

Table B.1 Benefit / Cost Summary

Category	Units	Selected options					
		No investment	Non-structural investment	Off-channel storage	N. Sask. Weirs	Highgate Dam	
		Status quo	Small farm irrigation	8-Mile Lake +irrigation	P&H Weir +industry	with finance charges	without finance charges
Costs:							
Capital cost (infrastructure plus on-farm costs)	2007 \$millions	0	36	57	12	3,043	2,497
Annual charges (interest charges + O&M)	NPC \$millions	0	28.4	45.5	9.5	2,361	110
Total costs	NPC \$millions	0	64	103	22	5,404	2,607
Benefits:							
Ethanol industry benefits	NPV \$millions	0	0	0	71	71	71
Irrigation net benefits, mixed crops	NPV \$millions	0	46	65	0	248	248
Hydropower benefits	NPV \$millions	0	0	0	0	1,046	1,046
Flood control benefits (Prince Albert)	2007 \$millions	0	0	0	0	146	146
Recreational property development	2007 \$millions	0	0	0	0	268	268
Recreation property tax base	NPV \$millions	0	0	0	0	8	8
Indirect GDP net benefits	NPV \$millions	0	19	48	79	336	336
Total benefits	NPV \$millions	0	65	113	149	2,122	2,122
Net:							
Total net benefits	NPV \$millions	0	1	10	128	-3,282	-485
B/C ratio		n/a	1.01	1.09	6.91	0.39	0.81
B/C ratio excluding indirect GDP benefits		n/a	0.72	0.63	3.27	0.33	0.69

Notes:

1. Indirect GDP net benefits assumed due primarily to construction, reporting for initial 4 years only.
2. Assuming Highgate dam construction period of 4 years.
3. Hydropower benefits based on \$0.10 per kWh initial selling price (net of transmission losses).
4. Status quo option assumes no investment will result in no new industry and limited recreation property development.
5. Non-structural investment assumes 6 farms of 3 sections each irrigation development directly from the NSR.
6. Off-channel storage assumes water supply to irrigation only (i.e. no additional industry development).
7. N. Sask. Weirs assumes water supply to new industry only (i.e. no additional irrigation development).
8. N. Sask. Dam assumes benefits derived from irrigation, hydropower, recreation, flood control, industry.
9. Industry assumed to be an ethanol plant (50 ML/yr x \$0.60 sale price x 15% net revenue).
10. Recreation property development benefits report the net benefits of private property development.
11. All GDP benefits discounted to 2007.
12. All other NP costs and benefits reported for initial year of construction.
13. Dam decommissioning cost assumed to be \$1B in 2007, or \$20B in 100 years (at 3% inflation).
14. Industry initial capital investment costs have been excluded (assumed private investment).
15. Benefits due to sale of hydropower, ethanol, irrigated crops, and tax collection assume inflation at the stated inflation rate.

Assumptions:

- 2015 initial construction for Highgate dam
- 2012 year construction of other options
- 50 year repayment of capital investment
- 6% cost of capital
- 9% investment expected rate of return
- 3% inflation
- \$66.7 million annual hydropower benefit
- \$4.5 million annual ethanol net revenue

Table B.2a. Non-Structural Investment COSTS (small farm irrigation)

Item	Quantity	Units	Unit Cost	Cost
On-farm irrigation equipment costs	9,360	acres	\$900	\$8,424,000
Care of water	6	Lump sum	\$50,000	\$300,000
River Intake, floating seasonal (PFRA standard intake)	6	Lump sum	\$500,000	\$3,000,000
Coffer dam	0	Lump sum	\$200,000	\$0
Power supply	6	Lump sum	\$100,000	\$600,000
Intake pump house (~300 hp)	6	Lump sum	\$500,000	\$3,000,000
Distribution pipeline (250 - 400 mm HDPE)	24,000	m	\$350	\$8,400,000
Subtotal capital cost (excl. contingency, engineering)				\$23,724,000
Regulatory approvals (excl. IFN study)	6	Lump sum	\$30,000	\$180,000
Project management	10%	x	\$23,724,000	\$2,372,400
Engineering and Surveys	8%	x	\$23,724,000	\$1,897,920
Contingency on all costs	20%	x	\$28,174,320	\$5,634,864
Interest during construction (1 yr period)	6%	x	\$33,809,184	\$2,028,551
Total capital cost				\$35,837,735
Annual charges				
Initial interest charges	6%	x	\$35,837,735	\$2,150,264
Operation & maintenance	0.5%	x	\$23,724,000	\$118,620

Table B.2b. Non-Structural Investment BENEFITS (small farm irrigation)

Item	Quantity	Units	Unit Benefit	Benefit
Annual benefits				
Agriculture net incremental (annual benefit)	9,360	acres	\$316	\$2,957,760

Notes:

1. Intakes are each assumed to be seasonal floating intakes (PFRA-style), to provide water for each farm separately.
2. Assuming 9,360 acre (3 sections) average size irrigation development, 6 farm developments, irrigation on 130 acres each quarter.

