Lake Powell Pipeline Economic Feasibility Analysis for Washington County, UT

October 2015

Lake Powell Pipeline Feasibility for Washington County Water District

The following summarizes concerns about the ability of the Washington County Water Conservancy District (WCWCD) to repay debt issued by the State of Utah for the WCWCD's financial obligation for participating in the proposed Lake Powell Pipeline (LPP).

1. Washington County Water District's Questionable Water Needs. Based on declining population growth, potential to convert additional agricultural water, potential water conservation savings, and previously unconsidered water sources, Washington County has ample water to serve future populations without participation in the Lake Powell Pipeline.

1a. Outdated Population Forecasts. The Governor's Office of Planning and Budget (GOPB) 2012 Baseline Population Projections estimates Washington County will grow to 581,731 residents by the year 2060, 32.4 percent lower than population projections made by the GOPB in 2005.[1] Since the District's water needs projections rely on these population projections, the more updated data pushes the supposed need for the LPP back over 12 years. The labeled *2006 Population* and *2012 Projection with No Conservation* lines in Figure 2 on page 3 illustrates the difference between these two different population forecasts on water use.

1b. Potential Agricultural Water Transfers. In the most recent Kanab Creek/Virgin River Basin Plan by the Division of Water Resources (DWRe) from 1993 (1993 KCVRBP) it was estimated the basin had 25,600 acres of irrigated cropland, diverting over 123,000 acre-feet of water (pg. 10–14), with 87,800 acre-feet of the agricultural diversions in the basin occurring in Washington County. Much of the water diverted for agriculture in Washington County uses inefficient conveyance systems and it is estimated "If the overall irrigation efficiency could be increased one percent, it would save 2,500 acre-feet of water in the basin." (pg. 2–8 1993 KCVRBP).

TABLE 5-12
ESTIMATED CURRENT IRRIGATION WATER USE[15]

County	Area[a] (acres)	Diversion (acre-feet)	Depletions (acre-feet)
Washington	16,680	87,800	39,320
Iron	1,520	7,860	1,490
Kane	7,400	27,640	10,490
Total	25,600	123,300	51,300

[a]Includes idle cropland

As future development replaces former agricultural lands in the county, the new development creates a surplus of water formerly used to irrigate crops. Table ES-11 in the 2011 DWRe Water Needs Assessment claims that Washington County can only expect to convert 10,080 acre-feet of agricultural water for M&I needs. However Table 10-6 of the 1993 KCVRBP implies, using linear interpolation, that there will be a reduction of 27,100 acre-feet of irrigated cropland water diversions from 2011 to 2040.[2] According to the 2012 USDA Census of Agriculture, Washington County had 14,781 acres of irrigated lands in 2012, a reduction of over 10,000 acres since 1993.

The 2015 Legislative Audit of the Division of Water Resources found that "the state engineer typically approves the conversion of 100 percent of agricultural water to municipal use"[3] and thus Washington County can expect much more than 10,000 acre-feet of water to be available from agricultural conversions.

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[1] http://governor.utah.gov/DEA/projections.html, 2012 Baseline Projections, "Population and Households by Area." Available as http://governor.utah.gov/DEA/ERG/ERG2012/Households%20by%20Area.xlsx

[2] Utah State Water Plan, Kanab Creek/Virgin River Basin, Utah Division of Water Resources, August 1993.

[3] "A Performance Audit of Projections of Utah's Water Needs," Office of the Legislative Auditor General, May 2015, Page 54. http://le.utah.gov/audit/15_01rpt.pdf

Table ES-11 Future Planned and Potential WCWCD Water Supply Projects

Project	Estimated Reliable Culinary Supply (ac-ft/yr)	Estimated Reliable Secondary Supply (ac-ft/yr)
Ash Creek Pipeline[1]	3,830	0
Maximize Existing Wastewater Reuse[2]	0	7,300
Agricultural Conversion from Development[3]	0	10,080
Lake Powell Pipeline	69,000	0
Potential Future Wastewater Reuse[4]	0	27,620
Total Potential Yield from Future Projects	72,830	45,000

TABLE 10-6
CURRENT AND PROJECTED IRRIGATED CROPLAND WATER USE

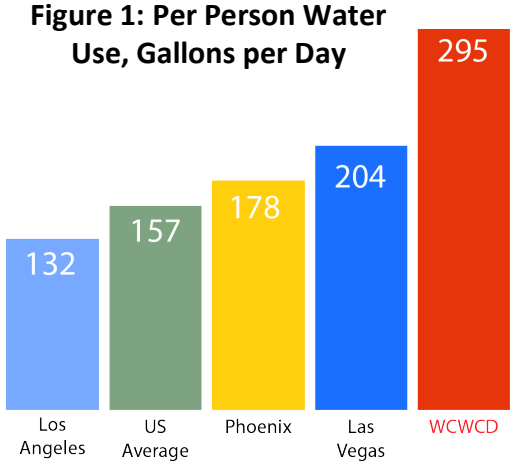
Year	Area[a] (Acres)	Diversions (acre-feet)	Depletions (acre-feet)
1990	25,600	123,300	51,300
2020	21,400	96,300	43,300
2040	18,600	80,000	37,600

aIncludes some idle land.

WCWCD claims only 10,080 ac-ft of water will be available for municipal use from the conversion of agricultural lands as a function urban growth, yet the 1993 KCVRBP projects there will be 27,100 acre-feet made available by 2040.

1.c Potential Water Conservation Savings. According to the 2011 DWRe Water Needs Assessment, WCWCD uses 295 gallons per capita per day ("GPCD"; p. ES-7) and had 13 percent water conservation savings from 2000–2009 (p. ES-10). If WCWCD encouraged residents to get closer to neighboring cities or the state conservation goal of 220 GPCD,[4] the district could extend its water supply even further into the future.

Figure 1: Per Person Water Use, Gallons per Day



Since WCWCD's per person water use is nearly twice the national average, it is clear there is great potential for additional water conservation efforts.

The recent legislative audit noted:

> *"The Southern Nevada Water Authority, which serves the Las Vegas region, has a goal to reduce water use to 199 by 2035. In contrast, the communities in Southwestern Utah, which have a climate similar to that of Southern Nevada, have a goal to reduce water use to 292 GPCD by the year 2060."*[5]

[4] Utah baseline per capita water use: http://state.awra.org/utah/sites/default/files/AdamsMillis-WaterNeeds.pdf.
[5] "A Performance Audit of Projections of Utah's Water Needs," Office of the Legislative Auditor General, May 2015, Page 41. http://le.utah.gov/audit/15_01rpt.pdf

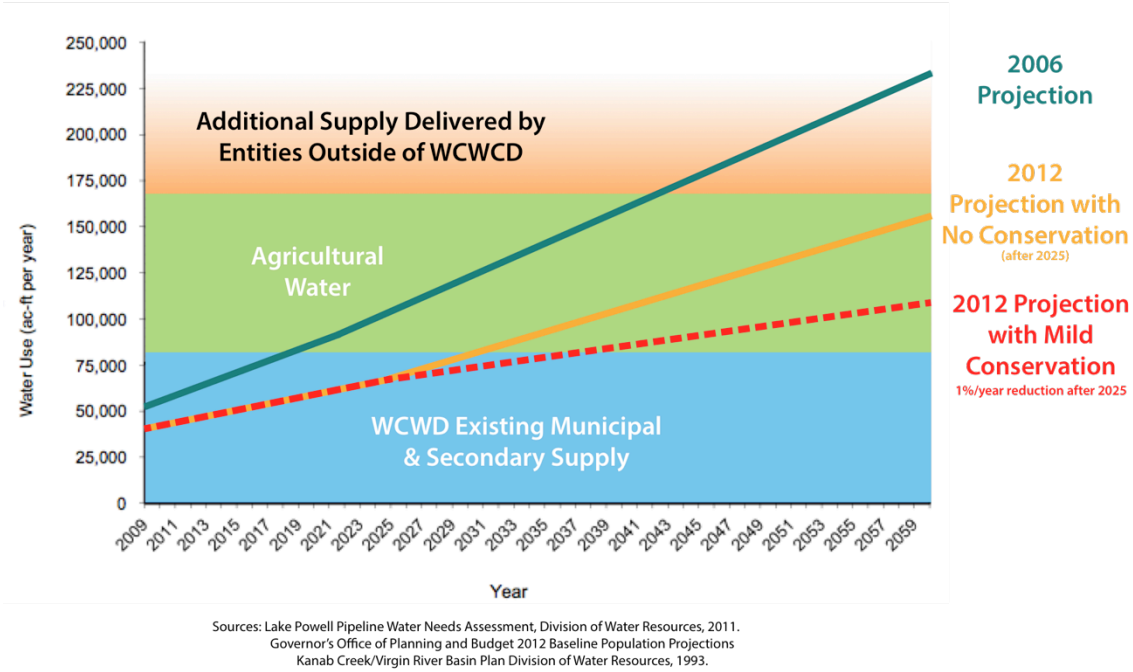


Figure 2: Population projections from the Governor's Office of Planning & Budget demonstrate reduced water demand for Washington County. The recent Legislative Audit of water needs projections questioned the conservation efforts of Utah and criticized the DWRe for not including local sources of water available outside of WCWCD supplies in planning documents. The dotted red line shows water demand if per capita water use was reduced each year after 2025 by 1 percent of the 2025 level.

