Bear, Little Bear, Cub & Asher Lakes Hydrologic / Nutrient Budgets & Management Plans

Conceptual Improvement Projects and Costs

Presentation to the Bear Lake Preservation Association on November 13, 2012

BEAR LAKE Preservation Association

SEMINOLE COUNTY FLORIDA'S NATURAL CHOICE

ERD Water Quality Engineering

Pegasus ENGINEERING

Overall Vicinity Map

Recommended Management Options for Bear Lake

Issue		Recommendation
Treatment of Stormwater Inputs	a.	Construct treatment systems for Sub-basins 1,6, and 10, if feasible
	b.	Recommend increased use of curb inlet baskets and street sweeping
Rear Yard Berms and Swales	a.	Construct berms and swales along all developed shoreline areas of Bear Lake
Vegetated Shorelines	a.	Establish natural shoreline vegetation in all non-exempt shoreline areas within 3-5 years
Internal Recycling/GW Seepage Inputs	a.	Conduct alum treatment to control internal recycling and remove P from seepage inflows
Lawn Maintenance Activities	a.	Develop a strong ordinance which strictly prohibits discharge of yard waste or placement of fertilizers onto impervious surfaces
Public Education	a.	Establish a comprehensive public education program to inform residents of link between watershed activities and water quality
Boating	a.	Restrict normal boating to areas >10 feet and enhanced wake boating to areas >15 ft; idle speed in all other areas

Recommended Management Options for Little Bear Lake

Issue		Recommendation
Treatment of Stormwater Inputs	a.	Correct deficient pond construction for Sub-basin 1
	b.	Recommend increased use of curb inlet baskets and street sweeping
Rear Yard Berms and Swales	a.	Construct berms and swales along all developed shoreline areas of Little Bear Lake
Vegetated Shorelines	a.	Establish natural shoreline vegetation in all non-exempt shoreline areas within 3-5 years
Internal Recycling/GW Seepage Inputs	a.	Conduct alum treatment to control internal recycling and remove P from seepage inflows
Lawn Maintenance Activities	a.	Develop a strong ordinance which strictly prohibits discharge of yard waste or placement of fertilizers onto impervious surfaces
Public Education	a.	Establish a comprehensive public education program to inform residents of link between watershed activities and water quality
Boating	a.	Restrict normal boating to areas >10 feet and enhanced wake boating to areas >15 ft; idle speed in all other areas

Recommended Management Options for Cub Lake

Issue	Recommendation	
Treatment of Stormwater Inputs	a.	Stormwater treatment not recommended at this time
Rear Yard Berms and Swales	a.	Construct berms and swales along all developed shoreline areas of Cub Lake
Vegetated Shorelines	a.	Establish natural shoreline vegetation in all non-exempt shoreline areas within 3-5 years
Internal Recycling/GW Seepage Inputs	a.	Conduct alum treatment to control internal recycling and remove P from seepage inflows
Lawn Maintenance Activities	a.	Develop a strong ordinance which strictly prohibits discharge of yard waste or placement of fertilizers onto impervious surfaces
Public Education	a.	Establish a comprehensive public education program to inform residents of link between watershed activities and water quality
Boating	a.	Restrict normal boating to areas >10 feet and enhanced wake boating to areas >15 ft; idle speed in all other areas

Recommended Management Options for Lake Asher

Issue		Recommendation
Treatment of Stormwater Inputs	a.	Connect Sub-basin 1 to existing wet detention pond for Sub-basin 2.
	b.	Recommend increased use of curb inlet baskets and street sweeping
Rear Yard Berms and Swales	a.	Construct berms and swales along all developed shoreline areas of Asher Lake
Vegetated Shorelines	a.	Establish natural shoreline vegetation in all non-exempt shoreline areas within 3-5 years
Internal Recycling/GW Seepage Inputs	a.	Conduct alum treatment to control internal recycling and remove P from seepage inflows
Lawn Maintenance Activities	a.	Develop a strong ordinance which strictly prohibits discharge of yard waste or placement of fertilizers onto impervious surfaces
Public Education	a.	Establish a comprehensive public education program to inform residents of link between watershed activities and water quality

Calculated Mass Loadings from Stormwater Runoff

Lake	Sub-Basin No.	Basin Area (ac)	Mass Loadings (kg/yr)			Percent of Total Runoff Load (%)		
			Total N	Total P	TSS	Total N	Total P	TSS
Bear	BL1	76.19	165	8.4	568	26	15	15
	BL2	29.06	15.7	2.1	99	2	4	3
	BL3	11.20	8.3	1.1	52	1	2	1
	BL4	105.86	65.7	2.3	360	10	4	9
	BL5	2.67	3.6	1.3	75	1	2	2
	BL6	12.66	17.3	6.1	354	3	11	9
	BL7	5.67	8.1	2.9	164	1	5	4
	BL8	2.42	3.4	1.2	69	1	2	2
	BL9	43.96	64.0	4.4	289	10	8	7
	BL10	75.62	93.0	6.4	420	14	11	11
	BL11	16.81	16.2	1.0	60	3	2	2
	BL12	8.65	4.2	1.4	118	1	3	3
	BL13	56.22	41.5	1.0	108	6	2	3
	Overland Flow	143.46	139	16.8	1135	22	30	29
	Totals:	590.45	644	56.3	3871	100	100	100
Cub	CL1	18.43	15.4	0.1	24.9	25	2	6
	Overland Flow	45.38	47.4	5.7	387	75	98	94
	Totals:	63.81	62.7	5.9	412	100	100	100
Asher	LA1	13.55	5.8	0.4	54	13	7	5
	LA2	43.55	21.2	2.8	693	48	53	65
	LA3	11.46	7.3	1.0	239	17	18	22
	Overland Flow	10.43	9.7	1.2	80	22	22	7
	Totals:	78.99	44.1	5.3	1065	100	100	100
Little Bear	LBL1	49.18	6.7	3.4	1093	12	27	42
	LBL2	8.12	3.2	1.6	514	6	13	20
	LBL3	7.47	3.0	1.5	497	5	12	19
	LBL4	8.90	4.7	1.4	199	8	11	8
	Overland Flow	30.11	39.4	4.8	323	69	37	12
	Totals:	103.78	57.0	12.8	2625	100	100	100

Management Philosophy

- The Bear Chain-of-Lakes are primarily P limited lakes and P loadings must be controlled to improve water quality
- Control of phosphorus is essential to maintain and improve water quality
  - A wide variety of sources contribute phosphorus
  - Due to the small watershed areas and low runoff concentrations, stormwater is less significant as a phosphorus source than in most urban lakes
- Management of P loadings should emphasize significant inputs
- Smaller inputs should be managed as opportunities arise
- Structural phosphorus management projects should be constructed first in upstream portions of the chain so that water quality benefits can migrate downstream

Stormwater Management

- Stormwater runoff contributions of Total P to the Bear Chain-of-Lakes:

Lake	Total P Load (kg/yr)	Percent of Total Loading (%)
Asher	2.8	25
Bear	39.5	14
Little Bear	8.0	19
Cub	0.1	<1

- With the exception of Asher (and possibly Little Bear), runoff contributes a relatively small percentage of the annual TP loadings
- Stormwater management projects may be appropriate for Lake Asher and Little Bear
- Stormwater management for Lakes Bear and Little Bear may be feasible if the cost is low

Calculated Nutrient Budgets

Lake	Source	Total N		Total P		TSS	
		kg/yr	% of Total	kg/yr	% of Total	kg/yr	% of Total
Asher	Precipitation	16.2	24	1.3	12	365	33
	Runoff	29.4	44	2.8	25	646	59
	Overland Flow	9.7	15	1.2	11	79.7	7
	GW Seepage	11.0	17	0.9	8	0	0
	Internal Recy.	0	0	5.0	45	0	0
	Totals:	66.3	100	11.1	100	1,090	100