Table B.3a. Off-Channel Storage COSTS (8-Mile Lake Option only)

Item	Quantity	Units	Unit Cost	Cost
On-farm irrigation equipment costs	13,130	acres	\$900	\$11,817,000
Care of water	1	Lump sum	\$50,000	\$50,000
Coffer dam	1	Lump sum	\$200,000	\$200,000
River Intake, bank style	1	Lump sum	\$2,000,000	\$2,000,000
Downstream water level control weir (if necessary)	1	Lump sum	\$2,000,000	\$2,000,000
Intake pump house	1,000	hp	\$1,200	\$1,200,000
Power supply	5	km	\$50,000	\$250,000
Transmission pipeline (900 mm HDPE)	12,000	m	\$500	\$6,000,000
Storage Ponds	430,000	m ³	\$7	\$3,010,000
Pump Station 1	600	hp	\$1,200	\$720,000
Pump Station 2	1,000	hp	\$1,200	\$1,200,000
Distribution pipeline (900 mm HDPE)	4,100	m	\$500	\$2,050,000
Distribution pipeline (600 mm HDPE)	12,000	m	\$400	\$4,800,000
Distribution pipeline (400 mm HDPE)	8,000	m	\$350	\$2,800,000
Subtotal capital cost (n.i. contingency, engineering)				\$38,097,000
Regulatory approvals and monitoring (n.i. IFN study)	1	Lump sum	\$200,000	\$200,000
Project management	10%	x	\$38,097,000	\$3,809,700
Engineering and Surveys	8%	x	\$38,097,000	\$3,047,760
Contingency on all costs	20%	x	\$45,154,460	\$9,030,892
Interest accumulated during 1 yr construction	6%	x	\$54,185,352	\$3,251,121
Total capital cost				\$57,436,473
Annual charges				
Initial interest charges	6%	x	\$57,436,473	\$3,446,188
Operation & maintenance	0.5%	x	\$38,097,000	\$190,485

Table B.3b. Off-Channel Storage BENEFITS (8-Mile Lake Option only)

Item	Quantity	Units	Unit Benefit	Benefit
Annual benefits				
Agriculture net incremental (benefit)	13,130	acres	\$316	\$4,149,080

Notes:

1. Intake assumed 9 m long along face of river.
2. Pond berms assumed 4 m high with 5 m top, 4:1 inside slopes, 2:1 outside slopes, 5 km length x 2 ponds.
3. Pumping rate from North Saskatchewan River about 0.75 m³/s over 250 days.
4. Downstream water level control weir assumed to be 50 m across a river side channel.
5. Irrigation assumed for 101 quarter sections at 130 acres each.
6. Pump capacity and pipe sizes based on river elevation of 464 m, storage pond elevation of 500 m and irrigated fields at 540 m.

Table B.4a. NSR Weir COSTS (P&H Weir only)

Item	Quantity	Units	Unit Cost	Cost
Land purchase	320	acres	\$1,000	\$320,000
Care of water	1	Lump sum	\$50,000	\$50,000
Coffer dam	1	Lump sum	\$200,000	\$200,000
River Intake, bank style	1	Lump sum	\$1,000,000	\$1,000,000
Water level control weir	1	Lump sum	\$2,000,000	\$2,000,000
Intake pump house	300	hp	\$2,000	\$600,000
Power supply	8	km	\$50,000	\$400,000
Transmission pipeline (600 mm HDPE)	4,000	m	\$400	\$1,600,000
Storage Pond dykes	100,000	m ³	\$7	\$700,000
Pump Station	100	hp	\$2,500	\$250,000
Outlet control structure	1	Lump sum	\$100,000	\$100,000
Distribution pipeline (600 mm HDPE)	1,600	m	\$400	\$640,000
Subtotal capital cost (excl. contingency, engineering)				\$7,860,000
Regulatory approvals and monitoring (excl. IFN study)	1	Lump Sum	\$200,000	\$200,000
Project management	10%	x	\$7,860,000	\$786,000
Engineering and Surveys	8%	x	\$7,860,000	\$628,800
Contingency on all costs	20%	x	\$9,474,800	\$1,894,960
Interest accumulated during 1 yr construction	6%	x	\$11,369,760	\$682,186
Total capital cost				\$12,051,946
Annual charges				
Initial interest charges (water infrastructure only)	6%	x	\$12,051,946	\$723,117
Operation & maintenance (water infrastructure only)	0.5%	x	\$7,860,000	\$39,300