1d. Previously Unconsidered Water Sources. According to a May 2015 bond rating update for WCWCD from Fitch Ratings:

> "The district has ample water supply, is expanding its water reserves through a groundwater recharge program, enjoys surplus system capacity, operates predominantly new infrastructure, and faces no known regulatory issues."

The District noted it operates a groundwater recharge program that currently provides 100,000 acre-feet of water and will provide access to up to 300,000 af in the future.[6] This amount of water more than twice the District's supply, yet is not accounted for in the LPP planning documents.

The 2015 Legislative Audit of the state sponsor of the Lake Powell Pipeline, the Utah Division of Water Resources, showed that water planners are ignoring the fact that local water providers have the ability to expand their own sources of water supply. The auditors noted St. George has the ability to expand its water supply without the assistance of WCWCD through new well drilling and other sources.[7] These future water sources were also not included in the LPP planning documents.

[6] "Fitch Affirms Washington County Water Conservancy Dist, UT's LTGOs at 'AA+'; Outlook Stable" Business Wire, May 22, 2015. http://www.businesswire.com/news/home/20150522005845/en/#.VW88PufqITk

[7] "A Performance Audit of Projections of Utah's Water Needs," Office of the Legislative Auditor General, May 2015, Page 62. http://le.utah.gov/audit/15_01rpt.pdf

2.Estimate of Existing Revenues vs. Debt Service for WCWCD.

One important question is whether or not local taxpayers can support Washington County's repayment obligation for the LPP as is required by Utah Law. The Lake Powell Pipeline (LPP) Development Act (Utah Code 73-28-402) mandates the entire project cost be repaid to the State of Utah with interest.

Repayment of the LPP construction costs requires the District's total revenues to cover their existing operation and maintenance costs, preexisting debt obligations, debt from LPP construction, and the operation and maintenance costs associated with the LPP.

A review of the WCWCD's revenue streams is warranted, based on the 2013 Audited Financial Statement Prepared for WCWCD, the "2013 WCWCDAFS".[8]

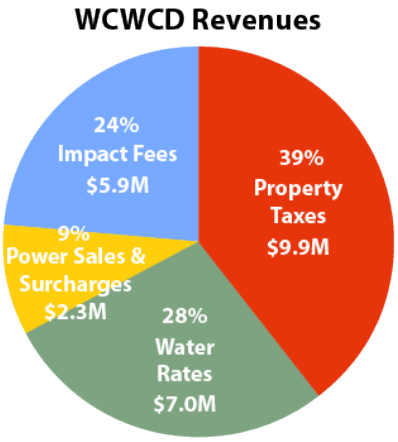


Figure 3: Revenue Sources from 2012 Audited financial statement from WCWCD

2a. Current Revenues

Operating Revenues. WCWCD received $7,013,377 in water sales revenue, $926,134 in power sales revenues and $1,379,171 in Water Development and Connection Fees (page 22 of the 2013 WCWCDAFS). These last two categories are represented as "Power Sales & Surcharges" in the above pie chart.

	2013
OPERATING REVENUES:	
Power Sales	$ 926,134
Water Sales (net of rebates)	7,013,377
Water Development and Connection Fees	1,379,171
Total Revenues	9,318,682

Property Tax Revenues. In 2013 WCWCD collected $9,938,660 from property taxes (see the source in the next paragraph). Its levy rate was 0.000970544 times the taxable value of the county (p. 19 of the 2013 WCWCDAFS).

Impact Fee Revenues. WCWCD collected $5,919,316 in impact fees for new development in 2013 (page 19 of the 2013 WCWCDAFS):

	General Fund	Virgin River Program	Capital Projects Fund	Total Governmental Funds
REVENUE:				
Property Taxes	$ 9,938,660	$ -	$ -	$ 9,938,660
Impact Fees - Current Year	-	-	5,919,316	5,919,316

[8] "Washington County Water Conservancy District Financial Statement With Other Government Reports For the year ending June 30, 2013."

Revenues from Sale of WCWCD's Surplus Real Property. According to page 7 of the 2013 WCWCDAFS, the District has between 1000–1200 acres in real property that can be sold at market value for additional funds. The District claims this property is valued between $50,000–$125,000 per acre. For this analysis it was assumed the District would sell 1200 acres at the highest market value to help pay for the LPP, giving the district a one-time revenue source of $150,000,000.

> The District owns real property which is shown on the books at cost. Approximately 1000 - 1200 acres may eventually be declared surplus property and sold at market value. The current fair market value for this property is $50,000 to $125,000 per acre. It is anticipated that the value will continue to increase over time. These values are not reflected in the statement of net position.

2b. Existing Debt Service by WCWCD (not including LPP). The WCWCD has $7,026,322 in annual debt service for previous obligations for FYE 2013, not including debt from the Lake Powell Pipeline, as shown on the 2014 row of the District's debt service schedule (p. 39 of the 2013 WCWCDAFS). This non-LPP debt service increases annually through 2037 before being extinguished in 2050, totaling $94.3 million. The District's debt schedule is included below.

Total remaining principle and interest debt service by year is as follows:

Year Ending December 31	Principal	Interest	Annual Debt Service
2014	$ 4,235,743	$ 2,790,579	$ 7,026,322
2015	4,422,856	2,616,602	7,039,458
2016	4,580,005	2,468,102	7,048,107
2017	4,780,193	2,268,125	7,048,318
2018	4,992,420	2,058,228	7,050,648
2019	4,599,688	1,851,402	6,451,090
2020	4,784,997	1,671,335	6,456,332
2021	4,657,349	1,481,231	6,138,580
2022	3,810,746	1,284,484	5,095,230
2023	3,999,189	1,102,551	5,101,740
2024	4,197,680	911,505	5,109,185
2025	4,380,220	719,745	5,099,965
2026	2,658,811	519,539	3,178,350
2027	2,782,454	396,541	3,178,995
2028	2,921,151	267,724	3,188,875
2029	1,653,905	132,385	1,786,290
2030	1,556,716	53,744	1,610,460
2031	1,558,587	51,873	1,610,460
2032	1,560,520	49,940	1,610,460
2033	1,562,516	47,944	1,610,460
2034	64,578	45,882	110,460
2035	66,709	43,751	110,460
2036	68,909	41,551	110,460
2037	71,183	39,277	110,460
2038	73,532	36,929	110,461
2039	75,956	34,504	110,460
2040	78,462	31,998	110,460
2041	81,051	29,409	110,460
2042	83,724	26,736	110,460
2043	86,486	23,974	110,460
2044	89,339	21,121	110,460
2045	92,286	18,174	110,460
2046	95,331	15,129	110,460
2047	98,476	11,984	110,460
2048	101,724	8,736	110,460
2049	105,080	5,380	110,460
2050	108,340	2,118	110,458
Totals	$71,136,912	$23,180,232	$94,317,144

WCWCD existing debt schedule, not including LPP debt.

2c. Existing Operation and Maintenance Expenses. In addition to its debt obligations, WCWCD has operating and maintenance expenses, totaling $13,231,636 according to the 2013 WCWCDAFS. These expenses are assumed to grow proportionally to the number of new households in the county, shown in the attached spreadsheet's Column J[9]. Operating and maintenance costs have been included as part of LPP participation in Column L. Our estimates of WCWCD Total Expenses are shown in Column N[10].

3. Estimate of Additional Debt Service from the Lake Powell Pipeline on WCWCD

3a. 50-Year Repayment Obligation for Lake Powell Pipeline by Washington County Taxpayers. The following is the calculation of total annual debt service the WCWCD would incur to participate in the LPP. The WCWCD has announced they intend to receive 94.5 percent of the project water[11], meaning they will be required to repay 94.5 percent of the roughly $1.4–$1.8 billion cost.[12] The WCWCD can therefore expect to repay $1.33 billion – $1.75 billion in capital costs to repay. Assuming a 50-year repayment period, the annual debt service varies with the interest rate as follows:

Annual Debt Service Payments for LPP
by the Washington County Water Conservancy District

	Interest Rate			
Repayment Cost	**0.03**	**0.04**	**0.05**	**0.07**
$1.33 Billion	$51,631,330	$61,840,170	$72,758,808	$96,260,153
$1.75 Billion	$101,799,606	$130,945,384	$166,211,969	$258,354,138

In other words, the repayment obligation from the LPP will add between $51.6 and $258 million in additional annual debt burden onto WCWCD's existing debt service, depending on final project cost and interest rate. A reasonable assumption for a 50-year interest rate is 4 percent, meaning an additional $61.8–131 million in new annual debt payments due to the LPP, shown in the attached spreadsheet's Column K.