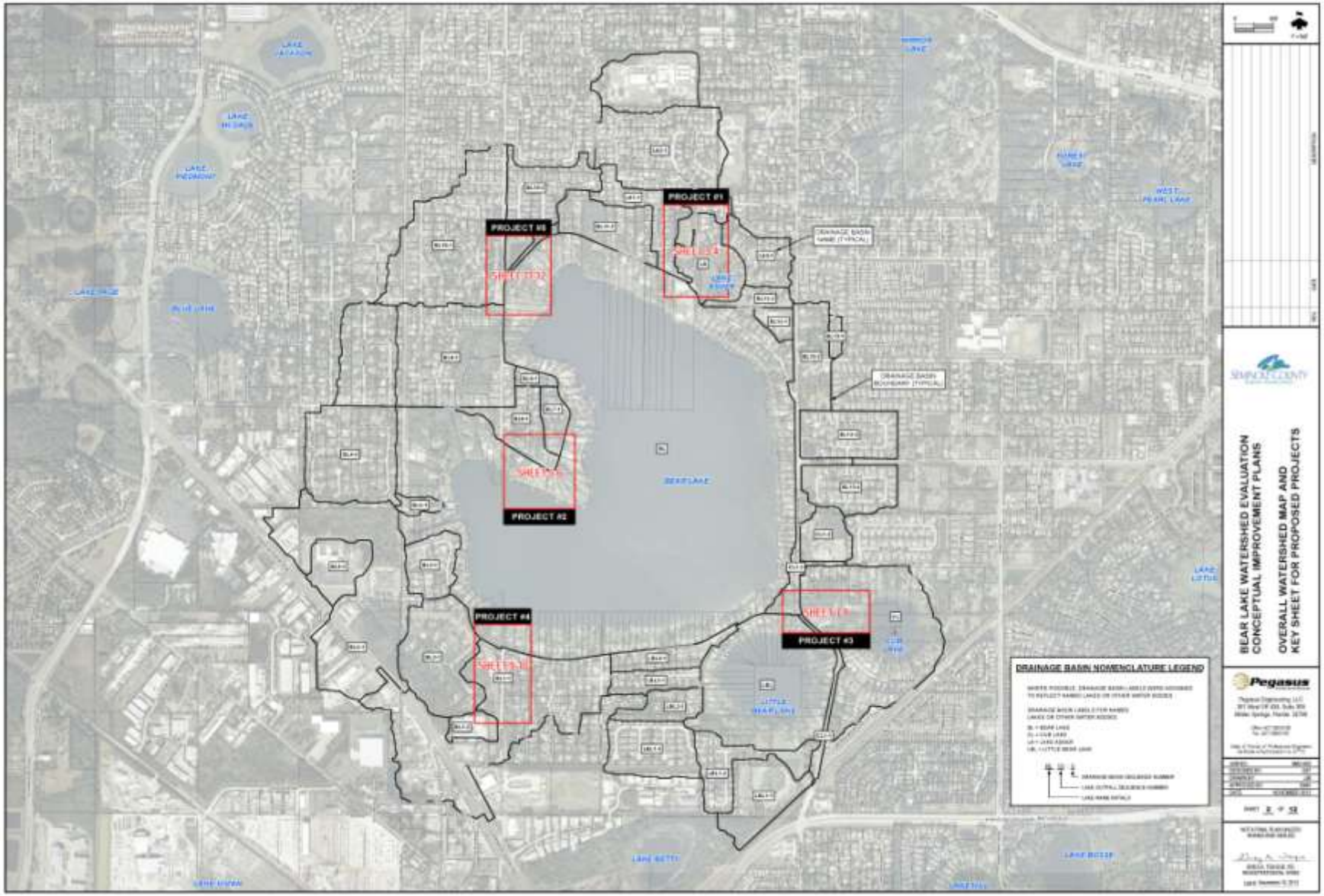
Lake	Source	Total N		Total P		TSS	
		kg/yr	% of Total	kg/yr	% of Total	kg/yr	% of Total
Bear	Precipitation	1196	36	94.8	32	26,872	87
	Runoff	506	15	39.5	14	2,736	9
	Overland Flow	139	4	16.8	6	1,135	4
	GW Seepage	1404	43	7.7	3	0	0
	Asher Inflow	37.9	1	1.3	0	245	1
	Internal Recy.	0	0	132	45	0	0
	Totals:	3283	100	292	100	30,989	100

Calculated Nutrient Budgets

Lake	Source	Total N		Total P		TSS	
		kg/yr	% of Total	kg/yr	% of Total	kg/yr	% of Total
Little Bear	Precipitation	105	44	8.3	19	0	0
	Runoff	17.6	7	8.0	19	2,303	88
	Overland Flow	39.4	17	4.8	11	323	12
	GW Seepage	75.9	32	0.7	2	0	0
	Internal Recy.	0	0	20.8	49	0	0
	Totals:	237	100	42.6	100	2,625	100

Lake	Source	Total N		Total P		TSS	
		kg/yr	% of Total	kg/yr	% of Total	kg/yr	% of Total
Cub	Precipitation	54.2	6	4.3	13	1,219	30
	Runoff	15.4	2	0.1	0	24.9	1
	Overland Flow	47.4	5	5.7	17	387	9
	GW Seepage	67.2	8	0.2	1	0	0
	Bear Inflow	669	77	18.4	55	3,403	83
	L. Bear Inflow	67.1	8	1.6	5	302	7
	Internal Recy.	0	0	7.4	22	0	0
	Totals:	866	100	33.5	100	4,117	100

LOCATION OF CONCEPTUAL IMPROVEMENT PROJECTS



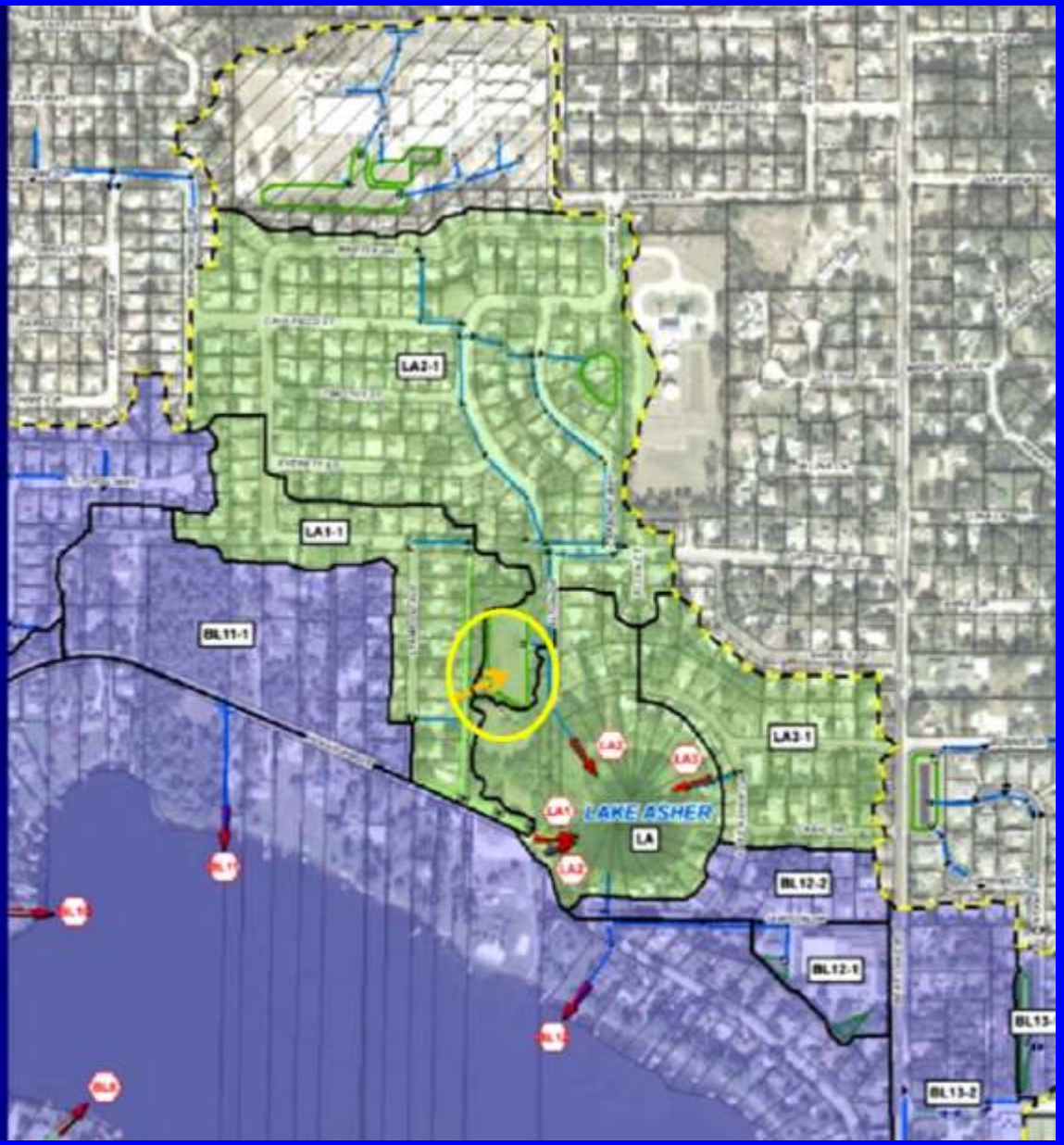
Overview of the Lake Asher Drainage Basin