Table B.4b. NSR Weir BENEFITS (P&H Weir only)

Item	Quantity	Units	Unit Benefit	Benefit
Annual benefits				
Industry net revenue	50	ML/yr	\$90,000	\$4,500,000

Notes:

1. Intake assumed 9 m long along face of river.
2. Pond berms assumed 2 m high with 4 m top, 3:1 slopes, 5 km length, including stripping
3. Peak pumping rate from North Saskatchewan River about 0.2 m³/s (daily rate depends on natural inflows to pond and industry usage).
4. Downstream water level control weir assumed to be 50 m across a river side channel.
5. Water uses by industry near terminal location.
6. Land purchase of non-cultivated areas only.
7. Industry net benefit assumes \$0.60/L ethenol sale price @ 15% net revenue.
8. Minimum 75,000 acres may be needed to support the ethenol plant.
9. Costs do not include initial investment to construct the ethenol plant.

Table B.5a Highgate Dam COSTS (irrigation & industry & hydropower & recreation)

Item	Quantity	Units	Unit cost	Cost
Dam costs				
Care of water		1 Lump Sum		\$10,000,000
Embankment		1 See Cost Details		\$369,629,000
Spillway		1 See Cost Details		\$255,924,000
Diversion and riparian works		1 See Cost Details		\$209,365,000
Fishway (for passage of lake sturgeon at dam site)		1 Lump Sum	\$20,000,000	\$20,000,000
Transmission line to North Battleford sub-station	31.1	km	\$400,000	\$12,440,000
SCADA SaskPower interface		1 Lump Sum	\$2,000,000	\$2,000,000
Access road		1 Lump Sum	\$500,000	\$500,000
Railway and highway crossing at the dam location		1 See Cost Details		\$59,895,000
Powerplant w/ surge tanks, incl. transmission (114 MW cap.)		1 See Cost Details		\$163,717,590
Subtotal dam costs				\$1,103,470,590
Reservoir costs				
Land purchase cultivated	6,579	acres	\$1,500	\$9,868,013
Land purchase non-cultivated	10,717	acres	\$500	\$5,358,500
First Nations land claims		3 each	\$10,000,000	\$30,000,000
Reservoir clearing	10,717	acres	\$1,000	\$10,717,000
Subtotal for reservoir costs				\$55,943,513
Infrastructure damage				
Maidstone Bridge (Hwy 21)		1 Lump Sum	\$30,000,000	\$30,000,000
Deer Creek Bridge (Hwy 3)		1 Lump Sum	\$25,000,000	\$25,000,000
Paynton Ferry (Hwy 674)		1 Lump Sum	\$1,400,000	\$1,400,000
15 other Hwy, Municipal, local road crossings	15	Lump Sum	\$200,000	\$3,000,000
Highgate railway grade and alignment modifications	6.4	km	\$1,000,000	\$6,400,000
Minor power transmission line modifications	20	each	\$50,000	\$1,000,000
Purchase/relocate farms, acreages, businesses, other bldgs	50	each	\$1,000,000	\$50,000,000
Environmental mitigation or compensation (budgeted)		1 Lump Sum	\$50,000,000	\$50,000,000
Dam decommissioning future cost (as net present cost)	100	years	\$20,000,000,000	\$3,617,264
Well abandonment & closure	269	each	\$100,000	\$26,900,000
River intake replacement	10	each	\$1,000,000	\$10,000,000
Pipeline abandonment or repair	1.4	x	\$26,900,000	\$37,660,000
Resource abandonment (i.e. oil wells only)	150	each	\$2,000,000	\$300,000,000
Subtotal for infrastructure damages				\$544,977,264
Irrigation costs				
On-farm irrigation equipment cost (cost separately)	50,000	acres	\$900	\$45,000,000
Irrigation infrastructure costs	4	modules	\$43,699,473	\$174,797,892
Subtotal irrigation costs				\$219,797,892
Regulatory approvals, environmental monitoring		1 Lump Sum	\$10,000,000	\$10,000,000
Project management		1 Lump Sum	\$10,000,000	\$10,000,000
Engineering and Surveys (excl. powerplant)	8%	x	\$1,704,528,156	\$136,362,253
Contingency on all costs	20%	x	\$2,080,551,512	\$416,110,302
Interest during construction (4 yr period)	6%	/yr for initial	\$2,080,551,512	\$546,096,836
Total capital cost				\$3,042,758,650
Annual costs				
Lost production on flooded cropland	3,485	acres	\$15	\$52,275
Initial interest charges after construction	6%	x	\$3,042,758,650	\$182,565,519
Annual depreciation of embankment over 100 years	100	yrs	\$369,629,000	\$3,696,290
Depreciation of structures over 50 years	50	yrs	\$499,536,590	\$9,990,732
O&M for hydropower		1 Lump sum	\$1,556,000	\$1,556,000
O&M for dam, reservoir, and structures	0.5%	x	\$1,093,470,590	\$5,467,353
Total initial annual costs				\$203,328,169

