I. Introduction/Site History

A. Property Location

The site is located west of 18 Road and north of K 6/10 Road, north of the City of Fruita, Colorado. The property is approximately 6.63 acres in size, which includes the adjacent street area to the centerline of the right of way.

B. Description of Property

As stated above, the property is approximately 6.63 acres in size. The site is currently undeveloped except an older house and out buildings in the center of the parcel.

The site slopes from the northeast to the southwest, with slopes averaging 2.2 percent. The lowest elevations occur near the southwest corner of the property in the Wilkie Drainage Ditch. Elevations vary from 4538 to 4554 feet.

According to the Natural Resource Conservation Service (NRCS), the soils across the site consist of FR-Fruitland Fine Sandy Loam over the majority of the property and TR-Turley Clay Loam along the drainage ditch. Both soils are Hydrologic Soils Group "B".

Roland Engineering completed a boundary and topographic survey for the planned development. Huddleston Berry of Grand Junction completed a soils investigation for the planned development.

C. Purpose of Drainage Report

The 6.63-acre parcel is planned to be developed in one phase. The purpose of this Drainage Report is to evaluate the impact or change to the existing drainage patterns and peak runoff from developing this 6.63 acre parcel.

II. Existing Drainage Conditions

A. Major Basin Characteristics

This area of Mesa County consists of a mixed rural residential, and agricultural land uses.

The general area dips to the south and west. The watershed for this site is located along the north side of K 6/10 Road north of the City of Fruita, Colorado. The site is bordered on the East by 18 Road (N Pine Street) and the west by the Wilkie Drainage Ditch. The site is located near a combination of agricultural and residential uses.

Drainage from the site is currently collected in the southwest corner and is conveyed to the "Wilkie Drainage Ditch" operated by the Grand Junction Drainage District. The Wilkie Drain is a sub watershed of the Little Salt Wash. At the western side of the proposed residential subdivision, the Wilkie Drain is comprised of an open drainage ditch. The ditch flows into an 18-inch culvert that crosses K 6/10 Road and then opens back into a drain ditch. The Wilkie Drain flows south and west until it is piped into a 36 inch RCP into City of Fruita where it discharges directly into Little Salt Wash and ultimately the Colorado River. According to the City of Fruita Storm Water Master Plan (SWMMP), no limitations or restrictions are suggested for this drainage.

B. Site Characteristics

As stated above, the property is approximately 6.63 acres in size. The site is currently undeveloped except for a single family residence located in the center of the property. The property is utilized for agricultural purposes and as a farmstead. The site slopes from the northeast to the southwest, with slopes averaging 2.2 percent. The lowest elevations occur near the southwest corner of the property in the Wilkie Drain. Elevations vary from 4538 to 4554 feet.

The existing drainage patterns of the property, includes a combination of sheet flow, shallow concentrated flow, and channel flow. The cover type for the site is currently pasture. Please refer to Exhibit 'A'- Pre-Development Drainage Area Map. In general, drainage flows from the north to the southwest corner of the property. Here it is collected into an existing 12-inch asbestos cement (AC) pipe, which drains into the Wilkie Drain.

III. Proposed Drainage Conditions

C. Changes in Drainage Patterns

As expected in most developments, conversion and development of this property from bare ground to a residential area will increase the storm water runoff, both in peak rates and volumes. However, with planned on site detention, runoff rates leaving the property will not be increased above the historic 100-year storm event.

Please reference Exhibit 'B'- Post Development Drainage Area Map for an accurate depiction of proposed drainage areas. The building's roofs will drain via gutters and down spouts discharging in the landscape areas and green areas, then sheet flow to the streets. From the streets the flow will be shallow concentrated and concentrated flows along the gutters to inlets located at the south end of the development. From the inlets, the storm water will be conveyed into the detention facility planned on site.

The detention facility will be equipped with a draw down structure. This structure will limit the storm drain release and convey the flow to the Wilkie Drain near its intersection with K 6/10 Road.