3b. LPP Power Generation Revenues and Operation and Maintenance Costs. The different cost estimates put forward in the 2012 Lake Powell Pipeline Modified Draft Study Report 10 are due to different levels of pump-storage power generation capacities presented in the planning documents. The $1.8 billion cost estimate generates more power sales revenues than the $1.4 billion project cost projection, but also requires much more operation and maintenance costs. The expected revenues and expenses can been seen here:

Construction Cost	**2026 Power Sales Revenue**	**2026 Operation and Maintenance Expenses**
$1.4 Billion	$9,947,747	$23,493,231
$1.8 Billion	$72,005,740	$62,867,794

[9] The First and Second Scenarios in the spreadsheet represent the low and high cost estimates of the LPP project assumed in our analysis. Existing revenues and expenses of the District were assumed to stay the same in both scenarios (Columns B-F). Differences in the two project cost scenarios resulted in changes to the debt associated with the project (Columns G-P) and the repayment options (Columns Q-V).
[10] Note: Columns K and L differ between the two project cost scenarios.
[11] 69,000 af / 73,000 af, Page ES-5, 2011 LPP Water Needs Assessment. (For the CICWCD see "Iron County pulls out of Lake Powell pipeline project," Salt Lake Tribune, March 22, 2012.)
[12] Lake Powell Pipeline Modified Draft Study Report 10, Socioeconomic and Water Resource Economics, February 2012

Based on the expected growth of existing revenue streams due to population increase in the county, WCWCD's revenues can be projected over the next 50 years, as shown in Column H. The deficit schedule for the repayment period can be seen in Columns O and P. These columns show that the District's revenues fall significantly short of the District's expenses for every year of the 50-year repayment schedule (except for any initial payment-free years). Unless the District has an increase in revenues, WCWCD's cumulative debt would grow to between $5.84–6.76 billion (cell P73) by the end of the project repayment period. Clearly, participation by the WCWCD in the LPP will require significant increases in impact fees and/or water rates.

4. Water Rate and Impact Fee Increases Required to Repay Debt

The fundamental question is whether the WCWCD can make these debt payments via an increase in revenue[13], and if so how they will raise this revenue.

Increasing Property Taxes. According to Utah law, water conservancy districts in the Lower Colorado River Basin may not tax higher than 0.001 per dollar of taxable value of taxable property in the district.[14] WCWCD currently collects property taxes at the rate of 0.00097. However, even if WCWCD increased their levy to the maximum collection rate, this only increases revenues $301,642 and revenues would still fall short of their expenses by tens of millions of dollars each year, accumulating to a deficit of billions dollars at the end of the 50-year repayment period. Therefore increasing water rates and/or impact fees must also be implemented by WCWCD.

Increasing Water Rates. Columns Q and R examine whether increasing water rates alone, without any impact fee increases, could repay Washington County Water District's total future debt. Although one might think the WCWCD could simply increase water rates to raise revenues, raising water rates will result in a decrease in total water demand. Because the debt is relatively large, in order for water sales to cover the debt obligations of the project, water sales revenues would need to increase by 320–358 percent, depending upon the total cost of the LPP (spreadsheet cell B10). This would still require the WCWCD to shoulder significant deficits over time, but would result in a balance of essentially zero in 2063 (Columns Q and R; cell R73).

Due to the fact that the price elasticity of demand for water is estimated to be -0.5, repayment through water sales alone would require rate increases of 1665–1995 percent (cell B12). This enormous increase in water rates would lead Washington County water users to need less water in 2060 than they used in 2010 (cells O12 and AA12 of the "Water Demand" worksheet), meaning that there would be no need for the water supplied by the LPP. In other words, if the LPP is financed only by increasing water rates, water would become so expensive that future water demand would drop below the current water demand of WCWCD,[15] even if one ignores other water sources identified above.

Increases in water rates may slow the rate of population growth in Washington County, which would make the LPP both harder to pay back and less necessary. To avoid this and maintain the desirability of homes and building lots in Washington County in the face of increases in water rates, the price of that real estate would have to fall. The lower property values would decrease the

[13] In the low-cost scenario, we assumed repayments start immediately, which keeps costs as low as possible. In the high-cost scenario, we assumed repayments begin after a delay of 10 years, which is more realistic and raises costs.
[14] Utah Code, Section 17B-2a-1006. http://le.utah.gov/code/TITLE17B/htm/17B02a100600.htm
[15] This is because cell B11 is larger than cell B8 in both scenarios.

property taxes collected by the District, forcing water rates to go up more than anticipated and forcing real estate values to go down more than anticipated.

Increasing Impact Fees. Columns S and T examine whether increasing impact fees alone, without any additional revenue increases, could repay Washington County Water District's total future debt. Impact fees are the fees new development pays to hook up to the water system, and there has been some discussion about making debt payments through an increase in impact fees. Currently WCWCD has an average impact fee of $6,102[16] and if the District chose to repay debt just using impact fees, revenues from impact fees would need to increase by 247–276 percent (cell B15), requiring an average impact fee of between $21,158–$22,927 (cell B17).

The large impact fees required in Washington County would be among the highest in the nation,[17] likely deterring new growth in the county or significantly lowering property values (or both). Both effects would add even more problems for WCWCD's repayment obligations: the first would lower the amount of impact fees collected, and the second would lower property values and lower the total property taxes collected by the district. Our analysis did not compensate for these factors.

Combination of Increased Water Rates and Impact Fees. The significant debt to participate in the LPP will require WCWCD to raise revenues by tens of millions of dollars every year**.** The District's only real flexibility in raising revenues for its debt payments comes from deciding the proportion of increased revenues, which will come from increased water rates versus from increased impact fees.

Participating in the $1.4 billion low-cost alternative of the Lake Powell Pipeline from 2012 Socioeconomics and Water Resource Economics Report could require the WCWCD to raise its revenues by:

- raising impact fees 123 percent (spreadsheet cell B21), to an average of $13,630 per connection (spreadsheet cell B22); together with
- raising water rates by 576 percent (spreadsheet cell B20); together with
- selling 1200 acres of land owned by the District; and with
- continuing to collect property taxes near the maximum levy rate allowed by state law.

Participating in the $1.8 billion high-cost alternative of the Lake Powell Pipeline from 2012 Socioeconomics and Water Resource Economics Report could require the WCWCD to raise its revenues by:

- raising impact fees 138 percent (cell B21), to an average of $14,514 per connection (cell B22); together with
- raising water rates by 678 percent (cell B20); together with
- selling 1200 acres of land owned by the District; and with
- continuing to collect property taxes near the maximum levy rate allowed by state law.

In addition, the 576–678 percent increase in water rates means that Washington County water users would demand more than their current water demand[18] but only 84–90 percent of their current water supply in 2060 (worksheet "Water Demand" cells U11 and AG11), so there would be no need for LPP water.

[16] 2013 WCWCD Audited Financial Statement

[17] 2012 National Impact Fee Survey, Duncan Associates: http://www.impactfees.com/publications%20pdf/2012_survey.pdf

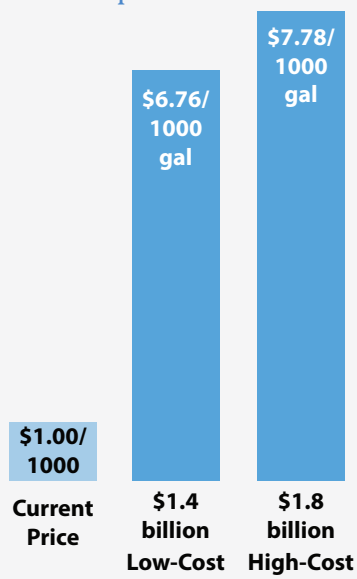
[18] This is because cell B19 is smaller than cell B8 in both scenarios.

