

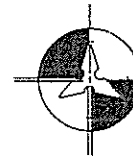
Drainage Design Considerations
for
Buffalo Creek Subdivision
Wellington, Colorado

July 31, 2002

Prepared for:

Great Plains Investment Group, LLC
4529 S. Stover Street
Fort Collins, Colorado 80525

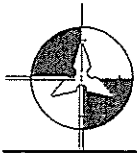
Prepared by:



DMW

Davis, Miller & Wohnrade Civil Engineers, Inc.
1435 W. 29th Street
Loveland, Colorado 80538
Phone: (970)461-2661, Fax: (970)461-2665

Project Number: 0107.00-BUF



DMW

Davis, Miller & Wohnrade Civil Engineers, Inc.

1435 W. 29th Street, Loveland, Colorado 80538
Phone: 970-461-2661, Fax: 970-461-2665

July 31, 2002

Larry Lorentzen
Town Administrator/Town Clerk
Town of Wellington
3735 Cleveland Avenue
Wellington, Colorado 80549

Re: Drainage Design Considerations for
Buffalo Creek Subdivision
Wellington, Colorado

Dear Mr. Lorentzen:

Davis, Miller & Wohnrade Civil Engineers, Inc. (DMW) is pleased to submit this drainage study for Buffalo Creek Subdivision for your review. This report complies with technical criteria set forth in the Urban Storm Drainage Criteria Manual by the Urban Drainage and Flood Control District for the design and analysis of drainage facilities.

We acknowledge that the Town of Wellington's review of this study is only for general conformance with submittal requirements, current design criteria and standard engineering principles and practices.

If you should have any questions or comments as you review this report, please feel free to contact me at your convenience.

Sincerely,
DAVIS, MILLER & WOHNRADE CIVIL ENGINEERS, INC.

Jade P. Miller, P.E.
Project Manager

Drainage Design Considerations for Buffalo Creek Subdivision

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***Drainage Design Considerations
for
Buffalo Creek Subdivision***

EXHIBITS

Exhibit 1	Historic Condition Plan
Exhibit 2	Offsite Basin O1
Exhibit 3	Offsite Basin O2
Exhibit 4	Buffalo Creek Subdivision Drainage Plan

APPENDICES

Appendix A:	Coal Creek Floodplain Feasibility Study
Appendix B:	Historic Condition Hydrology
Appendix C:	Developed Condition Hydrology
Appendix D:	Street Capacity
Appendix E:	Inlet Design
Appendix F:	Storm Sewer Design
Appendix G:	Swale Design
Appendix H:	Culvert Design
Appendix I:	Detention Pond Rating and Routing
Appendix J:	Riprap Calculations

Drainage Design Considerations
for
Buffalo Creek Subdivision
Wellington, Colorado
May 24, 2002

I. INTRODUCTION

1.1 Objective

This study documents the results of a comprehensive hydrologic and hydraulic analysis of both pre and post-development conditions for the proposed Buffalo Creek Subdivision development. The utility plans which accompany this report are entitled Final Construction Plans for Buffalo Creek Subdivision prepared by Davis, Miller & Wohnrade Civil Engineers, Inc.

1.2 Project History and Previous Studies

There are no known drainage studies that precede this report. In addition, there is no known master drainage plan for the Town of Wellington.

1.3 Mapping and Surveying

Field survey information and topographic mapping with a contour interval of 1-foot was obtained by Davis, Miller & Wohnrade Civil Engineers from King Surveyors, Windsor, Colorado. Additional topography outside of the project boundary was taken from USGS topographic mapping with a ten (10) foot contour interval.

II SITE LOCATION AND DESCRIPTION

2.1 Site Location

The site is located in the southwest quarter of Section 28, Township 9 North, Range 68 West of the 6th Principal Meridian in the Town of Wellington, Colorado. The site is bounded by Larimer County Road 9 on the west, Washington Avenue (Larimer County Road 64) on the south, and Boxelder Creek on the east (See Vicinity Map).