Lake Asher
Drainage Basin

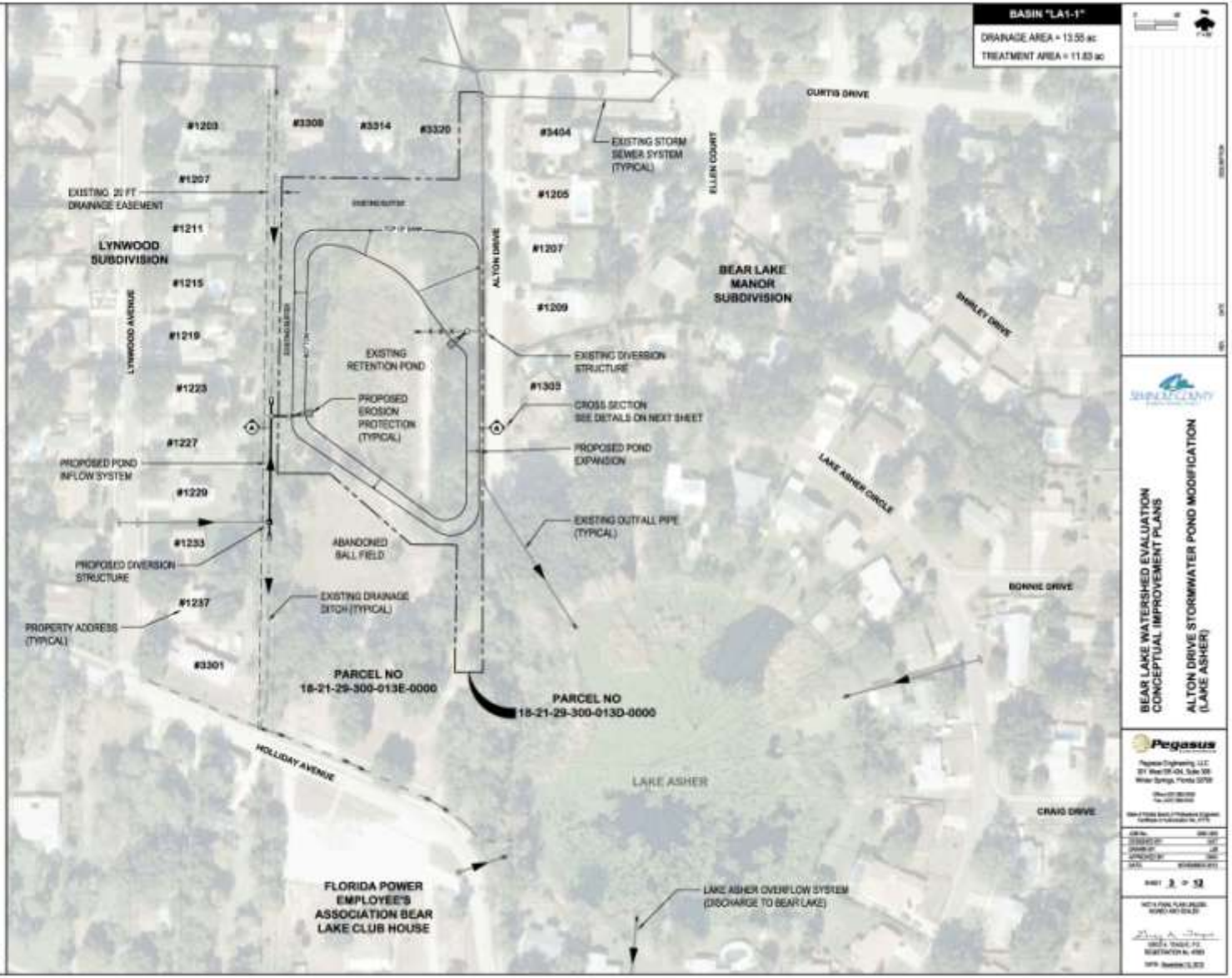
- 3 inflows
- 1 outflow

Basin ID	Area (acres)	Percent of Total
LA-1	13.55	16.2
LA-2	43.55	51.9
LA-3	11.46	13.7
LA-O	15.3	18.2
	83.8	100.0

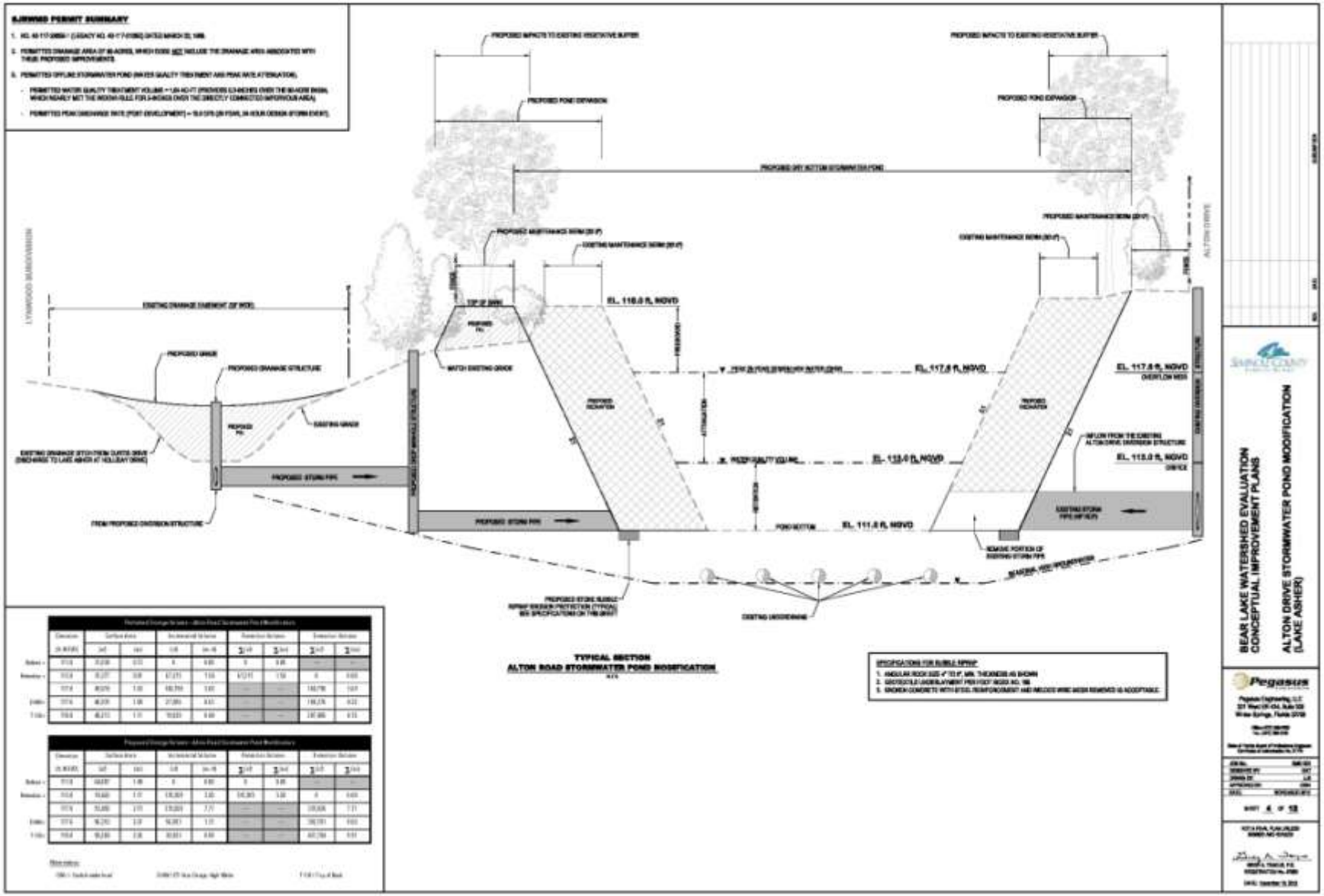
Imp. Area = 27.5 acres (33%)
Basin/Lake Area Ratio = 20.4



ALTON DRIVE STORMWATER POND MODIFICATION



Alton Drive Stormwater Pond Modification



Alton Drive Stormwater Pond Modification

Project #1

Line No.	Pay Item Category	Item Description	Estimated Quantity	Unit	Unit Price	Extended Amount
1	101	Mobilization	1	LS	5%	$10,200.00
2	102	Maintenance of Traffic	1	LS	$1,000.00	$1,000.00
3	104	Dewatering	1	LS	$10,000.00	$10,000.00
4	104	Erosion Control and Pollution Abatement	1	LS	$1,500.00	$1,500.00
5	110	Clearing, Grubbing and Demolition	1	LS	$10,000.00	$10,000.00
6	120	Pond Excavation	6,000	CY	$15.00	$90,000.00
7	120	Ditch Enclosure (Backfill, Compaction and Grading)	1	LS	$7,500.00	$7,500.00
8	425	Manhole (Type "J")	1	EA	$7,500.00	$7,500.00
9	425	Manhole (Type "P")	2	EA	$4,000.00	$8,000.00
10	425	Diversion Structure (Type "J" Box)	1	EA	$7,500.00	$7,500.00
11	430	Storm Pipe (24" RCP)	250	LF	$65.00	$16,250.00
12	430	Storm Pipe (48" RCP)	25	LF	$200.00	$5,000.00
13	430	Pipe Mitered End Section (24")	3	EA	$1,000.00	$3,000.00
14	430	Pipe Mitered End Section (48")	1	EA	$3,500.00	$3,500.00
15	530	Stone Rubble Riprap Erosion Protection	26	TN	$200.00	$5,200.00
16	550	Chain Link Fence	840	LF	$20.00	$16,800.00
17	570	Performance Turf (Bahia Sod)	4,500	SY	$2.50	$11,250.00