Water Rate and Impact Fee Increases from LPP

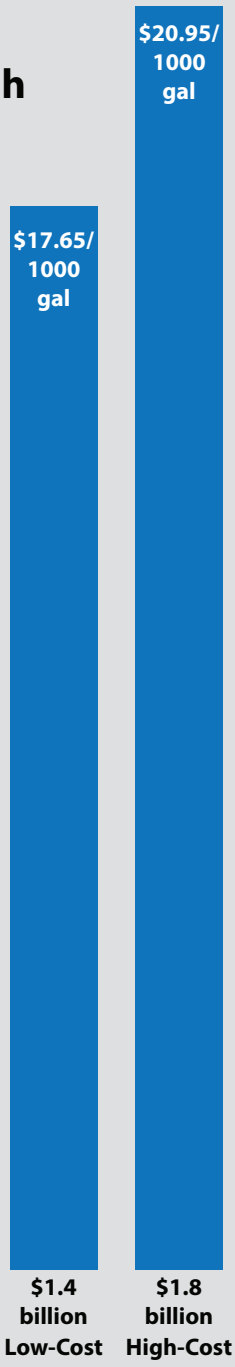
Debt Repaid with Impact Fees and Water Rates

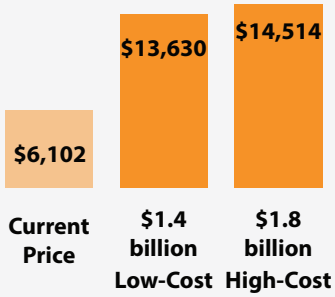
Figure 4: The WCWCD would be required to increase revenues substantially to cover annual LPP debt payments. Since WCWCD cannot raise taxes further, this increase in revenues would have to come from water rates and/or impact fees.

The right side of this graphic shows the increases required by WCWCD if they chose to only increase revenues from one source to repay the debt (cells B12 & B17). The left side of this graphic shows the increases required if WCWCD shifted the increases proportionally on the revenue sources (cells B20 & B22) The upper and lower parts of the graphic show the water price increases and impact fee increases required respectively.

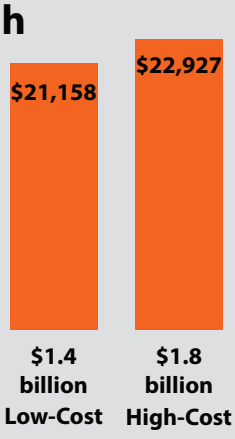


Water Rate Increases
*Typical Washington County City





Impact Fee Increases



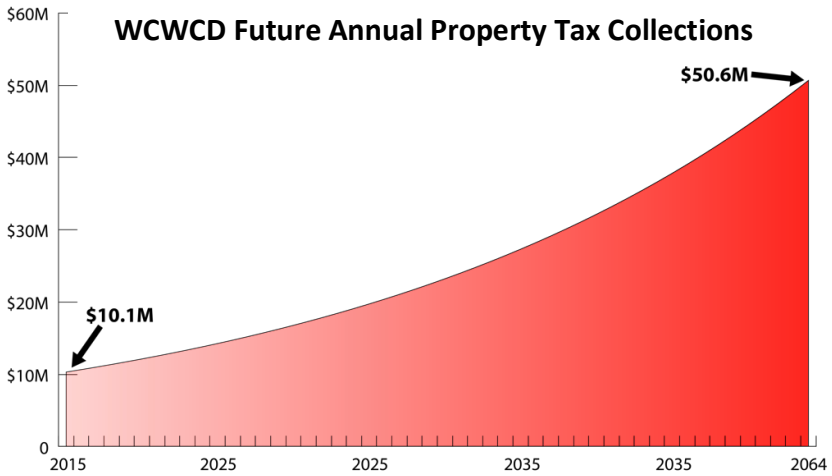


Figure 5. Since WCWCD's property tax collections are already near their maximum authorized levy amount, the future growth in property tax revenues will come from population growth (column B). Yet even with this increase in revenues the District must increase water rates and impact fees considerably to repay the annual debt from the Lake Powell Pipeline.

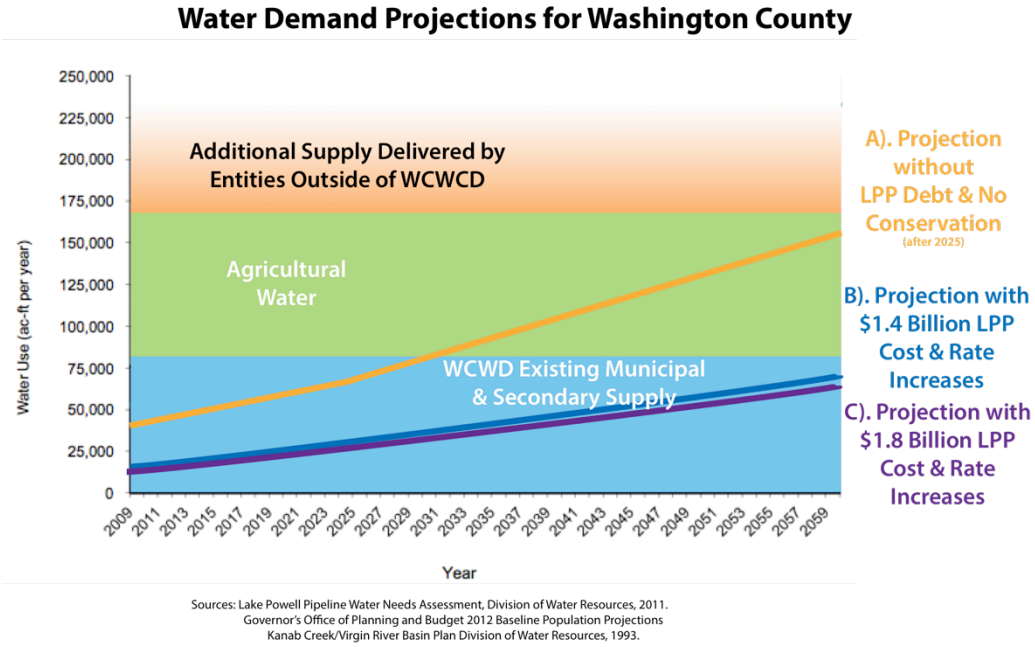


Figure 6. A). 2012 water demand projection for Washington County, which does not include the effect increased water rates would have on reducing water use. This projection assumes no additional water conservation after 2025, keeping water use at 241 GPCD until 2060. This is also the projection if the LPP is only paid for with impact fees.
B). Under the $1.4 billion LPP cost projection, WCWCD's water demand would decrease by 62% due to increased water rates to repay LPP debt (cell J21). This calculation assumes half the LPP debt would be paid through increased water rates and the other half through increased impact fees.
C). Under the $1.8 billion LPP cost projection, WCWCD's water demand would decrease by 64% due to increased water rates to repay LPP debt (cell J21). This calculation assumes half the LPP debt would be paid through increased water rates and the other half through increased impact fees.

5. Washington County Water District does not have a current repayment plan.

The most recent repayment plan for the LPP project was in the Regional Water Capital Facilities Plan and Impact Fee Analysis from 2006[19]. The 2006 CFP has many problems as it relies on data that is nearly a decade old, including growth projections made before the 2008 economic downturn. The 2006 CFP completely relied on impact fees for repayment of the project, increasing the fees by 5 percent per year to increase revenues. This impact fee increase is not sufficient to repay the WCWCD debt, as shown in Section 4 above.

The plan also relied on an outdated cost estimate for the LPP project of $562 million. Newer documentation shows the project will cost between $1.4 billion and $1.8 billion.

Despite these many problems, the WCWCD continues to rely on this plan to set their impact fee schedule. Due to the decrease in expected new growth in the area and the higher LPP construction costs, the fund is far behind where it should be to repay the project. The 2006 CFP projected the Impact Fee Fund balance to be $113,770,522 but in reality the 2013 WCWCDAFS showed the district had only $44,839,323, 61 percent lower than planned in the 2006 CFP.

6. 'Pay-As-You-Go' Repayment Concept Creates Large Subsidy Funded by State Taxpayers

In public discussions related to the repayment problems of the proposed Lake Powell Pipeline, water officials from the Division of Water Resources and the WCWCD coined a repayment concept called "Pay-As-You-Go." In a 2008 correspondence between WCWCD and the Division of Water Resources, the District's General Manager outlined this pay-as-you-go concept, asking for confirmation from the Division about the proposal. The concept would allow the WCWCD to defer paying for the entire project by instead buying smaller portions of the Lake Powell Pipeline's water, which they refer to as "blocks." According to these officials, the District would only pay the costs and interest associated with one small block of water at a time. This would leave the rest of the unused water and its costs to collect interest without any repayment for decades. This letter from WCWCD's general manager explicitly stated that he believed,

> *"No interest would be charged until such time as the actual contract to take the water occurs."*[20]

This was echoed and confirmed in correspondence from the Division of Water Resources.[21] The letters stated that WCWCD would not be required to pay interest on the entire project and would only have to pay interest on small blocks of the project which could be purchased at any point during the first 50 years after the project's completion. This would defer paying interest on the entire project, leaving the State of Utah holding billions of dollars of debt for an indeterminate amount of time.

[19] WCWCD Capital Facilities Plan, 2006.
[20] August 14, 2008 Letter from the General Manager of WCWCD to the Director of the Division of Water Resources.
[21] October 14, 2008 Letter from the Director of the Division of Water Resources to the General Manager of WCWCD.