The detention facilities will detain approximately 85 percent of the 100-year runoff from the site. Runoff from the adjacent street (K 6/10 Road) and the sidewalk along the Wilkie Drain will bypass the detention pond as it has historically done. The outlet structure in the detention facility will limit the release to the storm drain system to no more than the Pre-Development flow minus the bypass flows.

D. Maintenance Issues

Based on the drainage concept of the development and the relatively low storm water runoff rates, no maintenance to the detention facilities is anticipated beyond normal situations. The detention facility should be monitored throughout the life of the facility with appropriate maintenance performed as needed.

E. Wilkie Drain

At the request of the City of Fruita and the Grand Junction Drainage District, the Wilkie drain will be piped with an 18-inch reinforced concrete pipe. The pipe will have "open joints" in that rubber gaskets will not be put on the spigot to allow ground water to seep into the drain. The pipe will be bedded and backfilled six inches below and to the top of the pipe with screened gravel. Native material will be used to backfill approximately one foot above the top of the pipe.

IV. Design Criteria and Approach

A. General Considerations

The drainage constraints imposed on this site is to contain flows greater than 100 percent of peak historic flows during a 100-year runoff.

B. Hydrology

The hydrologic analysis presented in this drainage report used procedures per the Mesa County Storm Water Management Manual (SWMM) guidelines. The SWMM guidelines allow the use of WinTR-55 and TR-20, both developed by the United States Department of Agriculture for use in modeling watersheds.

WinTR-55 was used to calculate the weighted runoff curve numbers and times of concentrations for both the pre-development flows and the post development flows. Analysis for this development includes peak discharges for the 2-year and 100-year intensity precipitation events and the 24-hour duration event. WinTR-55 and TR-20 were used to calculate the pre-development flows and the post-development bypass flows. The Technical Release 20 (TR-20) computer-modeling program was utilized to determine the detained post-development runoff rates. This TR-20 model was needed to allow for the detention basin routing.

V. Results and Conclusions

A. Runoff Rates for the 2-Year and the 100-Year Storm

Please reference the attached WinTR-55 and TR-20 computations in the Appendices for a complete breakdown of the rates and input values utilized. The summary of estimated flows is as follows:

Condition	2 year runoff (cfs)	100 year runoff (cfs)
Pre-Development	Minor	1.63
Total Post-Development	0.06	4.74
By-Pass Flows	0.01	0.71
Detained Flows	0.05	4.03
Actual Discharge	0.03	0.90
Actual Discharge plus Bypass	0.04	1.61

B. Detention

A detention basin is proposed for this development to temporarily "store" 4.03 CFS of storm water during the 100-year design storm. The detention basin will be located in the southwest corner of the residential subdivision and will be connected by 12-inch pipe to the Wilkie Drain. The detention basin is shown on Exhibit B.

The detention basin will be approximately 4 feet deep and total approximately 8,655 cubic ft. in volume. The side slopes of the basins will be 4:1 for ease of landscaping and maintenance. A 6:1 vehicle entrance

ramp will be provided. Flows from the basin will be released through an outlet structure into a 12 inch HDPE pipe and then into the Wilkie Drain located immediately upstream of K 6/10 Road.

The detention basin proposed will be equipped with an outlet structure that will reduce the runoff rates from a one hundred-year storm. The discharge must be less than that of pre-development flows (1.63 cfs) minus bypass flows (0.71 cfs). Based on this the allowable discharge is 0.92 cfs.

Outlet Structure

The outlet structure designed for the detention basin is a concrete box, measuring 3.5 feet by 2 feet by 3 feet in height, width, and length. The flow into the outlet structure will be limited by a 4.5-inch diameter low flow orifice at the bottom of the structure. The outlet to the storm drain system will be a 12-inch pipe. The Outlet structure will have a partial open top measuring 18 inches by 24 inches for emergency overflow and for inspection and maintenance. A rebar trash rack has been designed to reduce the possibility of clogging the orifice outlets during intense rainfall events.

A detail of the proposed outlet structure is included in the Appendix V.