Pegasus ENGINEERING

TOTAL	=	**$214,200.00**
Engineering and Permitting	=	**$75,000.00**
Preliminary Design Contingency (5%)	=	**$10,710.00**
TOTAL ESTIMATED PROJECT COST	=	**$299,910.00**

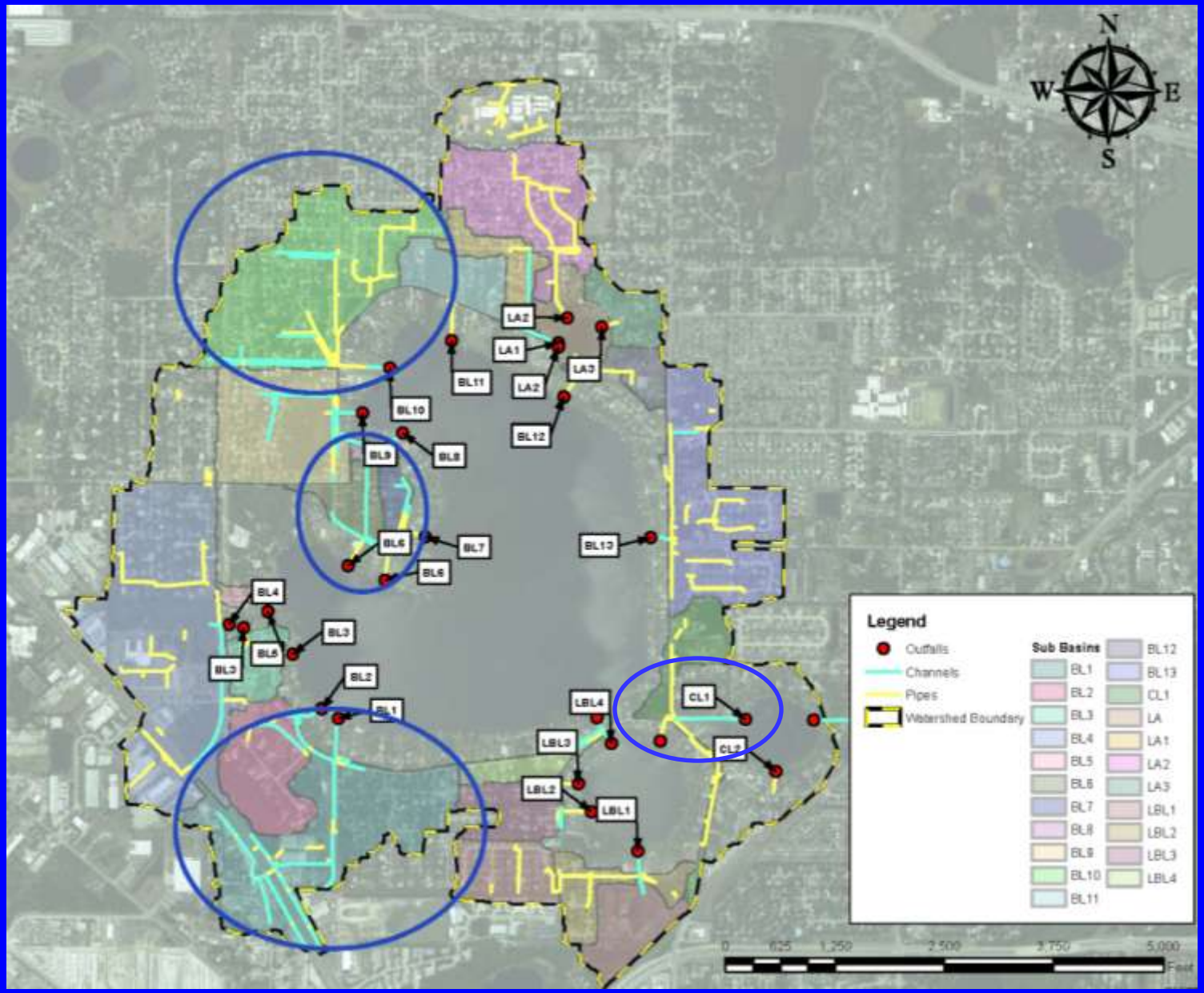
Stormwater Management (Bear Lake)

- In general, runoff loadings from individual sub-basins to Bear Lake contribute a small percentage of the annual TP loading
- Only 3 sub-basins contribute >10 % of the runoff generated TP loadings

Bear Lake Sub-basin	Total P Load (kg/yr)	Percent of Total Runoff Loading (%)
1	8.4	15
6	6.1	11
10	6.4	11

- Stormwater management projects may be feasible for these basin at moderate-low cost
- Most appropriate runoff management for the remaining sub-basins may be to aggressively construct catch basin inserts to capture leaves and debris and increase street sweeping frequencies, particularly during periods of leaf fall

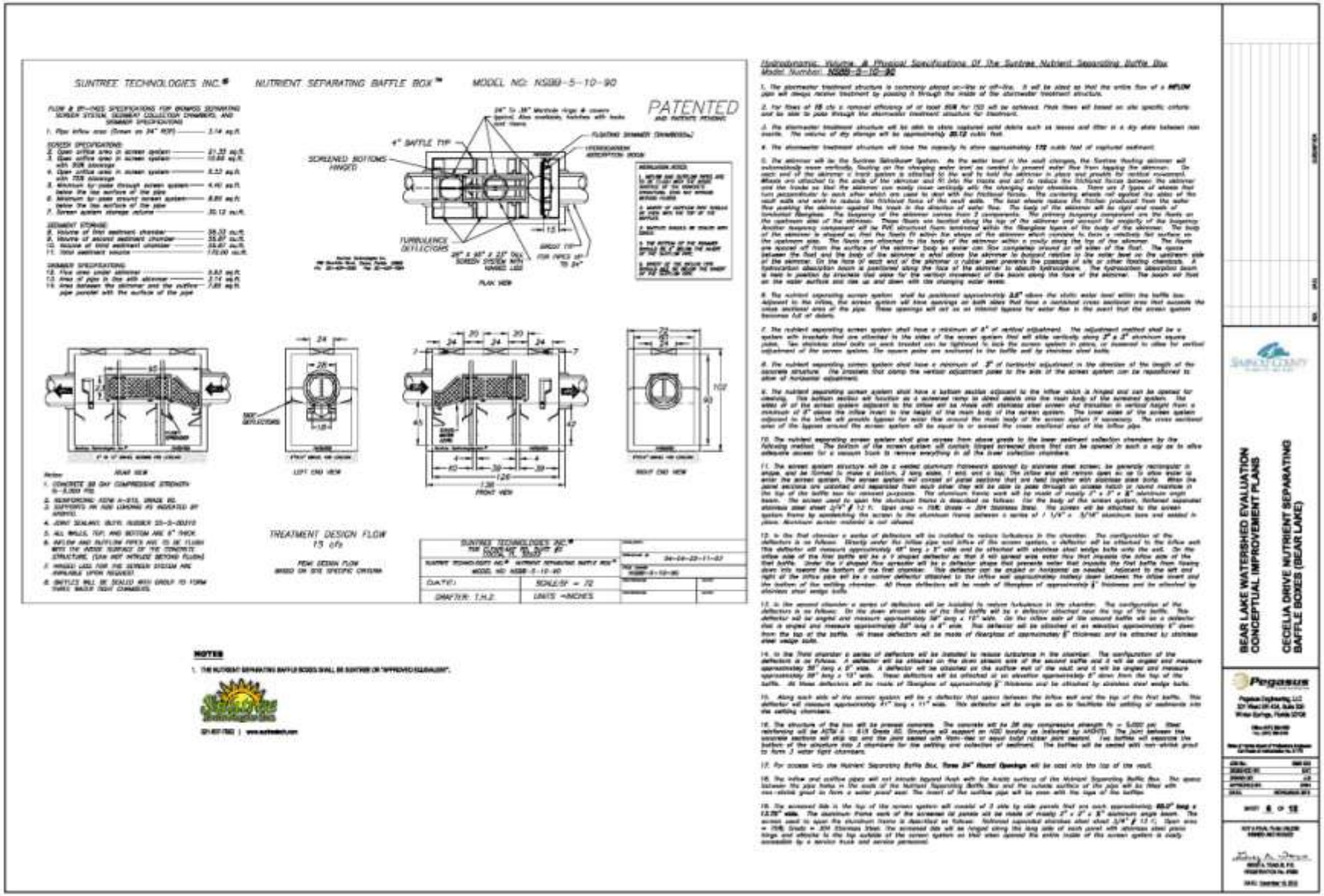
Drainage Sub-basins in the Bear Lakes Watershed



Bear Lake Sub-basin 6 (Cecelia Drive)