Table B.5b Highgate Dam BENEFITS (irrigation & industry & hydropower & recreation & industry)

Item	Quantity	Units	Unit Benefit	Benefit
Total benefits				
Recreation property development		1 Lump Sum	\$267,500,000	\$267,500,000
Flood damage reduction in Prince Albert (100yr flood)		1 Lump Sum	\$150,000,000	\$150,000,000
Annual net benefits				
Agriculture marginal net revenue	50,000	acres	\$316	\$15,800,000
Industry net revenue	50	ML/yr	\$90,000	\$4,500,000
Hydropower sales (net of transmission loss correction)	666.9	GWh	\$100,000	\$66,690,000
Total initial annual benefits				\$911,146,337

Notes:

- Dam design based on PFRA (1970).
- Costs updated based on Sask Hwys (bridges), Meridian dam (2002), Tramping Lake (1992), historical inflation rates, hydropower industry standards, irrigation industry standards in Alberta, and regional anecdotal information.
- Requirements for transmission line and telephone line modifications have not been updated from PFRA (1970).
- Pipeline abandonment or repair costs relative to well abandonment costs, similar to Meridian Dam.
- Resource abandonment costs assumed to be double the costs estimated for Meridian Dam in 2001.
- Costs for rail and highway crossing at dam location based on embankment geometry and discussions with CN Rail.
- Hydropower sales (net of transmission loss corrections) based on: \$0.10 per kWh
- Industry benefits based on 50 ML/yr ethanol plant.
- Ethanol initial sale price assumed to be: \$0.60 per L of ethanol sale price
- Ethanol plant net revenue assumed to be: 15% of gross sales revenue

Table B.6 Cost Details - Highgate Dam

Item	Quantity	Units	Unit Cost	Cost
Care of Water	1	Lump sum	\$10,000,000	\$10,000,000
Embankment				
Common Excavation	2,000,000	cu. yd.	\$6.00	\$12,000,000
Bedrock Excavation	900,000	cu. yd.	\$10.00	\$9,000,000
Borrow Area Excavation	39,000,000	cu. yd.	\$6.00	\$234,000,000
Embankment Foundation Excavation	500,000	cu. yd.	\$6.00	\$3,000,000
Compacted Embankment, Zones 1, 2 & 3	33,600,000	cu. yd.	\$1.00	\$33,600,000
Riprap Bedding, Zone 6 (Supply & Place)	55,000	cu. yd.	\$50.00	\$2,750,000
Riprap , Zone 5 (Supply and Place)	110,000	cu. yd.	\$100.00	\$11,000,000
Pervious Embankment, Zone 4 (Supply and Place)	2,200,000	cu. yd.	\$20.00	\$44,000,000
Additional Moisture	300,000	Million gallons	\$30.00	\$9,000,000
Toe Drain Material (Supply and Place)				
Fine, Zone 7	2,100	cu. yd.	\$40.00	\$84,000
Coarse, Zone 8	6,000	cu. yd.	\$50.00	\$300,000
Corrugated Pipe 8" Diameter	6,000	lin. ft	\$60.00	\$360,000
Relief Wells	2,700	lin. ft	\$50.00	\$135,000
Topsoil & Seeding	1	Lump sum	\$400,000	\$400,000
Miscellaneous Items	1	Lump sum	\$10,000,000	\$10,000,000
Subtotal embankment				\$369,629,000
Chute spillway				
Structure Excavation	90,000	cu. yd.	\$10.00	\$900,000
Reinforced Concrete (incl. forms and re-bar)	200,000	cu. yd.	\$1,000.00	\$200,000,000
Riprap Bedding (Supply & Place)	46,000	cu. yd.	\$50.00	\$2,300,000
Riprap (Supply & Place)	105,000	cu. yd.	\$100.00	\$10,500,000
Tamped Backfill	29,000	cu. yd.	\$6.00	\$174,000
Radial Gates (40x32) Hoists & Stoplogs	7	gates (32'x40')	\$2,000,000	\$14,000,000
Drainage Material	245,000	cu. yd.	\$50.00	\$12,250,000
Drainage System	1	Lump Sum	\$6,000,000	\$6,000,000
Bridge (walkway)	1	Lump Sum	\$2,000,000	\$2,000,000
Anchor Piles	5,600	piles	\$500.00	\$2,800,000
Miscellaneous Items	1	Lump Sum	\$5,000,000	\$5,000,000
Subtotal spillway				\$255,924,000
Diversion & riparian works				
Tunnel Excavation	9,700	lin. ft	\$1,000.00	\$9,700,000
Tunnel Temporary Ground Support	9,700	lin. ft	\$1,000.00	\$9,700,000
Tunnel Concrete	9,700	lin. ft	\$1,000.00	\$9,700,000
Control Shaft Excavation	40,000	cu. yd.	\$100.00	\$4,000,000
Control Shaft Temporary Ground Support	1	Lump Sum	\$2,500,000	\$2,500,000
Other Reinforced Concrete (incl. forms and re-bar)	155,000	cu. yd.	\$1,000.00	\$155,000,000
Riprap Bedding (Supply & Place)	2,500	cu. yd.	\$20.00	\$50,000
Riprap (Supply & Place)	5,000	cu. yd.	\$100.00	\$500,000
Tamped Backfill	90,000	cu. yd.	\$6.00	\$540,000
Control Gates (10x20) & Hoists	1	Lump Sum	\$5,000,000	\$5,000,000
Bulkeads, Supports & Trashracks	1	Lump Sum	\$1,125,000	\$1,125,000
Anchor Piles	3,100	piles	\$500.00	\$1,550,000
Miscellaneous Items	1	Lump Sum	\$10,000,000	\$10,000,000
Subtotal diversion and riparian works				\$209,365,000
Highway & rail crossing marginal cost				
Earthworks to widen embankment dam by 13 m	1,020,000	cu. yd.	\$7.00	\$7,140,000
Existing grid road upgrade	6.9	km	\$300,000	\$2,076,000
New road	1.8	km	\$500,000	\$875,000
New road over dam	1.9	km	\$800,000	\$1,504,000
Road bridge over spillway	1	Lump Sum	\$20,000,000	\$20,000,000
Rail re-alignment	0.7	km	\$1,000,000	\$700,000
New rail line	7.6	km	\$1,000,000	\$7,600,000
Rail bridge over spillway	1	Lump Sum	\$20,000,000	\$20,000,000
Subtotal Hwy&rail crossing				\$59,895,000