Miscellaneous

Approximately two (2) inlets, and one- (1) end sections, 90 feet of 12-inch diameter pipe, and 130 feet of 15-inch diameter pipe are planned for this development. Please reference the Structure and Pipe Schedules in Appendix IV for a detailed description.

C. Street/Drive Aisle Flow

Runoff from the street/drive aisles will sheet flow across and drain into inlets. The inlets will direct the storm flow to a network of piping that will discharge into the detention facilities. Please reference the proposed storm drain network plan in Appendix VI, for a map of the proposed storm drain network.

D. Finish Floor Elevations of Structures

The finished floor elevations for the permanent structures are a minimum of 1.0 foot above the 100-year water surface elevation, (4537.04).

E. Overall Compliance

The drainage plan for the proposed development will improve the existing drainage conditions by limiting the storm drain discharge to that of the historic discharge. Adherence to this drainage report will not cause any negative impacts to this site.

F. Construction Phasing

There is only one phase of construction planned for this project. The storm drains and detention basins will be constructed during this phase of construction.

VI. Limitations/Restrictions

This report is a site-specific design for Storm Water Management and is applicable only for the client for whom our work was performed. Use of this report under other circumstances is not an appropriate application of this document. This report is a product of Vortex Engineering Incorporated and is to be taken in its entirety. Excerpts from this report may be taken out of context and may not convey the true intent of the report. It is the owner's and owner's agents responsibility to read this report and become familiar with recommendations and design guidelines contained herein.

The recommendations and design guidelines outlined in this report are based on: 1) the proposed site development and plot plan prepared by Vortex Engineering Incorporated, 2) the site conditions disclosed at the specific time of the site investigation of reference, and 3) the boundary and topographic survey prepared by Rolland Engineering of Grand Junction, CO. Vortex Engineering, Inc. assumes no liability for the accuracy or completeness of information furnished by the client. Site conditions are subject to external environmental effects and may change over time. Use of this plan under different site conditions is inappropriate. If it becomes apparent that current site conditions vary from those anticipated, the design engineer should be contacted to develop any required design modifications. Vortex Engineering, Inc. is not responsible and accepts no liability for any variation in assumed design parameters.

Vortex Engineering, Inc. represents this report has been prepared within the limits prescribed by the owner and in accordance with the current accepted practice of the civil engineering profession in the area. No warranty or representation either expressed or implied is included or intended in this report or in any of our contracts.