2.2 Site Description

The Buffalo Creek Subdivision site is roughly 161.3 acres. The site has historically been used for agricultural purposes and is currently furrowed and sparsely vegetated. Boxelder Creek parallels the site along the east property line, flowing from north to south.

Property to the north and west is undeveloped and is currently used for agriculture. Wellington Point Subdivision is located to the south, and light industrial is located to the east, across Boxelder Creek.

There are two existing residences located on the site. The first home is located in the southwest corner of the site, adjacent to Larimer County Road 9. The second house is located in the southeast corner of the site, adjacent to Boxelder Creek.

The property has been irrigated in the past, therefore, there are concrete irrigation laterals located on the site. There are no known underground drain tiles located on the site.

Soil borings located throughout the site showed no evidence of groundwater within a depth of fifteen (15) feet from the ground surface(see soils report).

A portion of the Buffalo Creek site is located in the Boxelder Creek regulatory floodplain. The floodplain, however, is contained within the banks of the creek (See Appendix A).

III. HISTORIC CONDITIONS

3.1 Historic Drainage Patterns

Stormwater runoff from the Buffalo Creek site drains overland generally from north to south at slopes ranging from 0.5% to 5.3% toward an existing low point located adjacent to Washington Avenue on the south edge of the site. Stormwater runoff is conveyed under Washington Avenue through an existing culvert and enters the Windsor Ditch. If the discharge of stormwater exceeds the capacity of the existing culvert, it will be detained at this location and may eventually spill to the east over a high point in the north borrow ditch of Washington Avenue and be conveyed towards Boxelder Creek, or spill to the south over the road into Windsor Ditch and be conveyed east to an overflow weir into Boxelder Creek.

3.2 Historic Drainage Basins

The site contains one onsite historic drainage basin, Basin H1 (See Exhibit 1). Basin H1 (146.3 acres) drains overland from north to south to the culvert described in the previous paragraph. The 2 and 100 year discharges at Design Point H1 are 7.0 cfs and 161.0 cfs respectively.

Stormwater runoff enters the Buffalo Creek site from two offsite basins located to the west and north. Runoff from Basin OS1 (179.80 ac) located to the west enters the site through an existing culvert under Larimer County Road 9 near the northwest corner of the property. The 2 and 100-year discharges at Design Point OS1 are 2.5 cfs and 103.3 cfs respectively.

Runoff from Basin OS2 (100.78 ac) located to the north enters the site via an existing 12 inch culvert passing under the existing irrigation ditch which parallels the north property line. The 2 and 100-year discharges at Design Point OS2 are 1.6 cfs and 64.8 cfs respectively.

3.3 Total Historic Runoff

All Stormwater runoff from the offsite and onsite historic basins combined reaches the culvert under Washington Avenue. The 2 and 100-year discharges at this location are 9.3 cfs and 245.7 cfs respectively.

VI. DEVELOPED CONDITIONS

4.1 Proposed Site Development

Development of the Buffalo Creek Subdivision site will consist of single-family lots and open space. The site infrastructure includes local and collector streets, sanitary sewer, storm sewer, and a water distribution system. County roads adjacent to the site on the south and west will be improved to include paving and curb and gutter.

4.2 Developed Drainage Patterns

The developed site has been divided into thirty-nine (39) onsite drainage basins. Stormwater runoff will be conveyed overland and in storm sewers to two onsite detention ponds and released into Boxelder Creek. The peak 100-year developed discharge from the site will be released at a historic 2-year rate.

Runoff from Basins 2-4, 6-9 and 11-18 (68.46 acres) drains overland and through storm sewer and swales to Detention Pond 1. The peak 2 and 100-year inflows to Pond 1 are 30.4 and 154.6 cfs respectively.

Runoff from Basins 19-37 (71.19 acres) drains overland and through storm sewer and swales to Detention Pond 2. The peak 2 and 100-year inflows to Pond 2 are 38.5 and 181.5 cfs respectively.

Runoff from Basin 39 will drain to Boxelder Creek undetained.