Table B.7 Cost Details - Hydropower

Item	Quantity	Units	Unit cost	Cost
Steel pipelines and penstocks				
Pipe steel lining installed, ton.	1	Lump Sum		\$29,555,000
Surge tank	1	Lump Sum		\$18,510,000
Subtotal pipelines and penstocks				\$48,065,000
Powerhouse				
Allowance for conduit separation	1	Lump Sum		\$665,000
Sheet steel pile cellular cofferdam, pumping	1	Lump Sum		\$1,319,000
Concrete (excluding forms, re-bar)	17,179	m ³	\$534	\$9,174,960
Formwork	24,905	m ²	\$12	\$297,366
Reinforcing	1,782,980	kg	\$7	\$13,015,754
Powerhouse superstructure steel	347	tonnes	\$7,582	\$2,631,079
Walls	1,666	m ²	\$129	\$215,380
Roof	1,308	m ²	\$161	\$210,797
Subtotal powerhouse civil work cost				\$27,529,337
Tailrace				
Tailrace overburden excavation	49,269	m ³	\$9	\$437,016
Tailrace rock excavation	10,362	m ³	\$35	\$367,747
Subtotal tailrace excavation work				\$804,763
Total civil work cost				\$76,399,100
Major mechanical equipment				
Trashrack equipment	1	Lump Sum	\$984,000	\$984,000
Draft tube gate guide and hoist equipment	1	Lump Sum	\$1,729,000	\$1,729,000
Powerhouse crane	1	Lump Sum	\$924,000	\$924,000
Elevators	1	Lump Sum	\$496,000	\$496,000
Powerhouse ancilliary mechanical systems	1	Lump Sum	\$3,423,000	\$3,423,000
Subtotal major mechanical equipment, except units and valves				\$7,556,000
Generating equipment and transmission				
Transmission line	1	Lump Sum	\$3,130,000	\$3,130,000
Local transmission (powerhouse-intake)	1	Lump Sum	\$23,000	\$23,000
Switchyard	1	Lump Sum	\$414,000	\$414,000
Powerhouse station service	1	Lump Sum	\$105,000	\$105,000
W/W cost of generating equipment, switchgear and controls	1	Lump Sum	\$54,750,000	\$54,750,000
Subtotal of W/W equipment, including transmission				\$58,422,000
Total electromechanical work cost				\$65,978,000
Total direct cost				\$142,377,100
Indirect costs				
Feasibility studies and site investigations	2%	x	\$56,561,000	\$1,131,220
Environmental work	2%	x	\$57,692,000	\$1,153,840
Detailed designs and contract documents	4%	x	\$58,846,000	\$2,353,840
Site supervision work	6%	x	\$61,199,000	\$3,671,940
Contingencies on civil and overheads	15%	x	\$64,871,000	\$9,730,650
Contingencies on electromechanical work	5%	x	\$65,980,000	\$3,299,000
Subtotal indirect costs				\$21,340,490
Total capital cost (not including the dam)				\$163,717,590