Yet according to the LPP Development Act,

> *"The board [of Water Resources] shall establish and charge a reasonable interest rate for the unpaid balance of reimbursable preconstruction and construction costs."*[22]

We interpret this to mean that if "Pay-As-You-Go" is allowed—and we do not know whether it is allowed under the LPP Development Act—then any due-but-unpaid interest must be added to the principal owed by WCWCD, so that the due-but-unpaid interest must be paid back later with interest (a process called "negative amortization"). Our spreadsheet is constructed using this assumption. By making the District's repayment schedule to the State uncertain and conditional on how the District's wishes to take water during the next few decades, this "negative amortization" interpretation of "Pay-As-You-Go" increases the uncertainty of the State's financial condition during those decades, to the detriment of the State and, potentially, to the detriment of the State's bond rating.

In addition, if the District discovered the LPP water was not needed after all, as seems likely, the District might never buy LPP water, leaving the State to pay all the costs of the project. In the free market, a lender would not loan money without a documented income stream, and that would be a prudent policy for the State of Utah to follow when it lends.

The alternative to the "negative amortization" interpretation of "Pay-As-You-Go" is to forgive the interest for the Lake Powell Pipeline. This scenario would be much worse for the State and its bond rating since it would constitute an interest-free loan of billions of dollars for several decades from Utah taxpayers to the District. Such a lending scenario is completely alien to free-market lenders (except in bankruptcy proceedings, when attempting to recover funds that in hindsight were imprudently lent). The only grounds upon which interest forgiveness could be justified would be as a permanent subsidy from the State to the District, which would certainly violate the intent of the LPP Development Act. Accordingly, the "permanent interest forgiveness" interpretation of "Pay-As-You-Go" is irrelevant to LPP financing.

7. Consideration of the Public Bond Market

The USA has a deep and sophisticated municipal bond market whose participants are, for the most part, better equipped than anyone else to decide whether repayment plans for a public project are sound. The best solution would be for the WCWCD to go to those markets, instead of to the State of Utah, for LPP financing. If the markets decide the WCWCD's LPP financing scheme is sound, the markets will happily supply the needed funds. Otherwise, the market will have judged the WCWCD's LPP financing scheme unsound, and that judgment should stand.

[22] Utah Code, Section 73-28-403.

Appendices

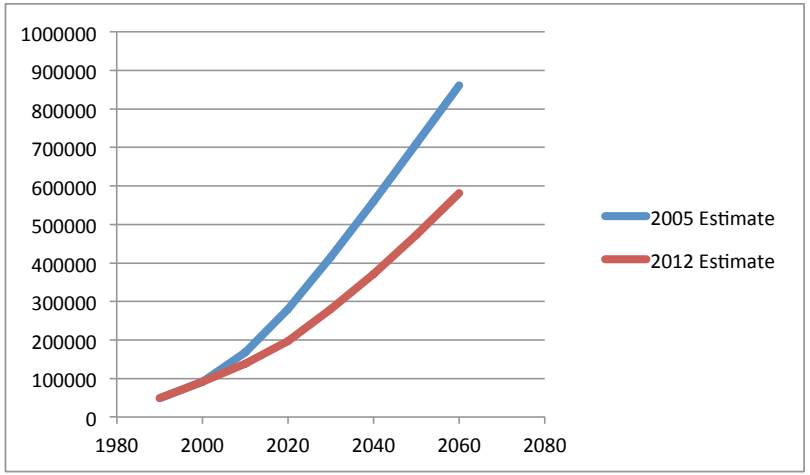
Appendix A

Washington County, UT Population Projections

GOPB Estimates	1990	2000	2010	2020	2030	2040	2050	2060
2005 Estimate	48,978	91,090	168,078	279,864	415,510	559,670	709,674	860,378
2012 Estimate	48,978	91,090	138,748	196,762	280,558	371,743	472,567	581,731
# Households (est. 2012)	15,481	30,191	46,545	70,919	112,378	151,647	192,884	237,065

To solve for geometric growth rates: x_2060 = x_2010 * Exp(r * (2060-2010)) and solve for r.
But that is for continuous compounding. For annual compounding:
x_2060 = x_2010 * (1+r)^(2060-2010) and solve for r.
=> Exp[Ln(x_2060/x_2010) / (2060-2010)] - 1 = r.
Also, for annual compounding, x_t = x_0 * (1+r)^t implies that
x_(t+1) - x_t = x_0 * (1+r)^t * r = x_t * r.

190,520	change in households
0.03309412	Annually Compounded Household Growth Rate, 2010--2060
0.02908183	Annually Compounded Population Growth Rate, 2010--2060



Source: GOPB 2012 Population Projections

Appendix B
Present Value Calculations

Data from the Draft Socioeconomics and Water Resource Economics Study Report

4.00% interest rate declared in the "First Scenario" (its N11)
4.00% interest rate declared in the "Second Scenario" (its N11)
4.00% interest rate used on this page for our calculations (not for the Draft Report calculations, which are B6, I6, B23, and I23)
2.50% FERC "escalation rate" (rate of benefit & cost increases) to be used in Scenario pages

Page 5-3, Table 5-1, No Pump Storage

4.14% Discount Rate
2.50% Escalation Rate

	PV, 2010$	***Annual, 2026***	***PV, 2015$***	
Benefits				
Power-Inline	45,167,000	2,587,006		from equation 5
Power-Pump Stations	127,587,000	7,307,733		from equation 5
Costs				
Capital Construction	1,124,717,000		1,402,458,713	from equation 6
Operation, Maintenance & Replacement	72,908,000	4,175,913		from equation 5
Power Opers.	284,353,000	16,286,737		from equation 5
Foregone Power	58,401,000	3,345,003		from equation 5

Page 5-4, Table 5-2, No Pump Storage

3.00% Discount Rate
2.50% Escalation Rate

	PV, 2010$	***Annual, 2026***	***PV, 2015$***	
Benefits				
Power-Inline	69,561,000	2,909,678		from equation 5
Power-Pump Stations	197,255,000	8,251,011		from equation 5
Costs				
Capital Construction	1,227,349,000		1,409,367,477	from equation 6
Operation, Maintenance & Replacement	95,113,000	3,978,497		from equation 5
Power Opers.	435,664,000	18,223,458		from equation 5
Foregone Power	88,843,000	3,716,228		from equation 5

For Washington County's share of these, see tab "Revenues and Expenses"

Avg. of 2 cases ***Annual, 2026***	***Avg. of 2 cases*** ***PV, 2015$***		
		Benefits	disagreement (ratio)
2,748,342		Power-Inline	0.89
7,779,372		Power-Pump Stations	0.89
10,527,714		*sum*	
		Costs	
	1,405,913,095	Capital Construction	0.995098
4,077,205		Operation, Maintenance & Replacement	1.05
17,255,098		Power Opers.	0.89
3,530,616		Foregone Power	0.90
24,862,918		*sum*	

Page 5-5, Table 5-3, Pump Storage Configuration

4.14% Discount Rate
2.50% Escalation Rate

	PV, 2010$	***Annual, 2026***	***PV, 2015$***	
Benefits				
Power-Inline	45,167,000	2,587,006		from equation 5
Power-Pump Stations	1,261,042,000	72,228,037		from equation 5
Costs				
Capital Construction	1,482,378,000		1,848,441,823	from equation 6
Operation, Maintenance & Replacement	96,015,000	5,499,401		from equation 5
Power Opers.	284,353,000	16,286,737		from equation 5
Power Pump Station Opers.	700,345,000	40,113,291		from equation 5
Foregone Power	58,401,000	3,345,003		from equation 5

Page 5-6, Table 5-4, Pump Storage Configuration

3.00% Discount Rate
2.50% Escalation Rate

	PV, 2010$	***Annual, 2026***	***PV, 2015$***	
Benefits				
Power-Inline	69,561,000	2,909,678		from equation 5
Power-Pump Stations	1,785,425,000	74,682,825		from equation 5
Costs				
Capital Construction	1,617,637,000		1,857,536,020	from equation 6
Operation, Maintenance & Replacement	125,256,000	5,239,353		from equation 5
Power Opers.	435,664,000	18,223,458		from equation 5
Power Pump Station Opers.	971,635,000	40,642,674		from equation 5
Foregone Power	88,843,000	3,716,228		from equation 5

Avg. of 2 cases ***Annual, 2026***	***Avg. of 2 cases*** ***PV, 2015$***		
		Benefits	
2,748,342		Power-Inline	0.89
73,455,431		Power-Pump Stations	0.97
76,203,774		*sum*	
		Costs	
	1,852,988,922	Capital Construction	0.995104
5,369,377		Operation, Maintenance & Replacement	1.05
17,255,098		Power Opers.	0.89
40,377,983		Power Pump Station Opers.	0.99
3,530,616		Foregone Power	0.90
66,533,073		*sum*	