CECELIA DRIVE NUTRIENT SEPARATING BAFFLE BOXES

Cecelia Drive Nutrient Separating Baffle Boxes



Cecelia Drive Nutrient Separating Baffle Boxes

Project #2

Line No.	Pay Item Category	Item Description	Estimated Quantity	Unit	Unit Price	Extended Amount
1	101	Mobilization	1	LS	5%	$5,138.75
2	102	Maintenance of Traffic	1	LS	$1,000.00	$1,000.00
3	104	Dewatering	1	LS	$3,000.00	$3,000.00
4	104	Erosion Control and Pollution Abatement	1	LS	$2,000.00	$2,000.00
5	110	Clearing, Grubbing and Demolition	1	LS	$2,000.00	$2,000.00
6	425	Drainage Inlet (Type "C" DBI)	1	EA	$2,500.00	$2,500.00
7	425	Drainage Inlet (Type "D" DBI)	1	EA	$3,500.00	$3,500.00
8	425	Nutrient Separating Baffle Box (18" Pipe)	2	EA	$40,000.00	$80,000.00
9	430	Storm Pipe Extension	1	LS	$1,000.00	$1,000.00
10	430	Storm Pipe (18" RCP)	30	LF	$55.00	$1,650.00
11	522	Concrete Driveway (6" Thick)	75	SY	$35.00	$2,625.00
12	570	Performance Turf (St. Augustine Sod)	500	SY	$5.00	$2,500.00
13	999	Drainage Easement Acquisition	2	EA	$500.00	$1,000.00

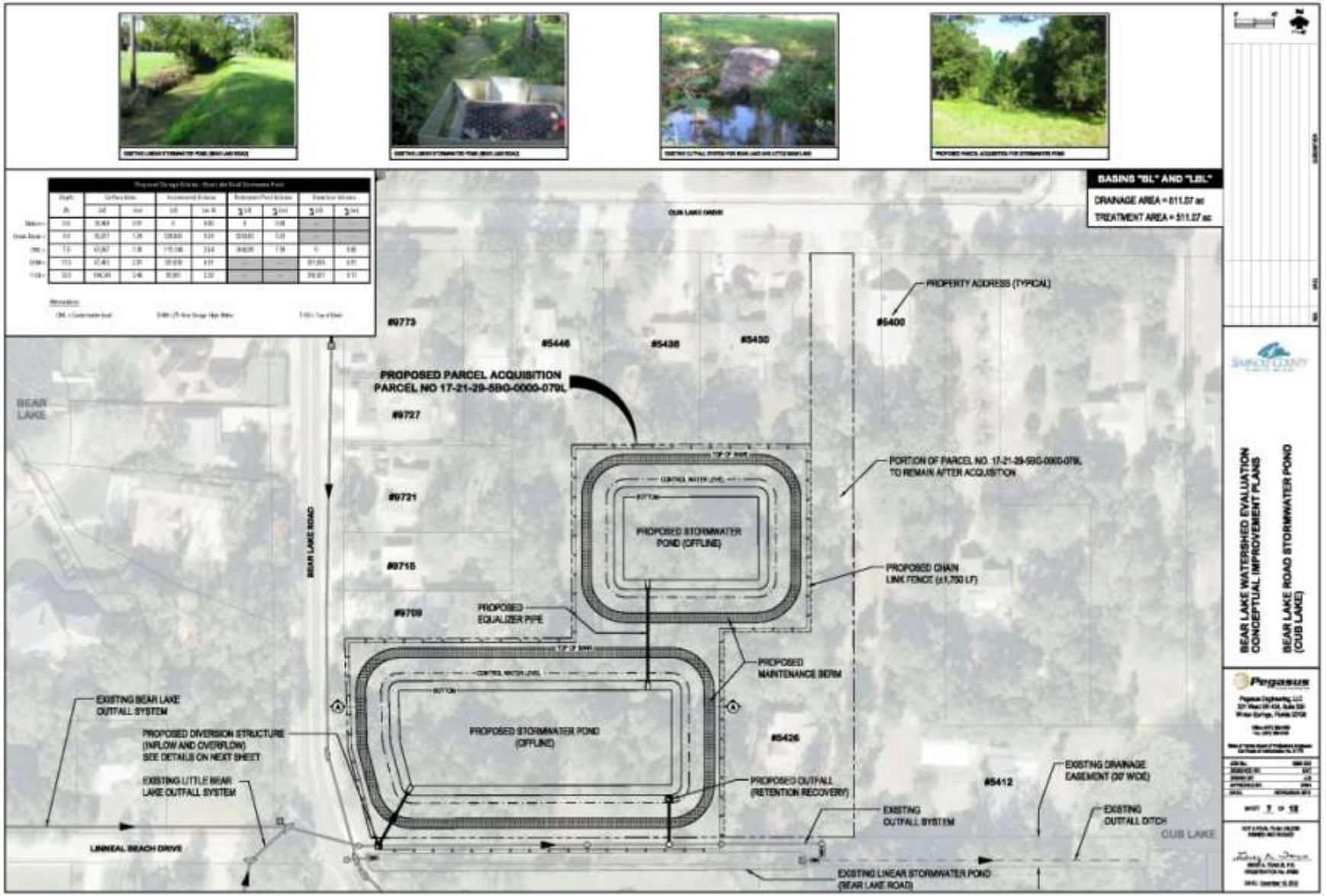
Pegasus ENGINEERING

TOTAL	=	**$107,913.75**
Engineering and Permitting	=	**$30,000.00**
Preliminary Design Contingency (5%)	=	**$5,395.69**
TOTAL ESTIMATED PROJECT COST	=	**$143,309.44**

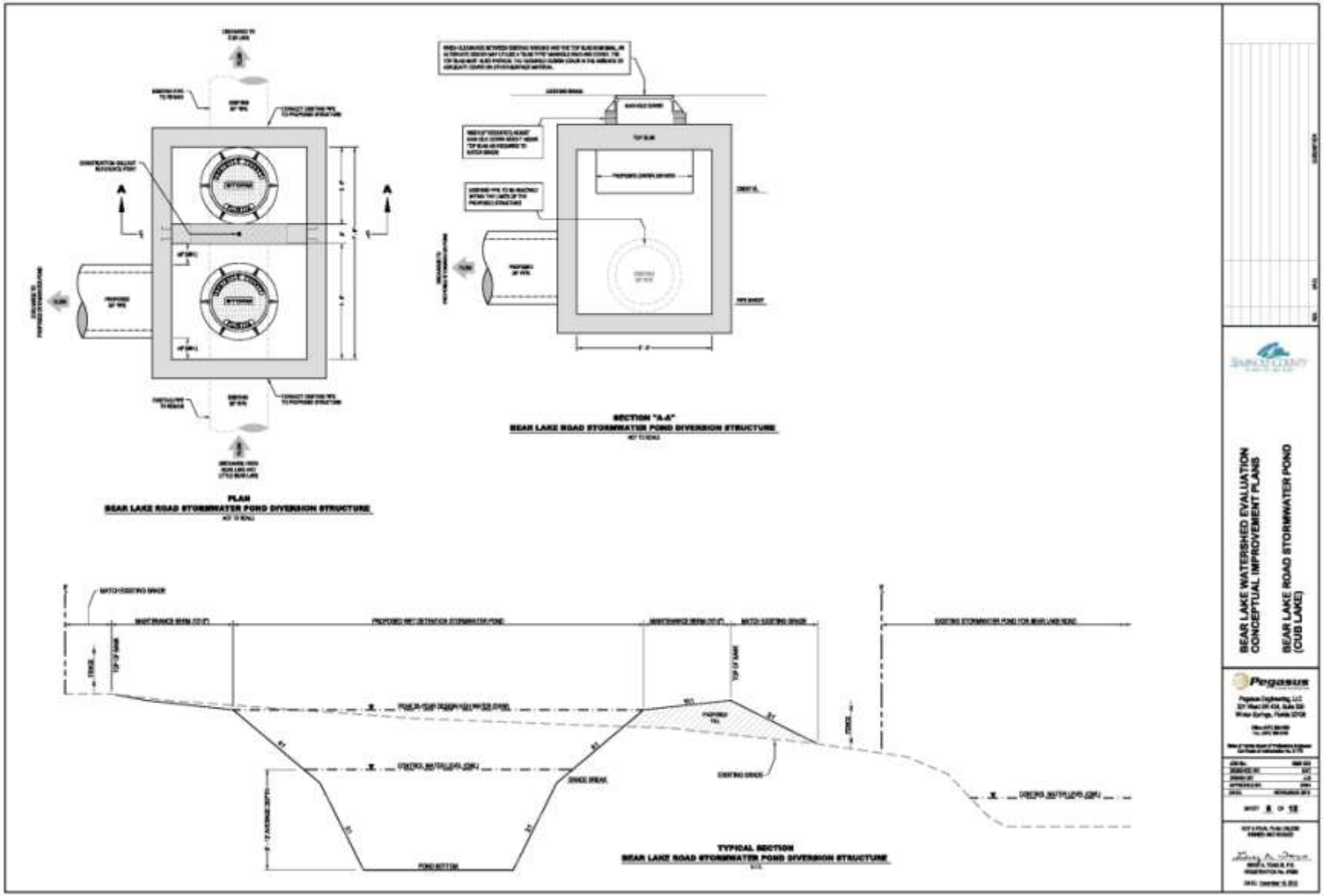
Stormwater Management (Little Bear and Cub Lakes)

