FLOODPLAIN ANALYSIS EXCERPT FROM BROCKWAY ENGINEERING STUDY FOR CROY CK, DATED 10/05/04

I. FLOOD PLAIN DELINEATION

Croy Creek passes through the center of the subdivision and may have the potential to flood and cause inundation of the area. Flood characteristics of Croy Creek at this location have not been the subject of an official study by the Federal Emergency Management Agency (FEMA) which typically delineates 100-year and 500-year flood plains in addition to the regulatory floodway (FEMA, 2000). In other words, there is no regulatory flood plain or floodway delineated for the project.

Brockway Engineering conducted a flood plain modeling study to determine the extent of inundation during the 100-year flood event and what flood control measures may be necessary to prevent inundation of any residential area. The study area is limited to the project area from the Rock Creek road crossing upstream to the west boundary of the property. This limited study will estimate the floodplain and floodway boundaries at the proposed subdivision using 2-foot contour aerial topographic information provided by Galena Engineering, Inc. and USGS accepted methods to determine the probable magnitude and area of inundation for the 100 year flood event at this location.

The hydraulic analysis to estimate the depth and inundation area subject to the 100-year flood was performed using HEC-RAS ver. 3.1, developed by the U.S. Army Corps of Engineers. This model is widely used by governmental agencies and private consultants to evaluate flooding from natural and man-made waterways. Since the Croy Creek channel is a relatively minor channel, additional field survey of the downstream culvert was performed to more accurately predict the downstream effects on upstream inundation.

The hydraulic water surface profile model HEC-RAS was employed to predict water surface elevations for the 100-year flood and estimate the boundary of the floodway. A constant discharge was used throughout the study reach since no significant tributary inflow occurs in the reach. Computations were begun at the downstream section using a fixed water surface elevation downstream of the culvert; the culvert itself acts as a control for upstream water surface elevation calculations.

A-8
EXHIBIT

Hydrologic Data

Croy Creek at this location is an intermittent stream that acts as the major drainage for an area of approximately 17 square miles to the north and west. Historical streamflow data is unavailable. Since site-specific flow data is limited, an estimation of 100 year peak flood flow was performed based upon determination of coefficients assuming a Log-Pearson Type III distribution[4]. This method of estimating peak streamflow is based on regional regression equations developed for the state of Idaho from observed streamflow records throughout the state and results in reasonable values given the available data. Hydrologic parameters of the basin and the flood discharge estimates for the study are provided in Table 5 below. The majority of the drainage area exceeds 6,000 ft elevation so according to the USGS study, the 100 year flood event will most likely be caused by rapid spring snowmelt or rain-on-snow events. The flow magnitude associated with the 100 year event (1% chance of occurring in any given year) was calculated to be approximately 420 cfs. Table 5 provides the parameters and results of the flood frequency estimation.

Topographic data

In order to define the channel and flood plain of Croy Creek at this location, aerial based topography was used with a 2-foot contour definition. An on-site inspection by Brockway Engineering was also performed to ensure reasonably accurate channel geometry was utilized during model development. Cross-sections for model input were taken from this contour information. Galena Engineering performed spot elevation measurements along the creek banks to better define the channel and bank geometry. Using computed flood elevations from HEC-RAS, the topographic contours were used to map the flood plain to the ground surface.

[4] Kjelstrom, L.C. & Moffatt, R.L. A Method of Estimating Flood-Frequency Parameters for Streams in Idaho. United States Department of the Interior Geological Survey Open-File Report 81-909. September, 1981.

Table 5. Flood frequency estimation for Croy Creek, using USGS procedure for ungaged streams (USGS Open-File Report 81-909).