The total combined release from Pond 1, Pond 2 and onsite undetained flows do not exceed the 2-year historic rate of 9.3 cfs.

4.3 Detention Pond 1

Detention Pond 1 is located in the southeast corner of the site adjacent to Washington Avenue and Boxelder Creek. Pond 1 will contain a single stage release consisting of a 3.5" diameter orifice. The maximum 100-yr release from Pond 1 is 0.9 cfs with an associated water surface elevation of 5218.2.

4.4 Detention Pond 2

Detention Pond 2 is located on the east side of the site adjacent to Boxelder Creek. Pond 2 will contain a single stage release consisting of a 4" diameter orifice. The maximum 100-yr release from Pond 1 is 1.1 cfs with an associated water surface elevation of 5226.1. Pond 2 will have a permanent pool elevation of 5219.1 to store water for irrigation purposes.

V. DESIGN CRITERIA

5.1 Design References

Drainage criteria specified in the Storm Drainage Criteria Manual by the Urban Drainage and Flood Control District has been referenced in the preparation of this study.

5.2 Hydrologic Criteria

Criteria in the Storm Drainage Criteria Manual state that the rational method be used for tributary basins "generally less than 160 acres" and that the CUHP method be used where the basin "exceeds 160 acres." Therefore, either method would be consistent with the criteria. Because the proposed site has been split into two, independent major sub-basins, the rational method has been used to estimate peak stormwater runoff from the project site. Calculations made as part of this investigation, along with other supporting material, are contained in Appendix B and C.

An initial 2-year and major 100-year design storms have been used to evaluate the proposed drainage system. Rainfall intensity data for the rational method has been taken from IDF equations generated specifically for the Buffalo Creek Subdivision site by the computer program "Watershed Modeling" by Eagle Point Software. Input of precipitation amounts for the generation of intensity equations have been taken from the NOAA Atlas 2, Volume III-Colorado.

5.3 Hydraulic Criteria

The Storm Drainage Criteria Manual has been referenced for all hydraulic calculations. In addition, the following computer models have been utilized:

- The computer program "UDINLET" has been used to analyze storm inlet capacity;
- The computer program "Flowmaster" has been used to analyze the capacity of proposed swales;
- The computer program "Storm Sewer Module" by Eagle Point Software has been used in the design of storm sewers;
- The computer model "HY8" by the U.S. Department of Transportation, Federal Highway Administration has been used to analyze proposed culverts.

VI. BOXELDER CREEK FLOODPLAIN

6.1 Feasibility Study

Drainage design considerations for the Buffalo Creek development have taken into account the possible changes to the Boxelder Creek floodplain and any future impact to the site. The report entitled, Coal Creek Floodplain Feasibility Study (Reference 2) describes four (4) possible alternatives for removing the Coal Creek floodplain from the eastern portion of the Town of Wellington planning area.

Alternative five was determined to be the preferred alternative which includes diverting undetained flows from Coal Creek to Boxelder Creek. The increase in

discharge in Boxelder Creek would be roughly 1270 cfs. The cross-section of Boxelder Creek would also be increased and would include a bike path.

Detention facilities have been evaluated based on the alternative five tailwater condition in Boxelder Creek using the flood hydrograph from the feasibility study. The detention pond routing for Ponds 1 and 2 have been based on the water surface elevation on Boxelder Creek by using the hydrograph for Conveyance Element 64 (CE64) from the feasibility study SWMM model.

6.2 Datums

Information reference on the Flood Insurance Rate Map (FIRM) is based on the NGVD 29 datum. Topographic information for the Buffalo Creek development is based on the NAVD 88 datum. The NAVD datum is 2.9 feet higher than the NGVD 29 datum.

VII. OFF-SITE FLOW ROUTING

7.1 Swale 39

Runoff from offsite basins to the north and west will be routed around the Buffalo Creek site in an open channel. Swales 39 and 40 will convey a peak one hundred (100) year discharge of 123.3 cfs to Boxelder Creek.