- Runoff loadings to Cub Lake contribute a negligible portion of the annual TP inputs
  - Treatment of runoff inputs does not appear to be necessary
- Runoff inputs to Little Bear Lake contribute 19% of annual TP loadings
  - 27% of runoff loadings are contributed by Sub-basin 1 (3.4 kg/yr)
  - Treatment of Sub-basin 1 may be feasible
- Most appropriate runoff management for the remaining sub-basins may be to aggressively construct catch basin inserts to capture leaves and debris and increase street sweeping frequencies, particularly during periods of leaf fall

BEAR LAKE ROAD STORMWATER POND



BEAR LAKE ROAD STORMWATER POND



BEAR LAKE ROAD STORMWATER POND

Project #3

Line No.	Pay Item Category	Item Description	Estimated Quantity	Unit	Unit Price	Extended Amount
1	101	Mobilization	1	LS	5%	$26,567.50
2	102	Maintenance of Traffic	1	LS	$1,500.00	$1,500.00
3	104	Dewatering	1	LS	$15,000.00	$15,000.00
4	104	Erosion Control and Pollution Abatement	1	LS	$5,000.00	$5,000.00
5	110	Clearing, Grubbing and Demolition	1	LS	$20,000.00	$20,000.00
6	120	Pond Excavation	15,000	CY	$15.00	$225,000.00
7	425	Manhole (Type "J")	1	EA	$7,500.00	$7,500.00
8	425	Diversion Structure (Type "J" Box)	1	EA	$7,500.00	$7,500.00
9	425	Outfall Structure (Type "D" DBI)	1	EA	$3,500.00	$3,500.00
10	430	Storm Pipe (30" RCP)	210	LF	$85.00	$17,850.00
11	430	Pipe Mitered End Section (30")	3	EA	$2,000.00	$6,000.00
12	550	Chain Link Fence	1,750	LF	$20.00	$35,000.00
13	570	Performance Turf (Bahia Sod)	5,000	SY	$2.50	$12,500.00
14	999	Property Acquisition	1	LS	$175,000.00	$175,000.00

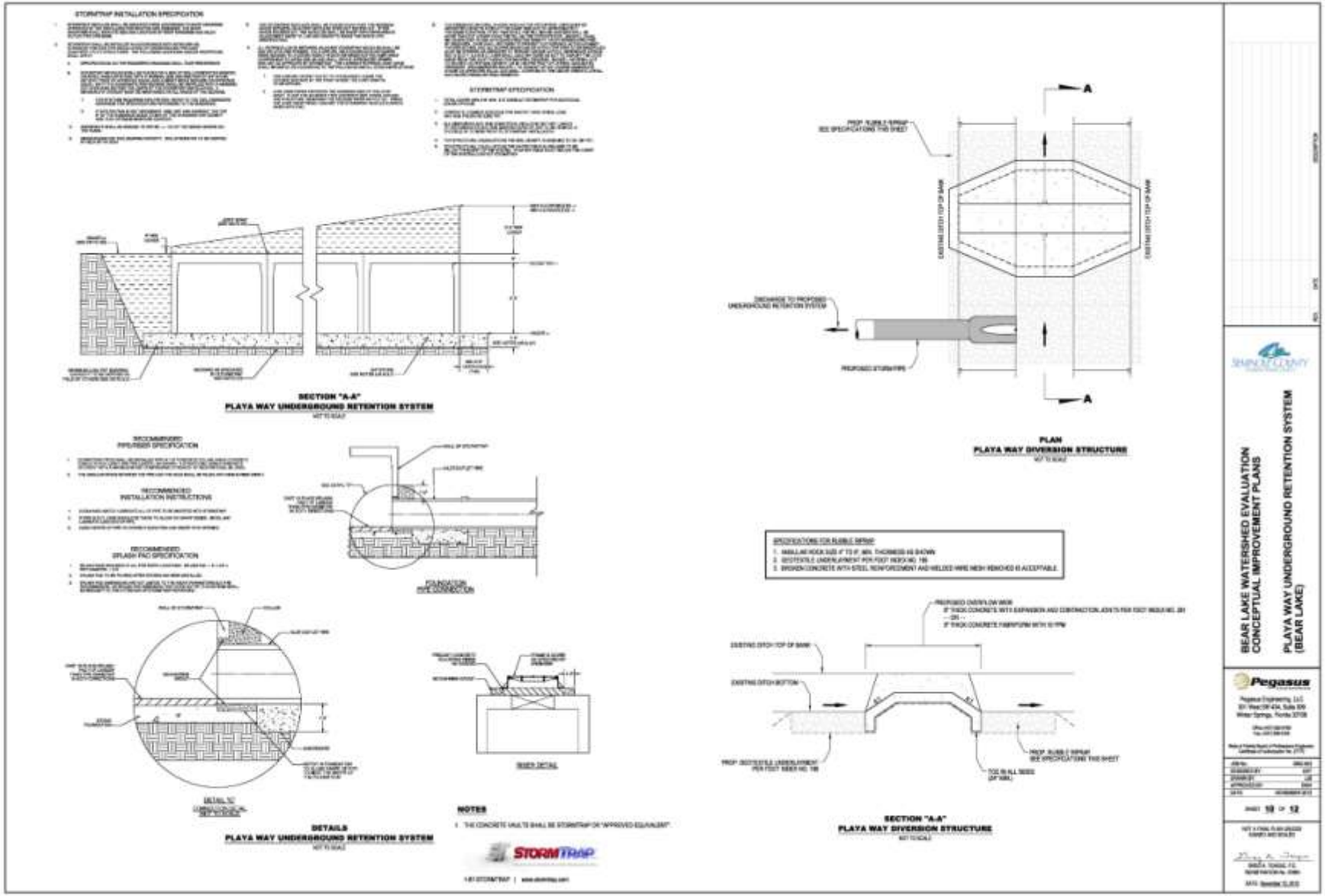
Pegasus ENGINEERING

TOTAL	=	**$557,917.50**
Engineering and Permitting	=	**$75,000.00**
Preliminary Design Contingency (5%)	=	**$27,895.88**
TOTAL ESTIMATED PROJECT COST	=	**$660,813.38**

Bear Lake Sub-basin 1 (Playa Way)