Table B.8 Basis of Evaluation - Recreation Property Development

Item	Quantity	Units	Unit value	Total value or cost
Development along NSR valley				
Initial investment benefits				
Sale price of parcels to be developed (2 acre/parcel)		500 parcels	20,000	\$10,000,000
Capital investment for property development		500 parcels	75,000	\$37,500,000
Regional economic investment multiplier		2 x	\$37,500,000	\$75,000,000
Total initial benefits				\$122,500,000
Infrastructure costs				
Roads		90 km	200,000	\$18,000,000
Power		90 km	50,000	\$4,500,000
Water		50 km	1,000,000	\$50,000,000
Wastewater		1 LS	10,000,000	\$10,000,000
Other services		1 LS	40,000,000	\$40,000,000
Total infrastructure costs				\$122,500,000
Net initial benefits (total initial benefits minus infrastructure costs)				\$0
Annual municipal tax base increase (net of costs)		500 parcels	0	\$0
Development along Highgate Dam reservoir				
Initial investment benefits				
Sale price of parcels to be developed (2 acre/parcel)		1,000 parcels	100,000	\$100,000,000
Capital investment for property development		1,000 parcels	125,000	\$125,000,000
Regional economic investment multiplier		2 x	\$125,000,000	\$250,000,000
Total initial benefits				\$475,000,000
Infrastructure costs				
Roads		150 km	200,000	\$30,000,000
Power		150 km	50,000	\$7,500,000
Water		100 km	1,000,000	\$100,000,000
Wastewater		1 LS	20,000,000	\$20,000,000
Other services		1 LS	50,000,000	\$50,000,000
Total infrastructure costs				\$207,500,000
Net initial benefits (total initial benefits minus infrastructure costs)				\$267,500,000
Annual municipal tax base increase (net of costs)		1,000 parcels	500	\$500,000

Notes:

1. All property development assumed to be on non-cultivated land.

Assumptions:

- 6% cost of capital
- 9% investment expected rate of return
- 3% inflation

Table B.9 Estimated Flood Damage in Prince Albert Based on 500-yr Floodplain Limits.

	Quantity	Units	Unit cost	Cost
Residential	1080	homes	\$100,000	\$108,000,000
Schools	3	Schools	\$1,000,000	\$3,000,000
Power substation	1	L.S.	\$5,000,000	\$5,000,000
Wastewater treatment plant	1	L.S.	\$10,000,000	\$10,000,000
Other infrastructure		L.S.		\$20,000,000
Total flood damage for 500-yr flood				\$146,000,000

Notes:

1. Flood damaged property inventory based on interpretation of Saskatchewan Flood Hazard Reports.
2. Flood damage reduction assuming Highgate Dam reduces the 500-yr flood to less than the 100-yr flood peak.
3. Flood damages assumed without verification.
4. Residential properties estimated based on number of residential blocks within the 500-yr floodplain assuming 20 homes per block.

Table B.10 Basis of Evaluation - On-Farm Costs

On-Farm Irrigation Equipment Costs (Electric)	Item	Pivot HP 35%	Pivot LP 40%
Type			
Percent**			
Pivot 1300'		\$58,600	\$58,600
Electric Engine	125 hp	\$9,850	\$9,850
Switching Gear		\$6,400	\$6,400
Vert.Turbine Pump	75-125 hp	\$7,100	\$7,100
Pump House		\$5,950	\$5,950
Suction Pipe	10"	\$1,330	\$1,330
Low Pres. Package	1300'		\$4,280
3-Phase Electricity*		\$12,500	\$12,500
Wheel Roll	1/4 mile		
Hand Move - Pipe	1/4 mile		
Total		\$101,730	\$106,010
Area/Unit (Acres)		132	132
Total/Acre		\$771	\$803
Weighted Average	Cost per acre (2003) =		\$787

* Based on a cost estimate of \$37,000/km. (or \$50,000/mile) for four systems.

Source: Cost data from AAFRD/Irrigation Branch, Lethbridge, 2003.