Due to limited site grades, the swale will be constructed at a slope of 0.32 % with a two (2) foot wide trickle pan for low flows. The FIRM base flood elevation for Boxelder Creek at the confluence with Swale 39 is 5225.5. The equivalent elevation based on the NAVD 88 datum is 5228.4. The floodplain will extend west along Swales 39 and 40 for a distance of roughly 742 feet. Finished grades on lots adjacent to the floodplain will have roughly five (5) feet of freeboard above the base flood elevation.

VIII. EROSION CONTROL

8.1 Erosion Control Plan and Criteria

The erosion control plan presented here is intended to control rainfall erosion. The reference, Urban Storm Drainage Criteria Manual, Volume 3, Best Management Practices by Urban Drainage and Flood Control District has been referenced for this erosion control plan.

8.2 Rainfall Erosion Control Plan

The proposed rainfall erosion control plan during construction will consist of temporary structural erosion control measures. Gravel inlet filters will be placed at all curb inlets. Silt fence inlet protection will be placed at the upstream end of all culverts and, the outlet pipes from Ponds 1 and 2.

8.3 Grass-Lined Swales

Grass-lined swales have been used to collect overland flows from roadways, yards and parking lots. The swales are used to limit the extent of directly connected impervious areas and, have been designed to maintain low velocities (2 fps) during the 2-year event. Grass-lined swales have been designed as an onsite BMP and can be expected to provide moderate removal of suspended solids.

See the Grading and Erosion Control Plan for locations of proposed erosion control measures.

IX. **CONCLUSIONS**













9.1 Compliance with Standards

All applicable drainage criteria have been complied with according to the "Storm Drainage Design Criteria", Urban Drainage and Flood Control District. No variances have been requested for the proposed development.

REFERENCES

- 1) Urban Storm Drainage Criteria Manual, Urban Drainage and Flood Control District, Wright McLaughlin Engineers, Denver, Colorado, March, 1969.
- 2) Coal Creek Floodplain Feasibility Study, Engineering Design and Research Corporation, January 8, 2001.

LEGEND:

-  EXISTING STORM SEWER
-  EXISTING STORM SEWER WITH INLET
-  PROPOSED STORM SEWER ON CLAYVERT
-  PROPOSED STORM SEWER ON CLAYVERT WITH INLET
-  30FO EXISTING CONTOUR
-  30 PROPOSED CONTOUR
-  PROJECT BOUNDARY
-  DESIGN DRAINAGE BASIN BOUNDARY
-  BASIN LABEL
-  AREA IN ACRES
-  DESIGN POINT
-  PROPOSED RIMP OUTLET PROTECTION

NOTE:

- 1) THE REGULATORY FLOODPLAIN DELINEATED ON THIS PLAN WAS TAKEN FROM THE FLOOD INSURANCE RATE MAP (FIRM), PANEL 135 OF 278, LARIMER COUNTY, COLORADO, DATED MARCH 23, 1999.
- 2) THE BFE'S SHOWN ON THIS PLAN (TAKEN FROM THE FIRM) ARE REFERENCED TO THE NATIONAL GEODETIC VERTICAL DATUM OF 1929. THE SITE SURVEY IS REFERENCED TO THE NAVD 88 DATUM. SUBTRACT 2.9 FEET FROM THE NAVD ELEVATIONS TO OBTAIN THE NGVD 29 ELEVATIONS.