Appendix C
WCWCD Revenues & Expenses

WCWCD Revenue Stream

Source: 2013 WCWCD Audited Financial Statement

Property Tax	$9,938,660
Impact Fees	
Total	$5,919,316
Cost per ERU	$6,102
Total New 2013 ERU's	970
Water Availability Surcharge	
Fee/ ERU	$1.75
2013 Total	$1,248,977
Total ERU's	713,701
2013 ERU Growth	0.001359199

Total Service Area Property Valuation	$10,240,302,002
2013 Property Tax Collection Rate	0.000970544
Maximum Legal Property Tax Rate	0.001
Additional Revenue if use Max. Rate	$301,642.00

Note: Equivalent Residential Unit (ERU) is the metric used to determine cost of impact fee per lot, equivalent to 1 ERU per 10,000 sq. ft. of irrigable land

Note: The Water Availability Surcharge is charged to all water bills as a monthly fee

WCWCD Revenue Stream

Source: 2013 WCWCD Audited Financial Statement

Long Term Debt	
Notes Payable	$1,165,000
GO Bonds	$2,680,000
Revenue Bonds	$67,291,912
Total	$71,136,912
Total with interest	$94,317,144
2013 Debt Payments	$7,026,322
Operating Expenses	
General Government	$4,443,620
Water and Power Utilities	$8,788,016
Total Operating Expenses	$13,231,636
Total Expenses	$20,257,958

Operating Revenues

Power sale revenue	$926,134	
water sales revenue	$7,013,377	
Water Development and Connection Fees	$1,379,171	$2,305,305
Total Operating Revenues	$9,318,682	

Real Property

Acres	1000	Annual	1200	Annual
Low Value	$50,000,000	$1,000,000	$60,000,000	$1,200,000
High Value	$125,000,000	$2,500,000	$150,000,000	$3,000,000
Average	$87,500,000	$1,750,000	$105,000,000	$2,100,000

According to page 7 of the 2013 WCWCDAFS the District has between 1000-1200 acres in real property that can be sold at market value for additional funds. The District claims this property is valued between $50,000-$125,000 per acre.

LPP Capital Costs

KCWCD	$53,200,000	
WCWCD	$912,500,000	Source: Facts: Lake Powell Pipeline Project - WCWCD (2012)
Total	$965,700,000	**0.94491043** WCWCD share of capital costs
(Baseline NED Assumptions)	$1,328,461,944	Source: 2012 Draft Study Report 10: Socioeconomics and Water Resource Economics - Page 5-3
FERC High Cost Estimate for WCWCD (Pump Storage Social Time Preference)	$1,750,908,555	Source: 2012 Draft Study Report 10: Socioeconomics and Water Resource Economics - Page 5-6

LPP Operation and Power Costs

Note: Since WCWCD is responsible for 94.5% (N5) of capital costs, it was assumed they would be responsible for 94.5% of OM&R costs.

FERC Low Cost Estimate for WCWCD (Baseline NED Assumptions)	$23,493,231	Source: 2012 Draft Study Report 10: Socioeconomics and Water Resource Economics - Page 5-3
FERC High Cost Estimate for WCWCD (Pump Storage Social Time Preference)	$62,867,794	Source: 2012 Draft Study Report 10: Socioeconomics and Water Resource Economics - Page 5-6

LPP Annual Power Revenues

FERC Low Cost Estimate for WCWCD (Baseline NED Assumptions)	$9,947,747
FERC High Cost Estimate for WCWCD (Pump Storage Social Time Preference)	$72,005,740

