Appendix A: Calculations

				Б	Г	Б		7.7	т т
1	A Decision Variables	В	C	D	Е	F	G	Н	I
2	Decision Variables Name	Variable	Unita						
			Units						
3	Allocated water to urban users	Q_{u}	ac-ft						
4	Allocated water to wetlands	Q_{w}	ac-ft						
5									
6	Constraints	** *	WY 4.						
7	Name	Value	Units						
8	Available water volume in river	320	ac-ft						
9	$V_{available} = Q_u + Q_w = 320 \text{ a}$	cre feet							
10			4 11 64						
11	Objective Maximize total benefit			S					
12	Objective Function Total hangests include the gyme of financial hangests from the yestland water yes and neumants from when water years								
13	Total benefits include the sum of financial benefits from the wetland water use and payments from urban water users.								
15	$B(Q_u, Q_w) = (800Q_u) + (2200Q_w^{0.8})$								
16	Formulate the Lagrangian and find the partials of each decision variable								
17	Formulate the Lagrangian and find the partials of each decision variable								
18	$L(Q_u, Q_w, \lambda) = B + \lambda(Constraints)$								
19	$L(Q_u, Q_w, \lambda) = 800Q_u + 220$	$0Q_w^{0.8} + \lambda(Q_u$	$+Q_w - 320$)					
20	- 21		-						
21	$\frac{\partial L}{\partial \Omega} = 800$	$0+0+\lambda$							
22	dQ_u		[0]						
23	$\nabla L = \frac{\partial L}{\partial Q} = 0 + 0.8(2)$	$(200Q_w^{-0.2}) + \lambda$	$\lambda = 0$						
24	$\nabla L = \begin{bmatrix} \frac{\partial L}{\partial Q_u} = 800 \\ \frac{\partial L}{\partial Q_w} = 0 + 0.8(2 \\ \frac{\partial L}{\partial \lambda} = 0 + 0 + Q_w \end{bmatrix}$		LOJ						
25	$\frac{\partial L}{\partial \lambda} = 0 + 0 + Q_1$	$u + Q_w - 320$							
26	2 0%								
27	Solve for first order conditions								
28	Excel Solve	er			Aı	nalytical H	and Soluti	on	
29	Parameter	Value	Units						
30	$Q_{\rm u}$	268.46	ac-ft	• 800 -	+ d = 0 0 Qu + Qu -02) =	- 7	スニー	<u>∞</u>	
31	$Q_{ m w}$	51.54	ac-ft	a IBron	A-0.2	1 = 0			
32	$\frac{1}{\lambda}$	-800	_		-0.2\S	1-1	-5		
33	7		_	(Qu -)=	THE)		
34	Benefits (\$)	\$266,307.20	5		Qu= (1 860	5 1610	51 ~ 51	st ac-ft
35	1				((1740)	312	s ~ =	
36	First Order Condition Equations	Value			^	a = 0			
37	Partial Qu	0.00000	D		-Qu -32				
38	Partial Qw	0.00000	$\overline{0}$	Q٠	+ 51.54	-320 =	0		
39	Partial λ	0.00000	Ō	Q	~~ 268	,46 ac-	.a		
40		L	= 1						
41	1								

	A	В	С	D	Е	F	G	Н	I
42	What if 10 more ac-ft of water we	ere available	in the river	r?					
43				$V_{available}$:	$=Q_u+Q_w$	= 330 acre	feet		
44	Parameter	Value	Units		$L(O_{u}, O_{w}, \lambda)$.)	1
45	$Q_{\rm u}$	278.46	ac-ft		$\lambda(Q_u, Q_w, \lambda)$ $\lambda(Q_u, Q_w, \lambda)$,		,	
46	$Q_{ m w}$	51.54	ac-ft	1000			(- 2	,	
47	1 λ "	-800			$ \frac{\partial L}{\partial Q_w} = 0 $ $ \frac{\partial L}{\partial Q_w} = 0 $ $ \frac{\partial L}{\partial Q_w} = 0 $	_ 900 + 0	1 1		
48	1		I		$\overline{\partial Q_i}$	- — 000 + 0 ι) Τ λ	r01	
49	Benefits (\$)	\$274,307.26		$\nabla L =$	$\frac{\partial L}{\partial L} = 0$	+ 0.8(2200	$O^{-0.2}$) + λ	$=\begin{bmatrix}0\\0\end{bmatrix}$	
50	1		•		∂Q_w	1 0.0(2200	\mathcal{L}_{W}		
51	First Order Condition Equations	Value			$\frac{\partial L}{\partial x} = 0 +$	$-0+Q_{u}+0$	$Q_w - 330$		
52	Partial Qu	0.00000							J
53	Partial Qw	0.00000		· 600+	λ=0 = 2ω + λ ω -0.2)= (=7 入ニ	-800		
54	Partial λ	0.00000			-0.2	•			
55			4	• 1460	۵س + ۸	=0			
56				(0	u ^{-0.2})= ((A)			
57					/ 0	60\-5	61051	L Gel en Ch	
58	_			G	()	160) =	3125	51.54 uc-ft	
59									
60					2-330				
61				Q~ 4	51.54 -3	530 = 0			
62	1			Qu	~278,40	ac-A			
63	1								
64									•