VII. References

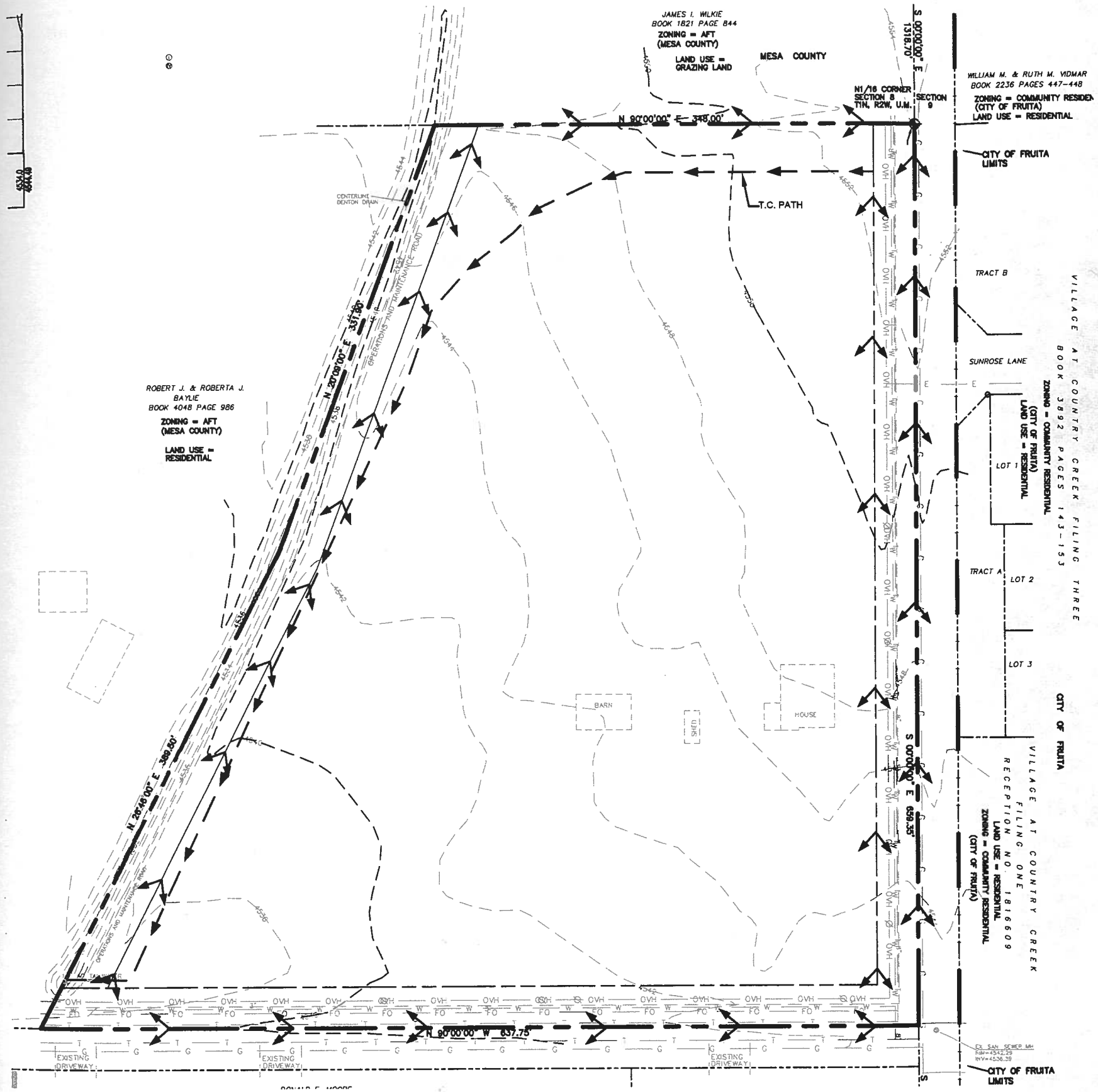
The following manuals and computer programs were used for this drainage report:

- Storm Water Management Manual, City of Grand Junction and Mesa County, May 1996.
- The NRCS method Technical Release 55 entitled "Urban Hydrology for Small Watersheds" was used to calculate runoff curve numbers and time of concentrations.
- The NRCS method Technical Release 20 entitled "Project Formulation-Hydrology" was used to calculate runoff rates and basin sizing.
- Storm Water Management Master Plan (SWMMP) for the City of Fruita, June 1998.

EXHIBIT 'A'

PRE-DEVELOPMENT DRAINAGE AREA MAP

COUNTRY ESTATES SUBDIVISION



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COUNTRY ESTATES SUBDIVISION

PROJECT: Country Estates Subdivision
18 & K 6/10 Road
Fruita, Colorado

TITLE: PRE DEVELOPMENT DRAINAGE PLAN

SCALE: 1" = 40'	DATE: 00-00-2006	SHEET No: 1
DRAWN BY:	PROJECT NO: FOG-013	
CHECKED BY: P.W.J.II	CAD ID: country-const.dwg	OF 1
CONSTRUCTION CHECK	DATE	REV. No: —