PLAYA WAY UNDERGROUND RETENTION SYSTEM

Playa Way Underground Retention System



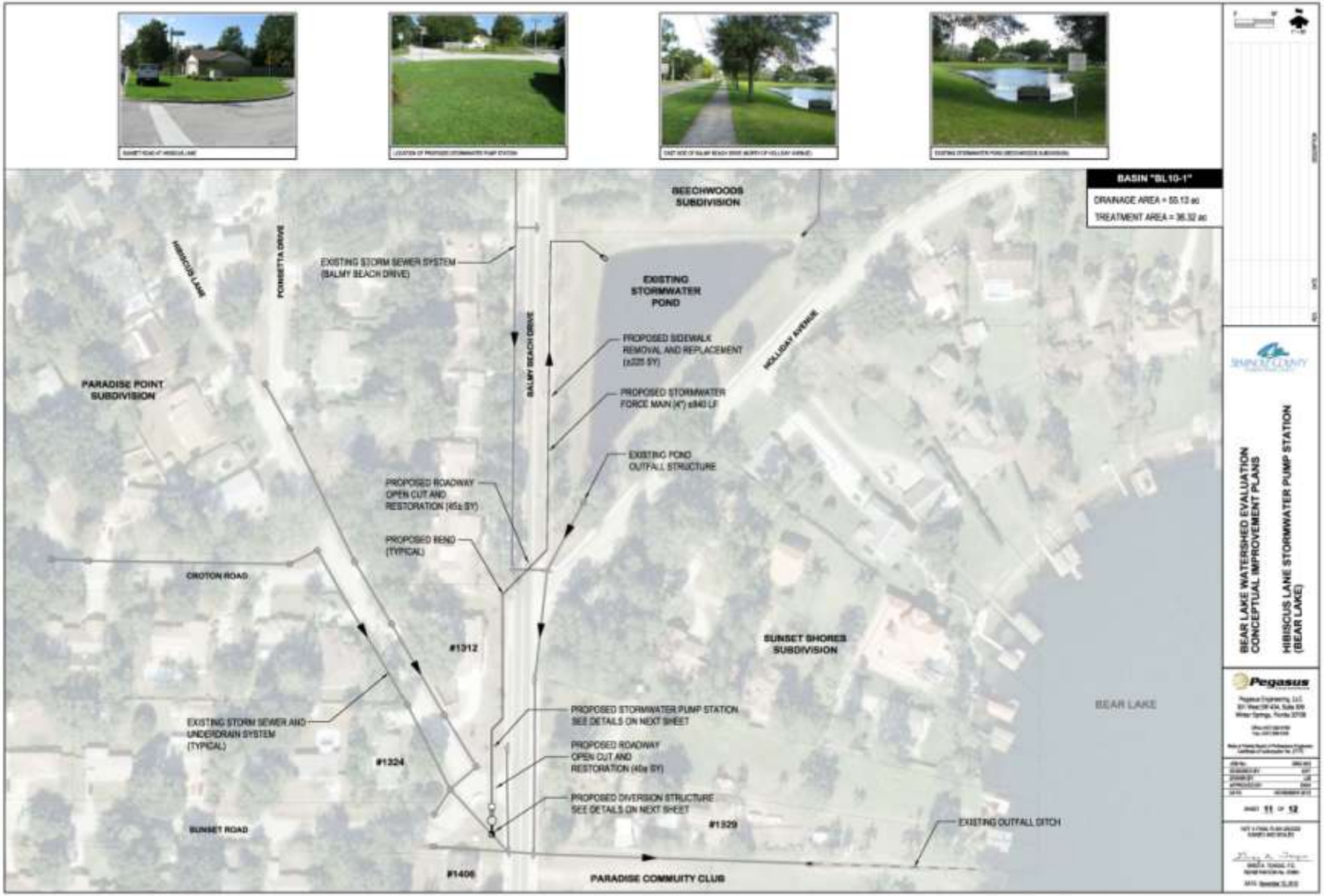
Playa Way Underground Retention System

Project #4

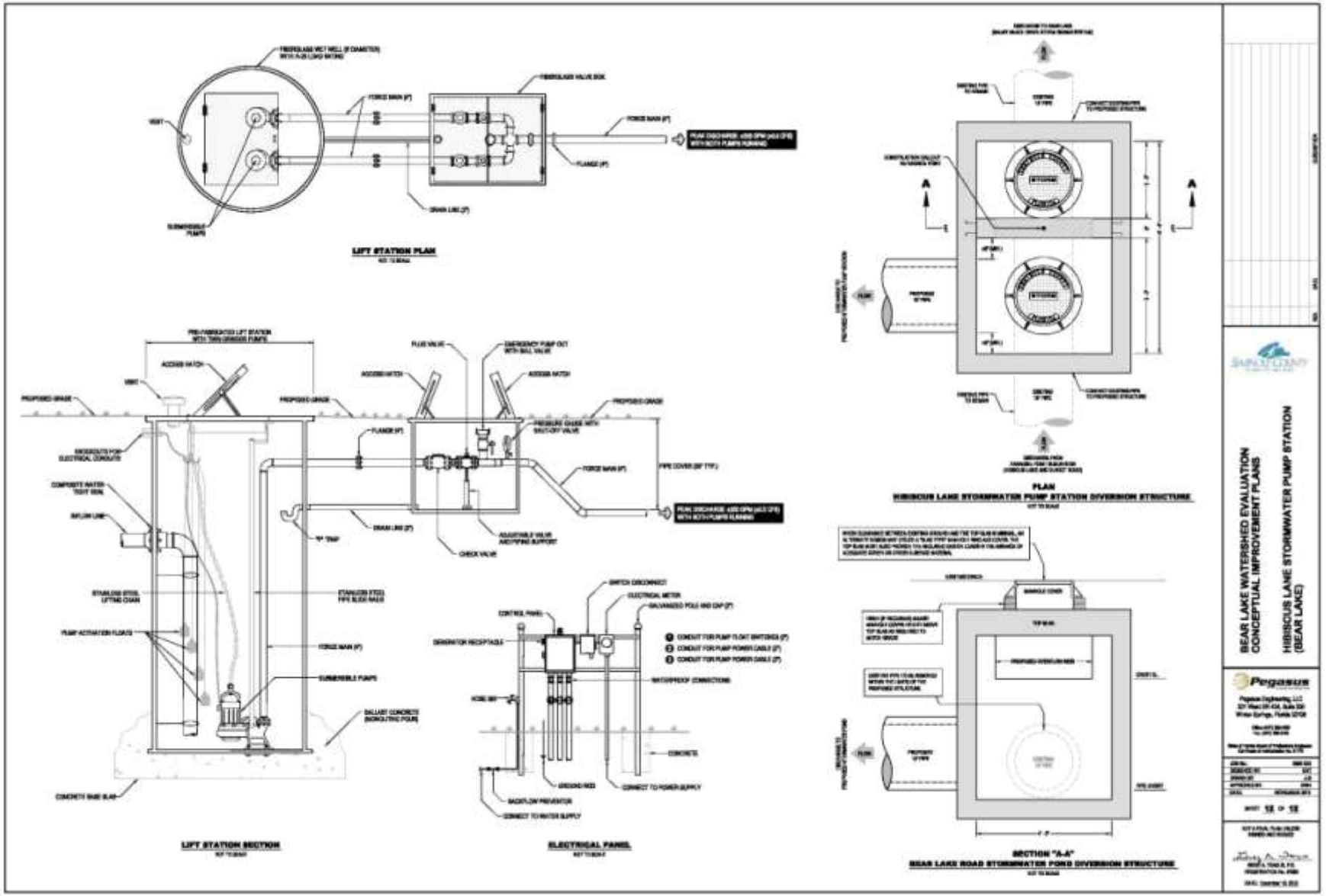
Line No.	Pay Item Category	Item Description	Estimated Quantity	Unit	Unit Price	Extended Amount
1	101	Mobilization	1	LS	5%	$27,467.50
2	102	Maintenance of Traffic	1	LS	$1,000.00	$1,000.00
3	104	Dewatering	1	LS	$1,500.00	$1,500.00
4	104	Erosion Control and Pollution Abatement	1	LS	$2,500.00	$2,500.00
5	110	Clearing, Grubbing and Demolition	1	LS	$10,000.00	$10,000.00
6	400	Concrete Diversion Structure	1	LS	$10,000.00	$10,000.00
7	430	Inflow Manifold and Header System	1	LS	$15,000.00	$15,000.00
8	522	Concrete Driveway (6" Thick)	250	SY	$35.00	$8,750.00
9	530	Stone Rubble Riprap Erosion Protection	60	TN	$200.00	$12,000.00
10	570	Performance Turf (Bahia Sod)	2,500	SY	$2.50	$6,250.00
11	570	Performance Turf (St. Augustine Sod)	3,000	SY	$5.00	$15,000.00
12	999	Underground Retention System				
		- Concrete Vaults (Including Freight and Delivery)	1	LS	$300,000.00	$300,000.00
		- Concrete Vault Installation	233	EA	$200.00	$46,600.00
		- Excavation and Haul Off Excess Material	5,525	CY	$15.00	$82,875.00
		- Stone Foundation	875	CY	$33.00	$28,875.00
		- Backfill and Compaction	450	CY	$20.00	$9,000.00

Bear Lake Sub-basin 10 (Hibiscus Lane / Sunset Road)

HIBISCUS LANE STORMWATER PUMP STATION



HIBISCUS LANE STORMWATER PUMP STATION



HIBISCUS LANE STORMWATER PUMP STATION

Project #5

Line No.	Pay Item Category	Item Description	Estimated Quantity	Unit	Unit Price	Extended Amount
1	101	Mobilization	1	LS	5%	$6,468.75
2	102	Maintenance of Traffic	1	LS	$1,500.00	$1,500.00
3	104	Dewatering	1	LS	$5,000.00	$5,000.00
4	104	Erosion Control and Pollution Abatement	1	LS	$5,000.00	$5,000.00
5	110	Clearing, Grubbing and Demolition	1	LS	$1,500.00	$1,500.00
6	334	Roadway Open Cut and Restoration	85	SY	$50.00	$4,250.00
7	425	Diversion Structure	1	LS	$7,500.00	$7,500.00
8	430	Stormwater Force Main (4" HDPE)	840	LF	$25.00	$21,000.00
9	430	Pipe Mitered End Section (4")	1	EA	$500.00	$500.00
10	522	Concrete Sidewalk Removal and Replacement	225	SY	$25.00	$5,625.00
11	570	Performance Turf (Bahia Sod)	1,000	SY	$2.50	$2,500.00
12	999	Pre-fabricated Stormwater Pump Station (Twin Pumps)	1	LS	$75,000.00	$75,000.00

Pegasus ENGINEERING

TOTAL	=	**$135,843.75**
Engineering and Permitting	=	**$50,000.00**
Preliminary Design Contingency (5%)	=	**$6,792.19**
TOTAL ESTIMATED PROJECT COST	=	**$192,635.94**

