAST
406-252-5146

TV CAMERA INSPECTION SHEET
JOB ADDRESS: Garfield School 9/6/96

PROBLEM	MEASUREMENTS ARE FROM	FEET TO FEET	TYPE OF PIPE	SIZE OF PIPE
	clean out on 6" roof drain old boiler rm		cast iron	6"
cast iron to PVC OFFSET JOINT	SAME	51"	PVC	"
turns 45 right south	same	61"	PVC	"
change types of pipe	same	94"	PVC to clay tile	"
turns 90 down	same	295"	clay tile	"
turns 90 to horizontal	same	345"	"	"
turns 90 to left direction I don't know	same	407"	"	"
can't go any more		407"		

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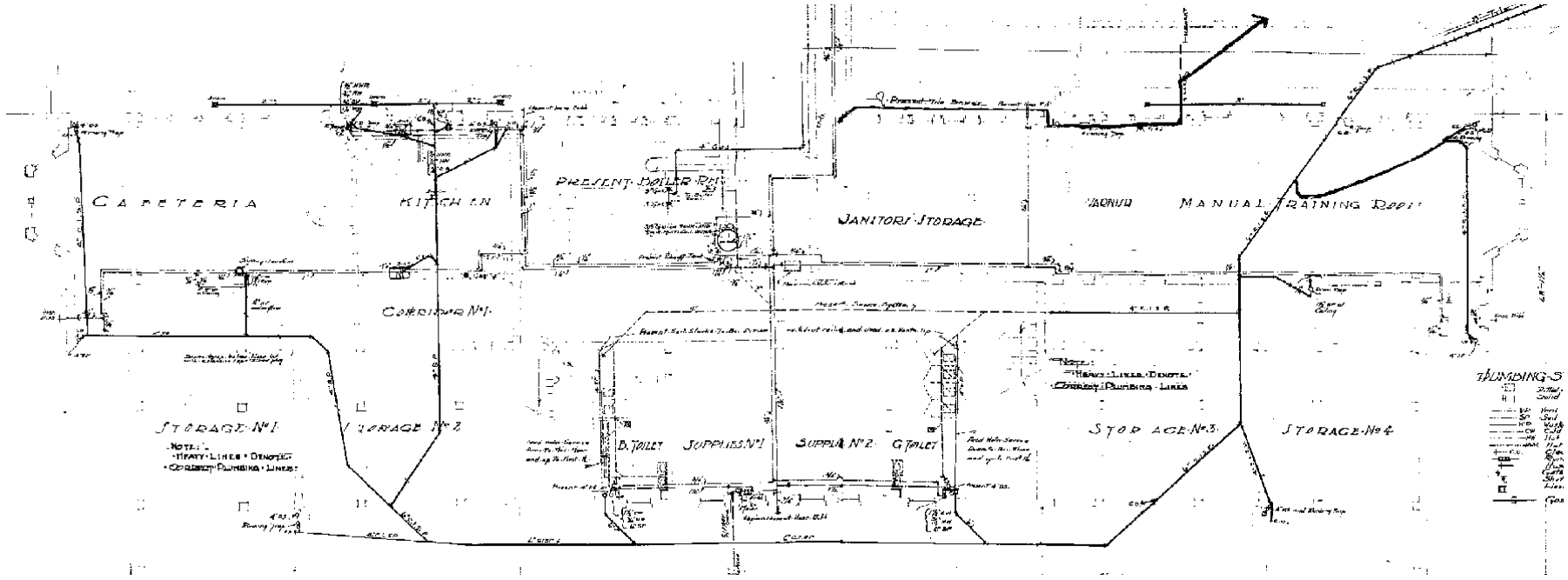
TV CAMERA INSPECTION SHEET
JOB ADDRESS: Garfield School

PROBLEM	MEASUREMENTS ARE FROM	FEET TO FEET	TYPE OF PIPE	SIZE OF PIPE
4" cast iron to 6" clay tile	clean out behind new ~~boiler~~	30"	4" C.I. 6" clay	
offset joint	same	31' to 64'	clay	6"
turns to the left at about 22	same	38'	"	"
wye from locker room restroom	same	41'	"	"
roots	same	67'	"	"
something at top of joint	same	94½'	"	"
turn 90 to right going south	same	103'9"	"	"
wye, on the top from east side restrooms	same	104'9"	"	"
can't go any more	same	150'		



REVISED BASEMENT SEWER LINE LOCATIONS
GARFIELD SCHOOL
NOT TO SCALE