Assume: \$900 per acre (2007) capital costs per acre

Table B.11a Basis of Evaluation - Agricultural Benefits

Crop Assumptions						
Crop mix	Current Mix (typ.)	Projected irrigation		Price (\$/b)	Dry yield (b/ac)	Irr. Yield (b/ac)
		Mixed	Potato			
Spring wheat	38%			4.75	32.3	
Barley	12%			2.75	41.8	
Canola	20%	25%		7.50	21.7	50
Field pea	8%			4.80	33.3	
Fallow	21%			0.00	0	
Potato		25%	100%	185.00		14
Soft wheat		25%		3.96		85
Timothy seed		25%		0.50		900

Notes:

1. Current existing agriculture crop mix based on census data for Battle Municipality.
2. Existing agriculture dryland costs based on AAFRD, Cost and Return Tables for Selected Crops, Dark Brown Soil Zone.
3. Projected agriculture irrigation costs based on SAF Irrigation Development Branch, Irrigation Economics and Agronomics, Saskatchewan, 2007.

Table B.11b Incremental Crop Benefits Due to Irrigation (per acre)

Scenario	Revenue	Costs	Net
1. Pure Processed Potato Projection	\$2,590	\$1,731	\$859
Existing Agriculture	\$120	\$105	\$15
Difference	\$2,470	\$1,626	\$845
2. Mixed Irrigated Crop Projection	\$938	\$607	\$331
Existing Agriculture	\$120	\$105	\$15
Difference	\$818	\$502	\$316

Assume: \$316 per acre (2007) net incremental benefit

Table B.12 Estimated Existing Crop Budgets for Dryland Agriculture (per acre)

ITEM	Spring Wheat	Barley / Other	H.T.Canola	Field Pea	Fallow	Average per acre
	1	2	5	6	7	8
LAND USE	38%	12%	20%	8%	21%	100%
(A) 1. Crop Sales	153.43	114.92	162.75	159.92	0.00	119.70
Yield	32.30	41.79	21.70	33.32	0.00	
Market Price	4.75	2.75	7.50	4.80	0.00	
2. Other Revenue	0.00	0.00	0.00	0.00	0.00	0.00
Gross return	153.43	114.92	162.75	159.92	0.00	119.70
(B) Variable Costs						
1. Seed	8.29	5.74	24.93	15.60	0.00	10.30
2. Fertilizer*	21.65	25.34	29.29	6.41	0.00	17.93
Nitrogen	0.00	0.00	0.00	0.00		
Phosphorus	0.00	0.00	0.00	0.00		
Potassium	0.00	0.00	0.00	0.00		
Sulphur	0.00	0.00	0.00	0.00		
Micros	0.00	0.00	0.00	0.00		
3. Herbicides	16.98	13.33	25.41	23.26	6.88	16.72
Pre-Seed**	0.00	0.00	0.00	0.00		0.00
In Crop	0.00	0.00	0.00	0.00	6.88	1.41
Pre-Harvest	0.00	0.00	0.00	0.00		0.00
4. Baling Twine/Additive						0.00
6. Crop/Hail Insurance**	20.00	20.00	20.00	20.00		15.89
7. Trucking/Storage/Fees/Marketing	1.06	0.57	1.00	1.35		0.80
8. Fuel, Oil & Lube	7.48	7.39	8.94	8.99	5.00	7.39
9. Repairs - Machinery	8.04	6.47	8.00	9.28	7.10	7.75
10. Repairs - Buildings	0.88	0.62	0.46	0.84	0.63	0.71
11. Utilities & Misc. Expenses	8.22	5.06	9.74	8.25	1.00	6.67
12. Custom Work/Special	4.03	4.45	5.29	2.79		3.41
13. Operating Interest Paid	1.30	1.36	3.36	1.63	0.62	1.62
14. Paid Labour & Benefits	1.62	2.64	3.24	2.76	0.48	1.94
15. Unpaid Labour	7.56	7.32	7.20	7.56	3.96	6.72
Total variable costs	107.11	100.29	146.86	108.72	25.67	97.84
(C) CAPITAL COSTS						
1. Land Taxes, Licenses/Insurance	4.63	4.63	4.63	4.63	4.63	4.63
2. Equipment & Bldg. Interest	9.38	9.38	9.38	9.38	9.38	9.38
3. Building & Equipment Depreciation	18.75	18.75	18.75	18.75	18.75	18.75
TOTAL CAPITAL COSTS	32.76	32.76	32.76	32.76	32.76	32.76
(D) CASH COSTS (B+C-C3-B15)	113.56	106.98	153.67	115.17	35.71	105.12
(E) TOTAL PRODUCTION COSTS (B+C)	139.87	133.05	179.62	141.48	58.42	130.59
(F) GROSS MARGIN (A-D)*	39.87	7.95	9.09	44.76	-35.71	14.58
RETURN TO UNPAID LABOUR (A-E+B15)	21.12	-10.80	-9.66	26.01	-54.46	-4.17
RETURN TO INVESTMENT (A-E+C2)	22.93	-8.75	-7.49	27.82	-49.05	-1.51
Percent Return to Investment	2.0%	-0.8%	-0.7%	2.5%	-4.4%	0.00
RETURN TO EQUITY (A-E)	13.56	-18.12	-16.87	18.45	-58.42	-10.89
INVESTMENT						
Land	750.00	750.00	750.00	750.00	750.00	750.00
Buildings	50.00	50.00	50.00	50.00	50.00	50.00
Machinery	325.00	325.00	325.00	325.00	325.00	325.00
Livestock						
TOTAL	1125.00	1125.00	1125.00	1125.00	1125.00	1125.00
LABOUR						
Hired Labour (hours)	0.135	0.22	0.27	0.23	0.04	
Unpaid Labour (hours)	0.63	0.61	0.6	0.63	0.33	
Total Labour (hrs./acre/yr.)	0.77	0.83	0.87	0.86	0.37	
Rate/Hour	12.00	12.00	12.00	12.00	12.00	
Straw/Aftermath Yield (tonnes)	0.6486	0.9805	0	0.5	0	
Market Price (\$/tonne)	0.00	0.00	0.00	0.00	0.00	