Cost Summary for Conceptual Improvements

Project No.	Watershed Location	Project Name	Construction Cost	Engineering and Permitting	Design Contingency	Project Cost
1	Lake Asher	Alton Road Stormwater Pond Modification	$214,200.00	$75,000.00	$10,710.00	$299,910.00
2	Bear Lake	Cecelia Drive Nutrient Separating Baffle Boxes	$107,913.75	$30,000.00	$5,395.69	$143,309.44
3	Cub Lake	Bear Lake Road Stormwater Pond	$557,917.50	$75,000.00	$27,895.88	$660,813.38
4	Bear Lake	Playa Way Underground Retention System	$576,817.50	$50,000.00	$28,840.88	$655,658.38
5	Bear Lake	Hibiscus Lane Stormwater Pump Station	$135,843.75	$50,000.00	$6,792.19	$192,635.94

Pegasus ENGINEERING

GRAND TOTAL = $1,952,327.13

BMP Performance Evaluation

Estimated Performance of Proposed Bear Lake Improvement Project No. 1

Lake: Asher
Sub-Basin: LA1-1
System Name: Alton Rd. Stormwater Pond Modifications
Treatment System Type: Dry Retention

Condition	Parameter	Units	Value
Current Sub-Basin Conditions	Sub-Basin Area	acres	13.55
	Total N Loading	kg/yr	8.2
	Total P Loading	kg/yr	1.1
	TSS Loading	kg/yr	269
Treatment System Characteristics	Treated Area	acres	11.83
	Percent of Basin Treated	%	87
	Est. Total N Removal	%	95
	Est. Total P Removal	%	95
	Est. TSS Removal	%	95
Post Treatment Characteristics	Total N Removal	kg/yr	6.80
	Total P Removal	kg/yr	0.91
	TSS Removal	kg/yr	223
	Total N Remaining	kg/yr	1.40
	Total P Remaining	kg/yr	0.19
	TSS Remaining	kg/yr	46
Project Cost Analysis	Project Capital Cost	$	299,910
	Annual O&M Cost	$	10,000
	Analysis Duration	yrs	20
	Interest Rate	%	4
	P/A Factor	-	13.59
	20 Year Present Worth		435,813
Removal Costs	Total N Removal Cost	$/kg	3,204
	Total P Removal Cost	$/kg	23,884
	TSS Removal Cost	$/kg	98

Comments: Combined retention depth for both basins is 0.99". Combined DCIA% for the two basins is 20.4% with non-DCIA = 45.7.

Estimated Performance of Proposed Bear Lake Improvement Project No. 2

Lake: Bear
Sub-Basin: BL6-1
System Name: Cecelia Dr. Baffle Box
Treatment System Type: Nutrient Separating Baffle Box

Condition	Parameter	Units	Value
Current Sub-Basin Conditions	Sub-Basin Area	acres	12.66
	Total N Loading	kg/yr	17.3
	Total P Loading	kg/yr	6.1
	TSS Loading	kg/yr	354
Treatment System Characteristics	Treated Area	acres	12.66
	Percent of Basin Treated	%	100
	Est. Total N Removal	%	25
	Est. Total P Removal	%	30
	Est. TSS Removal	%	65
Post Treatment Characteristics	Total N Removal	kg/yr	4.33
	Total P Removal	kg/yr	1.83
	TSS Removal	kg/yr	230
	Total N Remaining	kg/yr	13.0
	Total P Remaining	kg/yr	4.27
	TSS Remaining	kg/yr	124
Project Cost Analysis	Project Capital Cost	$	143,309
	Annual O&M Cost	$	6,000
	Analysis Duration	yrs	20
	Interest Rate	%	4
	P/A Factor	-	13.59
	20 Year Present Worth		224,851
Removal Costs	Total N Removal Cost	$/kg	2,599
	Total P Removal Cost	$/kg	6,143
	TSS Removal Cost	$/kg	49

Comments: Removal data obtained from previous research. Assumed that box is cleaned monthly at cost of $500/cleaning = $12,000 annually. Option has the lowest nutrient removal costs of the evaluated options.

BMP Performance Evaluation

Estimated Performance of Proposed Bear Lake Improvement Project No. 3

Lake: Cub
Sub-Basin: BL & LBL
System Name: Bear Lake Rd. Stormwater Pond
Treatment System Type: Wet Detention

Condition	Parameter	Units	Value
Current Sub-Basin Conditions	Sub-Basin Area	acres	511.07
	Total N Loading	kg/yr	489
	Total P Loading	kg/yr	13.3
	TSS Loading	kg/yr	2454
Treatment System Characteristics	Treated Area	acres	511.07
	Percent of Basin Treated	%	100
	Est. Total N Removal	%	10
	Est. Total P Removal	%	15
	Est. TSS Removal	%	25
Post Treatment Characteristics	Total N Removal	kg/yr	48.9
	Total P Removal	kg/yr	2.00
	TSS Removal	kg/yr	614
	Total N Remaining	kg/yr	440
	Total P Remaining	kg/yr	11.3
	TSS Remaining	kg/yr	1,841
Project Cost Analysis	Project Capital Cost	$	660,813
	Annual O&M Cost	$	10,000
	Analysis Duration	yrs	20
	Interest Rate	%	4
	P/A Factor	-	13.59
	20 Year Present Worth		796,716
Removal Costs	Total N Removal Cost	$/kg	815
	Total P Removal Cost	$/kg	19,968
	TSS Removal Cost	$/kg	65

Comments: Mean annual detention time = 3.5 days. Pond treats discharges from Bear Lake and L. Bear Lake which are low in TN, TP, and TSS with concentrations near irreducible concentrations for a wet detention pond. Therefore, the anticipated removals are low. Removals assume that pond has significant vegettive uptake for dissolved nutrients. Annual maintenance costs (mowing, etc.) assumed to be $10,000.

Estimated Performance of Proposed Bear Lake Improvement Project No. 4

Lake: Bear
Sub-Basin: BL1-1
System Name: Playa Way Retention System
Treatment System Type: Underground Retention

Condition	Parameter	Units	Value
Current Sub-Basin Conditions	Sub-Basin Area	acres	71.53
	Total N Loading	kg/yr	165
	Total P Loading	kg/yr	8.4
	TSS Loading	kg/yr	568
Treatment System Characteristics	Treated Area	acres	41.07
	Percent of Basin Treated	%	57
	Est. Total N Removal	%	40
	Est. Total P Removal	%	40
	Est. TSS Removal	%	40
Post Treatment Characteristics	Total N Removal	kg/yr	37.89
	Total P Removal	kg/yr	1.93
	TSS Removal	kg/yr	130
	Total N Remaining	kg/yr	127.11
	Total P Remaining	kg/yr	6.47
	TSS Remaining	kg/yr	438
Project Cost Analysis	Project Capital Cost	$	665,658
	Annual O&M Cost	$	10,000
	Analysis Duration	yrs	20
	Interest Rate	%	4
	P/A Factor	-	13.59
	20 Year Present Worth		801,561
Removal Costs	Total N Removal Cost	$/kg	1,058
	Total P Removal Cost	$/kg	20,775
	TSS Removal Cost	$/kg	307

Comments: Proposed retention volume provides treatment for 0.2" over treated area. Removal assumes that basin has DCIA=38.5% and non-DCIA CN value = 65. Annual maintenance cost assumed to be $10,000.

BMP Performance Evaluation

Estimated Performance of Proposed Bear Lake Improvement Project No. 5

Lake: Bear
Sub-Basin: BL10-1
System Name: Hibiscus Lane Pump System
Treatment System Type: Wet Retention

Condition	Parameter	Units	Value
Current Sub-Basin Conditions	Sub-Basin Area	acres	55.13
	Total N Loading	kg/yr	93
	Total P Loading	kg/yr	6.4
	TSS Loading	kg/yr	420
Treatment System Characteristics	Treated Area	acres	36.32
	Percent of Basin Treated	%	66
	Est. Total N Removal	%	42
	Est. Total P Removal	%	42
	Est. TSS Removal	%	42
Post Treatment Characteristics	Total N Removal	kg/yr	25.73
	Total P Removal	kg/yr	1.77
	TSS Removal	kg/yr	116
	Total N Remaining	kg/yr	67.27
	Total P Remaining	kg/yr	4.63
	TSS Remaining	kg/yr	304
Project Cost Analysis	Project Capital Cost	$	192,634
	Annual O&M Cost	$	15,000
	Analysis Duration	yrs	20
	Interest Rate	%	4
	P/A Factor	-	13.59
	20 Year Present Worth		396,489
Removal Costs	Total N Removal Cost	$/kg	770
	Total P Removal Cost	$/kg	11,195
	TSS Removal Cost	$/kg	171

Comments: Analysus assumes that the pump station will divert 80% of annual runoff volume in treated portion of basin into pond. Also assumes that the pond will remove 80% of the incoming loadings by infiltration and water column removal. Annual O&M cost assumed to be $15,000.

Closing Points

- Anticipated costs based on preliminary engineering
- Benefit / Cost analysis has not been completed
  - ✓ Cost per pound of removal
- Some projects require property acquisition and/or authorization from other entities
- Funding considerations

Questions and Discussion