Basin:		Croy Creek above P.U.D. Subd.	
Area (sq. mi.):		17	
Mean altitude (feet):		6522	
MAP (in.):		20	
Computed			
Mean of logs:		2.080	
SD of logs:		0.258	
		Snowmelt (G = -0.3)	
T (years)	Pe	Ke	Peak Q (cfs)
2	0.5	0.050	124
5	0.2	0.853	200
10	0.1	1.245	252
25	0.04	1.643	319
50	0.02	1.890	370
100	**0.01**	**2.104**	**420**
200	0.005	2.294	470
500	0.002	2.517	537

Roughness Coefficients

A visual inspection of the channel and flood plain conditions was made to determine reasonable values of roughness coefficients. Croy Creek at this location consists of gravel/silt matrix with sparse vegetation growing in or protruding into the channel. The overbanks contain some growth of native grasses, brush, and are not generally overgrown. The overbank is farmed and relatively clear with some sagebrush particularly near the stream channel. Chow (1959) conducted an extensive literature review and provided recommended values for all possible types of natural and man-made conditions. Using these values as a guide, conservative roughness coefficients of 0.03 and 0.04 were selected for the channel and overbank, respectively.

Results

The model of the channel in its current state indicates that the 100-year flood can be contained within the incised channel of Croy Creek at some locations but will inundate the overbank in some areas. Flood plain and floodway limits are delineated on the preliminary plat. Water depths within the overbanks will generally be less than 1.5 feet. The flood plain does not encroach on any proposed subdivision lot.

The riparian restoration plan will include a grading plan to partially re-shape the creek banks. A more gradual bank slope will be created and protected from erosion, eliminating the incised channel that presently exists. In conjunction with the bank reshaping, the elevation of the banks will be maintained to ensure that the channel conveyance capacity is maintained or increased. In this manner, the flood plain will not be altered from the current situation.

Estimation of the floodway utilizing the HEC-RAS model was also performed, allowing no more than a 1.0-foot rise in flood elevation due to encroachment, per FEMA criteria. The floodway delineated by the model lies close to the banks of Croy Creek, approximately at the line of the current cultivation limits.

The computed water surface profiles for each surveyed river section are shown in Appendix E. Raw output from the model or additional details regarding the model can be provided by Brockway Engineering upon request.

J. CONCLUSIONS

1. Cluster wells will be utilized to provide potable water. The water source for the wells is the Croy Creek alluvial aquifer, which is adequate to supply the maximum potable water requirement with imperceptible drawdown at wells outside the subdivision boundary. Water quality in the aquifer beneath the site is excellent, and is suitable for potable water usage.

2. The irrigation water sources are Croy Creek, Bullion Creek, and groundwater under existing water rights. No additional domestic or irrigation rights will be applied for. These water rights are adequate to provide a reliable water supply for irrigation. Both the peak demand and the annual volume can be met with a combination of surface water as the primary supply and groundwater as the supplemental supply. Irrigation water will be provided via a central system, metered and controlled by the homeowners' association.

3. Fire flow requirements will be provided by the existing irrigation storage reservoir. Drawdown in this reservoir during the design fire event will be no more than 0.25 feet.

4. Wastewater disposal will occur via individual sub-surface disposal systems. These systems will consist of fixed-film aerobic treatment units and individual sub-surface drainfields. Soil types are generally appropriate for standard drainfields, but specific design data may be needed for some lots. The subdivision will not cause a significant degradation of water quality. The maximum increase in nitrate-N concentration in the aquifer is estimated to be 1.0 mg/l at the down-gradient subdivision boundary, which meets IDEQ criteria.

5. Irrigated area with the project will decrease from 319 acres to approximately 80.0 acres of "regular" irrigation of turf and landscaping and 239 acres of native grasslands. The native grasslands will receive light irrigation during the first 2 to 3 years, and should be self-sufficient from that point forward except during severe

drought periods.

6. Average annual recharge to the aquifer will increase with the project, due to a full water supply being available for the residential irrigation. This increase in recharge will occur even though total irrigated area will decrease.

7. The project will result in a decrease in consumptive use of both groundwater and surface water, an increase in annual recharge to the aquifer, and an increase in total groundwater discharge in the Croy Creek aquifer down-gradient of the project. In short, the project will not adversely impact the groundwater or surface water systems.