Appendix D

Repayment Obligation Scenarios

Scenario 1 - $1.4B Cost Option

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1		$9,938,660	2013 Property Tax Collections												Scenario A	Scenario B	DSWRESR!I3 gives the FERC "escalation rate"					
2		$7,013,377	2013 Water sale revenue Revenue												FERC Low Cost	FERC High Cost Estimate						
3		$6,102	2013 Impact Fee per ERU											Cost Estimate	$1,328,461,944	$1,750,908,555						
4		0.03309	GOPB 50-Year Household Growth Rate Projection										LPP O&M Costs (Column K)		$23,493,231	$62,867,794						
5		1.03309	GOPB 50-Year Household Growth Rate Projection, plus one.										LPP Power sale revenue (Column F)		$9,947,747	$72,005,740						
6		1.040	<- enter 1 plus assumed interest rate on reserves											A	<- enter A or B (capitalized) for which Scenario you want to analyze							
7			Q ∝ P^(-1/2) is the assumed demand curve, so revenues R = P^(1/2), so to increase R by a factor of "x" requires P to go up by a factor of "x^2".											$1,328,461,944	Loan Amount							
8		5.09324	If price rises by a factor > this, (Q_2060 under new water price) < (Q_2010 under current water price).											2064	year when all debt has to be paid back							
9			**Given unchanged impact fees:** (see Column P)											2015	initial year of spreadsheet							
10		3.20085	The factor by which water sale revenue needs to increase to eliminate the debt by 2062, minus one											0	<- enter number of initial payment-free years (can be zero); water rates & impact fees don't change during this time							
11		4.20085	The factor by which water sale revenue needs to increase to eliminate the debt by 2062.											4%	<- enter interest rate							
12		17.64717	The factor by which water prices need to increase to eliminate the debt by 2062.											50	years allowed for paying back the loan							Total Expected Project Costs Cost w/ interest and O&M
13		0.23805	The factor by which water demanded will change vs. base case when water prices rise enough to eliminate debt by 2062 (since revenue = PQ ∝ B5^(-2t) Q^(-2) Q = B5^(-2t) (1/Q)).											$1,328,461,944	Loan Amount after initial years of negative amortization							$3,092,008,489 minus power sale revenue
14			**Given unchanged water prices:** (see Column R)											61,840,170	Annual Debt Service							$3,092,008,489
15		2.46738	The factor by which Impact Fees need to increase to eliminate the debt by 2062, minus one.											If either this ->	($0)	or this ->	$0	is not zero,				
16		3.46738	The factor by which Impact Fees need to increase to eliminate the debt by 2062.											click on this button ->	RECALCULATE	to make them zero.						
17		$21,158	2013 average Impact Fee per ERU, if Impact Fees increased as much as needed to eliminate the debt by 2062.											(This will ensure that R75 and T75 change in order to make Q73, S73, and hence U73 equal to zero.)								
18			**Given Split Between Impact Fees and Water Rates:** (see Column T)										50%	<- enter Impact Fees' portion of Split financing								
19		2.60043	The factor by which water sale revenue needs to increase to eliminate the debt by 2062.										50%	Water Rates								
20		6.76222	The factor by which water prices need to increase to eliminate the debt by 2062.																			
21		2.23369	The factor by which Impact Fees need to increase to eliminate the debt by 2062.							0.38	The factor by which water demanded will change vs. base case if water prices behave this way.											
22		$13,630	2013 average Impact Fee per ERU, if Impact Fees increased as much as needed to eliminate the debt by 2062.																			
23	Year	Property Taxes	Water sale revenue	Power sale revenue and Surcharges	Impact Fees	Real Estate sale revenue	LPP Power sale revenue	TOTAL REVENUES	Annual Debt Service on Existing Debt	Existing O&M Costs	Annual LPP Debt Service	LPP O&M Costs	Total Annual Debt Service	TOTAL EXPENSES	Net Annual Surplus (Deficit)	Cumulative Surplus (Deficit)	Repayment Option 1: Annual Surplus (Deficit) w/ Increased Water Rate sale revenue	Repayment Option 1: Cumulative Surplus (Deficit) w/ Increased Water Rate sale revenue	Repayment Option 2: Annual Surplus (Deficit) w/ Increased Impact Fees	Repayment Option 2: Cumulative Surplus (Deficit) w/ Increased Impact Fees	Repayment Option 3: Annual Surplus (Deficit) w/ 50/50 Split Between Impact Fees and Water Rates	Repayment Option 3: Cumulative Surplus (Deficit) w/ Split Between Impact Fees and Water Rates
24	2015	$10,267,571	$7,245,479	$2,381,597	$9,399,311	$15,000,000	$0	$44,293,958	$7,026,322	$13,231,636	$61,840,170	$0	$68,866,492	$82,098,128	($37,804,170)	($37,804,170)	($14,612,457)	($14,612,457)	($14,612,457)	($14,612,457)	($14,612,457)	($14,612,457)
25	2016	$10,607,367	$7,485,261	$2,460,414	$9,710,373	$15,000,000	$0	$45,263,415	$7,039,458	$13,669,525	$61,840,170	$0	$68,866,492	$82,536,017	($37,272,602)	($76,588,938)	($13,313,379)	($28,510,334)	($13,313,379)	($28,510,334)	($13,313,379)	($28,510,334)
26	2017	$10,958,409	$7,732,979	$2,541,839	$10,031,729	$15,000,000	$0	$46,264,956	$7,048,107	$14,121,906	$61,840,170	$0	$68,879,628	$83,001,534	($36,736,577)	($116,389,073)	($11,984,446)	($41,635,193)	($11,984,446)	($41,635,193)	($11,984,446)	($41,635,193)
27	2018	$11,321,068	$7,988,895	$2,625,959	$10,363,720	$15,000,000	$0	$47,299,643	$7,048,318	$14,589,258	$61,840,170	$0	$68,888,277	$83,477,535	($36,177,892)	($157,222,529)	($10,606,611)	($53,907,212)	($10,606,611)	($53,907,212)	($10,606,611)	($53,907,212)
28	2019	$11,695,728	$8,253,281	$2,712,863	$10,706,699	$15,000,000	$0	$48,368,571	$7,050,648	$15,072,077	$61,840,170	$0	$68,888,488	$83,960,565	($35,591,994)	($199,103,424)	($9,174,453)	($65,237,954)	($9,174,453)	($65,237,954)	($9,174,453)	($65,237,954)
29	2020	$12,082,788	$8,526,416	$2,802,643	$11,061,027	$15,000,000	$0	$49,472,874	$6,451,090	$15,570,874	$61,840,170	$0	$68,890,818	$84,461,692	($34,988,818)	($242,056,378)	($7,697,012)	($75,544,483)	($7,697,012)	($75,544,483)	($7,697,012)	($75,544,483)
30	2021	$12,482,657	$8,808,590	$2,895,394	$11,427,082	$15,000,000	$0	$50,613,723	$6,456,332	$16,086,178	$61,840,170	$0	$68,291,260	$84,377,438	($33,763,715)	($285,502,348)	($5,568,711)	($84,134,973)	($5,568,711)	($84,134,973)	($5,568,711)	($84,134,973)
31	2022	$12,895,760	$9,100,103	$2,991,214	$11,805,251	$15,000,000	$0	$51,792,328	$6,138,580	$16,618,536	$61,840,170	$0	$68,296,502	$84,915,038	($33,122,710)	($330,045,151)	($3,994,617)	($91,494,989)	($3,994,617)	($91,494,989)	($3,994,617)	($91,494,989)
32	2023	$13,322,534	$9,401,262	$3,090,206	$12,195,936	$15,000,000	$0	$53,009,938	$5,095,230	$17,168,512	$61,840,170	$0	$67,978,750	$85,147,262	($32,137,324)	($375,384,281)	($2,045,263)	($97,200,052)	($2,045,263)	($97,200,052)	($2,045,263)	($97,200,052)
33	2024	$13,763,431	$9,712,389	$3,192,473	$12,599,550	$15,000,000	$0	$54,267,843	$5,101,740	$17,736,688	$61,840,170	$0	$66,935,400	$84,672,088	($30,404,245)	($420,803,898)	$683,686	($100,404,368)	$683,686	($100,404,368)	$683,686	($100,404,368)
34	2025	$14,218,920	$10,033,812	$3,298,125	$13,016,520	$0	$0	$40,567,377	$5,109,185	$18,323,668	$61,840,170	$0	$66,941,910	$85,265,578	($44,698,201)	($482,334,255)	($12,581,442)	($117,001,984)	($12,581,442)	($117,001,984)	($12,581,442)	($117,001,984)
35	2026	$14,689,482	$10,365,872	$3,407,274	$13,447,291	$0	$9,947,747	$51,857,666	$5,099,965	$18,930,074	$61,840,170	$23,493,231	$66,949,355	$109,372,659	($57,514,994)	($559,142,618)	($24,335,359)	($146,017,423)	($24,335,359)	($146,017,423)	($24,335,359)	($146,017,423)
36	2027	$15,175,618	$10,708,921	$3,520,035	$13,892,317	$0	$0	$53,642,548	$3,178,350	$19,556,548	$61,840,170	$24,432,960	$66,940,135	$110,929,643	($57,287,095)	($638,795,418)	($23,009,410)	($174,867,529)	($23,009,410)	($174,867,529)	($23,009,410)	($174,867,529)
37	2028	$15,677,841	$11,063,324	$3,636,527	$14,352,071	$0	$10,759,483	$55,489,246	$3,178,995	$20,203,755	$61,840,170	$25,410,278	$65,018,520	$110,632,553	($55,143,307)	($719,490,542)	($19,731,232)	($201,593,462)	($19,731,232)	($201,593,462)	($19,731,232)	($201,593,462)
38	2029	$16,196,686	$11,429,455	$3,756,875	$14,827,040	$0	$0	$46,210,056	$3,188,875	$20,872,380	$61,840,170	$26,426,689	$65,019,165	$112,318,234	($54,918,317)	($803,188,480)	($18,334,311)	($227,991,511)	($18,334,311)	($227,991,511)	($18,334,311)	($227,991,511)
39	2030	$16,732,701	$11,807,702	$3,881,205	$15,317,728	$0	$11,637,457	$59,376,793	$1,786,290	$21,563,133	$61,840,170	$27,483,757	$65,029,045	$114,075,935	($54,699,142)	($890,015,162)	($16,904,420)	($254,015,592)	($16,904,420)	($254,015,592)	($16,904,420)	($254,015,592)