Note:

*Sometimes called the "Contribution Margin" or "Cash Margin".

**Total cost = farmer share + federal share + provincial share. 70% coverage; no hail.

Sources: AAFRD, **Cost and Return Tables for Selected Crops**, Dark Brown Soil Zone, various.

AAFRD, Enterprise Analysis. www.agric.gov.ab.ca.

Table B.13 Projected Crop Budgets with Irrigation (per acre)

ITEM	Processed Potato	HT Canola	Soft Wheat	Timothy Seed	WT. AVERAGE
	1	2	3	4	5
PROJECTED CROP MIX	0.25	0.25	0.25	0.25	1
(A) 1. Crop Sales					
Yield	14	50	85	900	
Market Price****	185.00	7.50	3.96	0.50	
2. Other Revenue	0	0	0	0	
Gross return	2590	375	336.81	450	937.95
(B) Variable costs					
1. Seed	351	25	10.80		96.70
1a. Seed treatment/inoc.	48.60	9.00	5.94	0.00	15.89
2. Fertilizer					
Nitrogen	60.96	48.77	44.7	69.08	55.88
Phosphorus	24.67	10.96	10.96	16.44	15.76
Potassium	31.83	3.18	2.12	10.61	11.94
Sulphur	0	0	0	0	0.00
Micros	0	0	0	0	0.00
3. Herbicide	107.89	18	24	16.10	41.50
4. Insecticide	22	0	0	0	5.50
4a. Fungicide	70	0	0	0	17.50
5. Equipment fuel	90	13.65	13	15.60	33.06
6. Equipment repair	80	5.70	5.70	8.55	24.99
7. Custom work	48	0	0	0	12.00
8. Irrigation power*	11.73	11.73	11.73	11.73	11.73
9. Irrigation repairs*	6.78	6.78	6.78	6.78	6.78
10. Irrigation service/water charge					0.00
11. Crop insurance (Total Cost)	157.075	13.45	6.05	0	44.14
12. Hail insurance	0	9.45	5.40	0	3.71
13. Hired labour	180	0	0	36	54.00
14. Other	0	5.5	0	6	2.88
15. Storage O&M	71				17.75
16. Farm overhead	9.20	9.20	9.20	9.20	9.20
17. Operating Interest @5.7%	35.85	5.89	4.97	6.70	13.35
Total variable costs	1406.59	196.27	161.36	212.80	494.25
(C) CAPITAL COSTS					
1. Land Taxes, Licenses/Insurance					
2. Equipment & Bldg.	13.10	23.71	23.71	23.71	21.06
2a. Irrigation Equipment***					
3. Specialized Equipment	311.06	0.17	0	56.25	91.87
4. Building & Equipment Depreciation					
Total capital costs	324.16	23.88	23.71	79.96	112.93
(D) CASH COSTS (B)	1406.59	196.27	161.36	212.80	494.25
(E) TOTAL PRODUCTION COSTS (B+C)	1730.75	220.15	185.07	292.76	607.18
(F) GROSS MARGIN (A-E)**	859.25	154.85	151.75	157.24	330.77
LABOUR					
Hired Labour (hours)	15	0	0	3	
Unpaid Labour (hours)					
Total Labour (hrs./acre/yr.)					
Rate/Hour	12	12	12	12	

Note:

* Calculated under "Project Costs".

**Return to own labour, own capital, land, water, and management.

Sometimes called the "Contribution Margin" or "Cash Margin".

*** Included in cash flow analysis as a one-time capital cost.

**** See "Background Data". Softwheat adjusted to "all wheat average, Alberta".

Source: SAF Irrigation Development Branch, **Irrigation Economics and Agronomics, Saskatchewan, 2007.**

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