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By
Comment
No. Date

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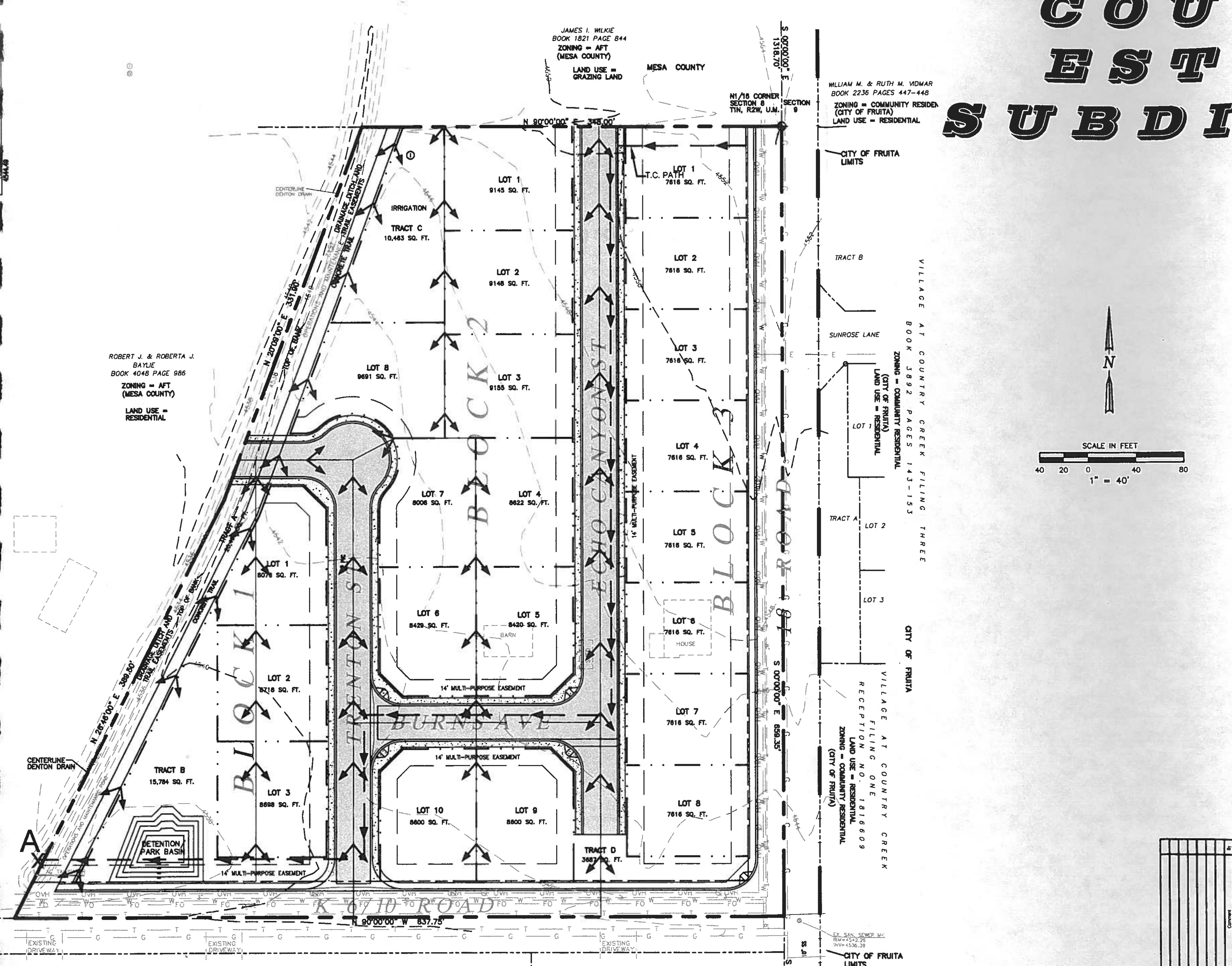
EXHIBIT 'B'

POST-DEVELOPMENT DRAINAGE AREA MAP

COUNTRY ESTATES SUBDIVISION



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COUNTRY ESTATES SUBDIVISION

PROJECT: Country Estates Subdivision, 18 & K 6/10 Road, Fruita, Colorado

TITLE: POST DEVELOPMENT DRAINAGE PLAN

R.W. JONES II — PROFESSIONAL ENGINEER
C. S. PARKER — PROFESSIONAL ENGINEER

SCALE: 1" = 40'
SHEET NO. 1 OF 1

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