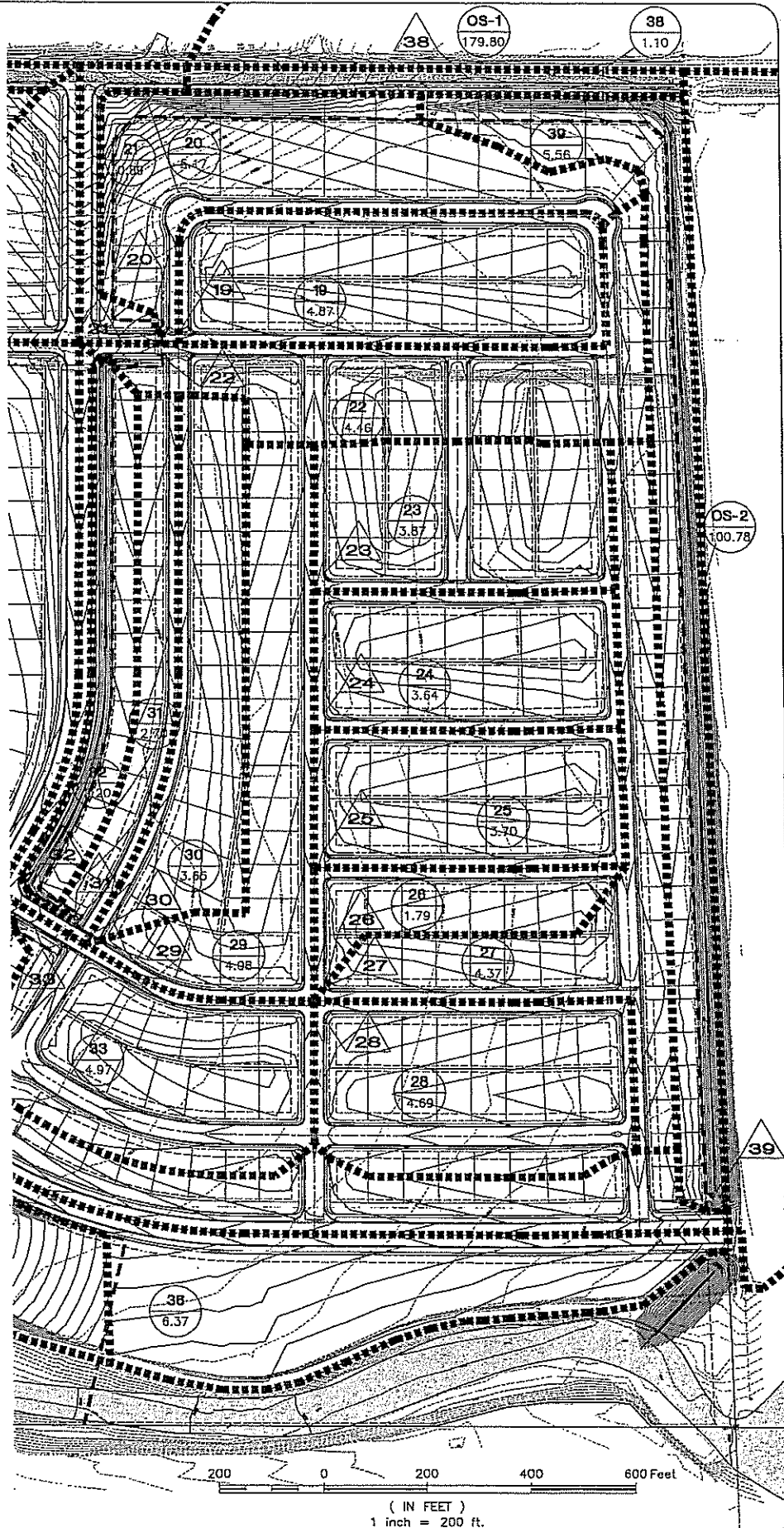


EXHIBIT 4

ALBERT L. GARDNER, SURVEYOR
HARRISBURG, MISSOURI
REGISTERED PROFESSIONAL SURVEYOR

WEST QUARTER CORNER
SECTION 24, T4N, R14E, S34E
FOUNDED BY RICHARD W. MILL
3/14/1870
POINT OF BEGINNING

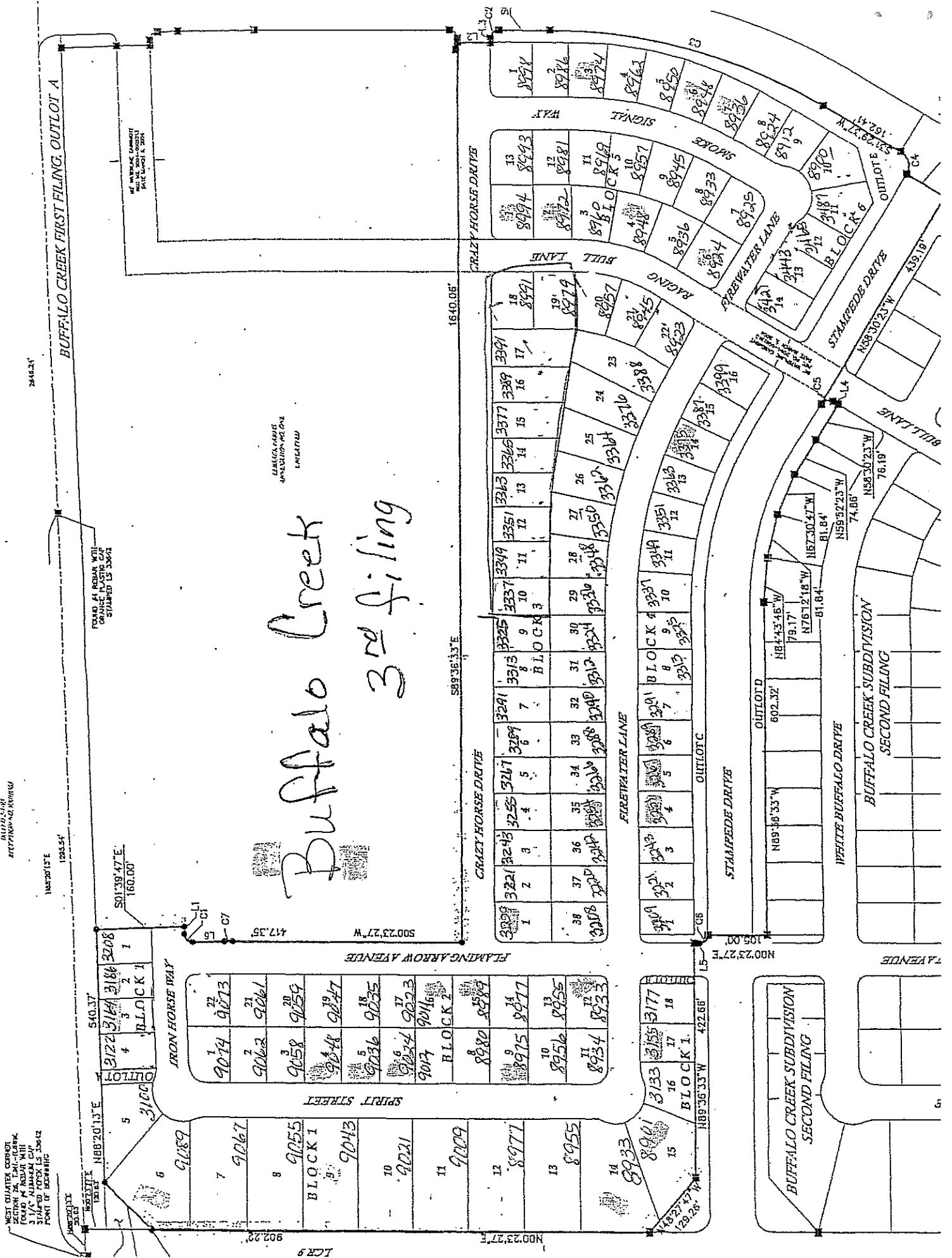
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WEST QUARTER CORNER
SECTION 24, T4N, R14E, S34E
FOUNDED BY RICHARD W. MILL
3/14/1870
POINT OF BEGINNING

BUFFALO CREEK FIRST FILING, OUTLOT A

Buffalo Creek
3rd filing



510.37
3122 3164 3184 3208
BLOCK 1

501.39 47'E
160.00

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500.23 27' W

589.36 13'E

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100.23 27'E

422.66'

105.00'

61.84'

74.06'

76.19'

435.18'

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