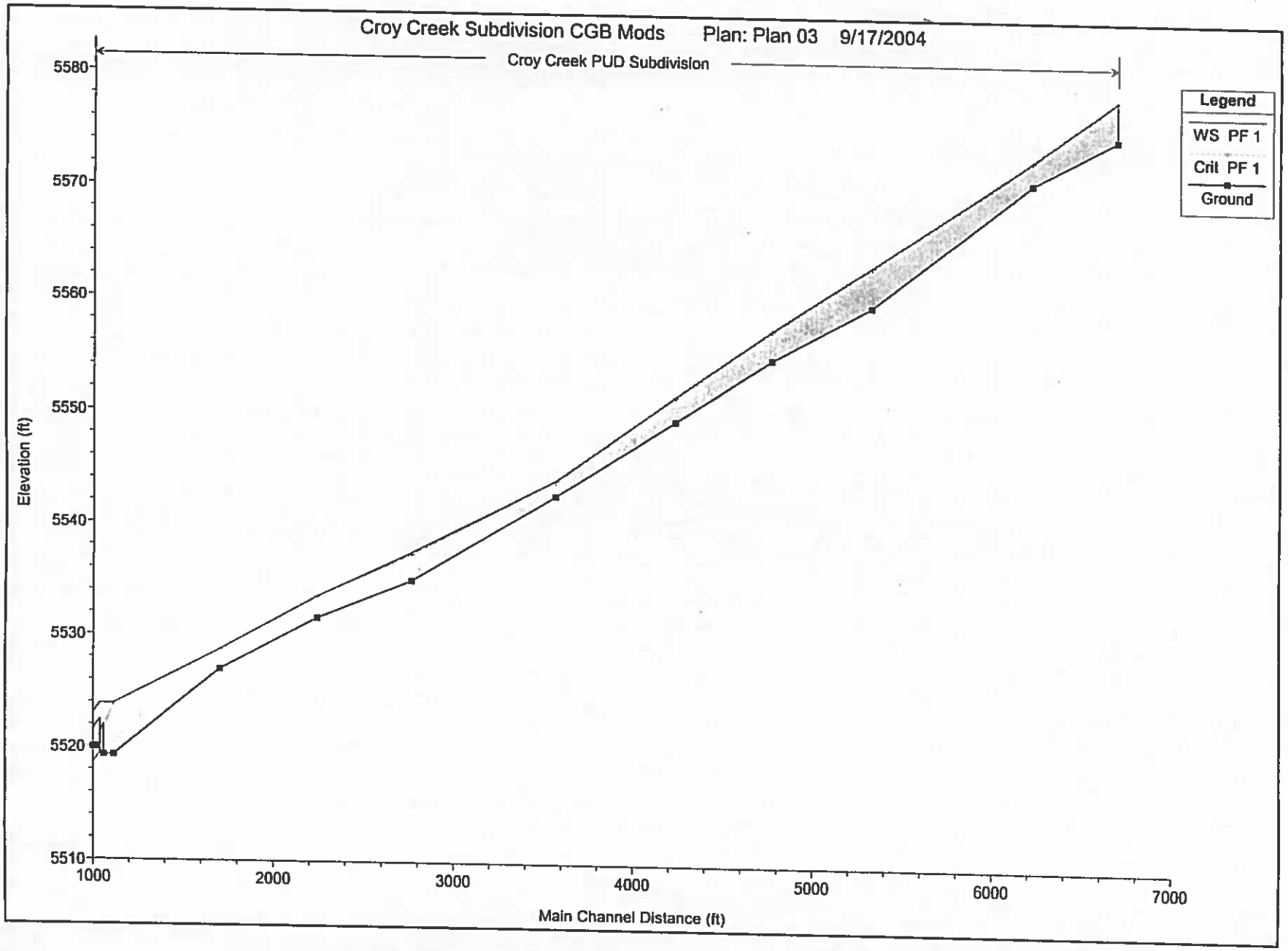
8. Existing irrigation rights provide adequate coverage based on an estimate of total irrigated area after full build-out of the subdivision. A transfer application will be submitted to modify the water right place of use to coincide with post-project water usage.

9. No flood plain or floodway delineation has been performed by FEMA or any other government agency. Brockway Engineering conducted the necessary hydraulic modeling using standard procedures outlined by FEMA, and delineated the 100-year flood plain and floodway. These are not regulatory flood zones, but are being used to define areas of inundation where flood protection may be needed. The computed flood plain does not encroach on any proposed subdivision lot. Bank re-grading in conjunction with the Croy Creek riparian restoration plan will maintain or increase the channel conveyance and will not alter the flood plain.

Appendix E
Flood Plain Information

HEC-RAS Plan: Plan 03 River: Croy Creek Reach: PUD Subdivision

Reach	River Sta	Profile	W.S. Elev	Prof Delta WS	E.G. Elev	Top Wdth Act	Q Left	Q Channel	Q Right	Enc Sta L	Ch Sta L	Ch Sta R	Enc Sta R
			(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)
PUD Subdivision	6100	PF 1	5578.48		5578.65	336.12	203.93	46.24	169.84		894.00	896.00	
PUD Subdivision	6100	PF 2	5579.37	0.89	5579.81	49.10	367.24	52.76		846.90	894.00	896.00	896.00
PUD Subdivision	5629	PF 1	5573.05		5573.23	359.64	278.75	108.44	32.81		1261.00	1273.00	
PUD Subdivision	5629	PF 2	5573.91	0.86	5574.71	36.01		244.15	175.85	1261.00	1261.00	1273.00	1297.01
PUD Subdivision	4818	PF 1	5563.41		5563.51	498.21	270.44	145.10	4.46		1261.00	1275.00	
PUD Subdivision	4818	PF 2	5563.42	0.02	5564.15	41.74	135.46	284.54		1233.26	1261.00	1275.00	1275.00
PUD Subdivision	4305	PF 1	5557.61		5557.63	305.00	362.00	57.99	0.01		634.00	672.00	
PUD Subdivision	4305	PF 2	5557.71	0.10	5557.89	124.25	235.54	184.46		547.75	634.00	672.00	672.00
PUD Subdivision	3791	PF 1	5551.70		5552.67	30.00	47.43	317.73	54.84		986.00	1003.00	
PUD Subdivision	3791	PF 2	5552.22	0.51	5553.54	17.00		420.00		986.00	986.00	1003.00	1003.00
PUD Subdivision	3169	PF 1	5544.11		5544.20	341.68	12.68	97.52	309.80		960.00	987.00	
PUD Subdivision	3169	PF 2	5545.04	0.93	5545.54	54.59		319.14	100.86	960.00	960.00	987.00	1014.59
PUD Subdivision	2547	PF 1	5537.54		5538.06	65.62	59.37	346.09	14.54		1270.00	1293.00	
PUD Subdivision	2547	PF 2	5537.34	-0.20	5538.42	23.00		420.00		1270.00	1270.00	1293.00	1293.00
PUD Subdivision	2085	PF 1	5533.55		5534.12	60.55		420.00			1038.00	1108.00	
PUD Subdivision	2085	PF 2	5533.94	0.40	5534.25	69.51		420.00		1038.00	1038.00	1108.00	1108.00
PUD Subdivision	1622	PF 1	5528.77		5528.92	552.93	229.29	110.47	80.25		1043.00	1056.00	
PUD Subdivision	1622	PF 2	5529.52	0.75	5530.31	37.17		251.95	168.05	1043.00	1043.00	1056.00	1080.17
PUD Subdivision	1133	PF 1	5523.86		5524.09	484.87	48.37	214.68	156.94		918.00	932.00	
PUD Subdivision	1133	PF 2	5523.91	0.05	5524.16	315.99	12.32	222.02	185.66	914.50	918.00	932.00	1240.37
PUD Subdivision	1059		Culvert										
PUD Subdivision	1000	PF 1	5523.00		5523.01	814.00	15.26	78.41	326.33		854.00	875.00	
PUD Subdivision	1000	PF 2	5523.00	0.00	5523.19	325.87		265.75	154.25	854.00	854.00	875.00	1179.87


Croy Creek Subdivision CGB Mods Plan: Plan 03 9/17/2004
Croy Creek PUD Subdivision
Legend
WS PF 1
Crit PF 1
Ground
Elevation (ft)
5580
5570
5560
5550
5540
5530
5520
5510
1000
2000
3000
4000
5000
6000
7000
Main Channel Distance (ft)