40	2031	$17,286,455	$12,198,468	$4,009,650	$15,824,654	$0	$12,102,955	$61,422,182	$1,610,460	$22,276,746	$61,840,170	$28,583,107	$63,626,460	$114,486,313	($53,064,131)	($978,679,899)	($14,018,626)	($278,194,842)	($14,018,626)	($278,194,842)	($14,018,626)	($278,194,842)
41	2032	$17,858,535	$12,602,165	$4,142,346	$16,348,357	$0	$12,587,073	$63,538,477	$1,610,460	$23,013,975	$61,840,170	$29,726,432	$63,450,630	$116,191,037	($52,652,560)	($1,070,479,655)	($12,314,879)	($301,637,514)	($12,314,879)	($301,637,514)	($12,314,879)	($301,637,514)
42	2033	$18,449,547	$13,019,223	$4,279,433	$16,889,392	$0	$13,090,556	$65,728,151	$1,610,460	$23,775,602	$61,840,170	$30,915,489	$63,450,630	$118,141,721	($52,413,570)	($1,165,712,410)	($10,740,949)	($324,443,963)	($10,740,949)	($324,443,963)	($10,740,949)	($324,443,963)
43	2034	$19,060,118	$13,450,082	$4,421,057	$17,448,331	$0	$13,614,179	$67,993,768	$1,610,460	$24,562,435	$61,840,170	$32,152,108	$63,450,630	$120,165,173	($52,171,405)	($1,264,512,312)	($9,119,665)	($346,541,387)	($9,119,665)	($346,541,387)	($9,119,665)	($346,541,387)
44	2035	$19,690,896	$13,895,201	$4,567,368	$18,025,768	$0	$14,158,746	$70,337,980	$110,460	$25,375,307	$61,840,170	$33,438,193	$63,450,630	$122,264,130	($51,926,150)	($1,367,018,954)	($7,449,651)	($367,852,693)	($7,449,651)	($367,852,693)	($7,449,651)	($367,852,693)
45	2036	$20,342,549	$14,355,050	$4,718,521	$18,622,315	$0	$14,725,096	$72,763,532	$110,460	$26,215,080	$61,840,170	$34,775,720	$61,950,630	$122,941,431	($50,177,899)	($1,471,877,611)	($4,229,489)	($386,796,290)	($4,229,489)	($386,796,290)	($4,229,489)	($386,796,290)
46	2037	$21,015,768	$14,830,118	$4,874,677	$19,238,604	$0	$15,314,099	$75,273,266	$110,460	$27,082,645	$61,840,170	$36,166,749	$61,950,630	$125,200,024	($49,926,758)	($1,580,679,473)	($2,457,727)	($404,725,868)	($2,457,727)	($404,725,868)	($2,457,727)	($404,725,868)
47	2038	$21,711,266	$15,320,908	$5,036,000	$19,875,289	$0	$15,926,663	$77,870,126	$110,460	$27,978,922	$61,840,170	$37,613,419	$61,950,630	$127,542,971	($49,672,845)	($1,693,579,497)	($632,868)	($421,547,771)	($632,868)	($421,547,771)	($632,868)	($421,547,771)
48	2039	$22,429,781	$15,827,940	$5,202,662	$20,533,044	$0	$16,563,730	$80,557,157	$110,460	$28,904,859	$61,840,170	$39,117,956	$61,950,630	$129,973,445	($49,416,288)	($1,810,738,965)	$1,246,623	($437,163,058)	$1,246,623	($437,163,058)	$1,246,623	($437,163,058)
49	2040	$23,172,075	$16,351,751	$5,374,839	$21,212,567	$0	$17,226,279	$83,337,512	$110,460	$29,861,440	$61,840,170	$40,682,674	$61,950,630	$132,494,744	($49,157,232)	($1,932,325,755)	$3,182,324	($451,467,257)	$3,182,324	($451,467,257)	$3,182,324	($451,467,257)
50	2041	$23,938,934	$16,892,898	$5,552,715	$21,914,578	$0	$17,915,330	$86,214,456	$110,460	$30,849,678	$61,840,170	$42,309,981	$61,950,630	$135,110,289	($48,895,833)	($2,058,514,619)	$5,175,854	($464,350,093)	$5,175,854	($464,350,093)	$5,175,854	($464,350,093)
51	2042	$24,731,172	$17,451,954	$5,736,477	$22,639,822	$0	$18,631,943	$89,191,368	$110,460	$31,870,621	$61,840,170	$44,002,380	$61,950,630	$137,823,631	($48,632,263)	($2,189,487,466)	$7,228,879	($475,695,217)	$7,228,879	($475,695,217)	$7,228,879	($475,695,217)
52	2043	$25,549,628	$18,029,511	$5,926,321	$23,389,067	$0	$19,377,221	$92,271,748	$110,460	$32,925,351	$61,840,170	$45,762,476	$61,950,630	$140,638,456	($48,366,708)	($2,325,433,673)	$9,343,109	($485,379,918)	$9,343,109	($485,379,918)	$9,343,109	($485,379,918)
53	2044	$26,395,171	$18,626,181	$6,122,447	$24,163,107	$0	$20,152,310	$95,459,217	$110,460	$34,014,986	$61,840,170	$47,592,975	$61,950,630	$143,558,591	($48,099,374)	($2,466,550,394)	$11,520,298	($493,274,816)	$11,520,298	($493,274,816)	$11,520,298	($493,274,816)
54	2045	$27,268,696	$19,242,598	$6,325,064	$24,962,764	$0	$20,958,402	$98,757,524	$110,460	$35,140,682	$61,840,170	$49,496,694	$61,950,630	$146,588,006	($47,830,481)	($2,613,042,891)	$13,762,252	($499,243,557)	$13,762,252	($499,243,557)	$13,762,252	($499,243,557)
55	2046	$28,171,129	$19,879,415	$6,534,386	$25,788,884	$0	$21,796,739	$102,170,554	$110,460	$36,303,632	$61,840,170	$51,476,561	$61,950,630	$149,730,823	($47,560,269)	($2,765,124,876)	$16,070,821	($503,142,478)	$16,070,821	($503,142,478)	$16,070,821	($503,142,478)
56	2047	$29,103,428	$20,537,307	$6,750,636	$26,642,345	$0	$22,668,608	$105,702,324	$110,460	$37,505,069	$61,840,170	$53,535,624	$61,950,630	$152,991,322	($47,288,999)	($2,923,018,870)	$18,447,906	($504,820,272)	$18,447,906	($504,820,272)	$18,447,906	($504,820,272)
57	2048	$30,066,580	$21,216,971	$6,974,042	$27,524,050	$0	$23,575,352	$109,356,995	$110,460	$38,746,266	$61,840,170	$55,677,049	$61,950,630	$156,373,944	($47,016,949)	($3,086,956,574)	$20,895,461	($504,117,622)	$20,895,461	($504,117,622)	$20,895,461	($504,117,622)
58	2049	$31,061,607	$21,919,128	$7,204,842	$28,434,934	$0	$24,518,367	$113,138,877	$110,460	$40,028,539	$61,840,170	$57,904,131	$61,950,630	$159,883,300	($46,744,422)	($3,257,179,259)	$23,415,488	($500,866,839)	$23,415,488	($500,866,839)	$23,415,488	($500,866,839)
59	2050	$32,089,563	$22,644,522	$7,443,280	$29,375,963	$0	$25,499,101	$117,052,429	$110,460	$41,353,248	$61,840,170	$60,220,296	$61,950,630	$163,524,174	($46,471,745)	($3,433,938,174)	$26,010,046	($494,891,466)	$26,010,046	($494,891,466)	$26,010,046	($494,891,466)
60	2051	$33,151,539	$23,393,922	$7,689,609	$30,348,134	$0	$26,519,065	$121,102,270	$110,460	$42,721,797	$61,840,170	$62,629,108	$61,950,630	$167,301,535	($46,199,265)	($3,617,494,966)	$28,681,246	($486,005,878)	$28,681,246	($486,005,878)	$28,681,246	($486,005,878)
61	2052	$34,248,660	$24,168,124	$7,944,090	$31,352,479	$0	$27,579,828	$125,293,180	$0	$44,135,638	$61,840,170	$65,134,272	$61,950,630	$171,220,539	($45,927,359)	($3,808,122,124)	$31,431,256	($474,014,857)	$31,431,256	($474,014,857)	$31,431,256	($474,014,857)
62	2053	$35,382,089	$24,967,946	$8,206,992	$32,390,062	$0	$28,683,021	$129,630,110	$0	$45,596,268	$61,840,170	$67,739,643	$61,840,170	$175,176,080	($45,545,970)	($4,005,992,979)	$34,372,761	($458,602,690)	$34,372,761	($458,602,690)	$34,372,761	($458,602,690)
63	2054	$36,553,028	$25,794,238	$8,478,596	$33,461,982	$0	$29,830,342	$134,118,186	$0	$47,105,236	$61,840,170	$70,449,229	$61,840,170	$179,394,634	($45,276,448)	($4,211,509,147)	$37,287,122	($439,659,676)	$37,287,122	($439,659,676)	$37,287,122	($439,659,676)
64	2055	$37,762,718	$26,647,876	$8,759,187	$34,569,377	$0	$31,023,556	$138,762,713	$0	$48,664,142	$61,840,170	$73,267,198	$61,840,170	$183,771,509	($45,008,796)	($4,424,978,309)	$40,287,143	($416,958,920)	$40,287,143	($416,958,920)	$40,287,143	($416,958,920)
65	2056	$39,012,442	$27,529,764	$9,049,065	$35,713,420	$0	$32,264,498	$143,569,188	$0	$50,274,639	$61,840,170	$76,197,886	$61,840,170	$188,312,694	($44,743,506)	($4,646,720,947)	$43,375,227	($390,262,050)	$43,375,227	($390,262,050)	$43,375,227	($390,262,050)
66	2057	$40,303,524	$28,440,837	$9,348,535	$36,895,324	$0	$33,555,078	$148,543,298	$0	$51,938,433	$61,840,170	$79,245,801	$61,840,170	$193,024,404	($44,481,106)	($4,877,070,892)	$46,553,838	($359,318,694)	$46,553,838	($359,318,694)	$46,553,838	($359,318,694)
67	2058	$41,637,334	$29,382,061	$9,657,917	$38,116,342	$0	$34,897,281	$153,690,935	$0	$53,657,290	$61,840,170	$82,415,633	$61,840,170	$197,913,093	($44,222,158)	($5,116,375,885)	$49,825,507	($323,865,934)	$49,825,507	($323,865,934)	$49,825,507	($323,865,934)
68	2059	$43,015,284	$30,354,435	$9,977,537	$39,377,769	$0	$36,293,172	$159,018,197	$0	$55,433,030	$61,840,170	$85,712,258	$61,840,170	$202,985,459	($43,967,262)	($5,364,998,183)	$53,192,828	($283,627,743)	$53,192,828	($283,627,743)	$53,192,828	($283,627,743)
69	2060	$44,438,837	$31,358,988	$10,307,735	$40,680,941	$0	$37,744,899	$164,531,400	$0	$57,267,538	$61,840,170	$89,140,749	$61,840,170	$208,248,456	($43,717,056)	($5,623,315,166)	$56,658,461	($238,314,392)	$56,658,461	($238,314,392)	$56,658,461	($238,314,392)
70	2061	$45,909,501	$32,396,786	$10,648,860	$42,027,241	$0	$39,254,695	$170,237,083	$0	$59,162,756	$61,840,170	$92,706,379	$61,840,170	$213,709,305	($43,472,222)	($5,891,719,994)	$60,225,135	($187,621,833)	$60,225,135	($187,621,833)	$60,225,135	($187,621,833)
71	2062	$47,428,836	$33,468,929	$11,001,275	$43,418,095	$0	$40,824,883	$176,142,017	$0	$61,120,695	$61,840,170	$96,414,634	$61,840,170	$219,375,499	($43,233,482)	($6,170,622,276)	$63,895,647	($131,231,060)	$63,895,647	($131,231,060)	$63,895,647	($131,231,060)
72	2063	$48,998,451	$34,576,554	$11,365,352	$44,854,979	$0	$42,457,878	$182,253,214	$0	$63,143,431	$61,840,170	$100,271,219	$61,840,170	$225,254,820	($43,001,606)	($6,460,448,773)	$67,672,866	($68,807,436)	$67,672,866	($68,807,436)	$67,672,866	($68,807,436)
73	2064	$50,620,011	$35,720,834	$11,741,479	$46,339,415	$0	$44,156,193	$188,577,932	$0	$65,233,107	$61,840,170	$104,282,068	$61,840,170	$231,355,345	($42,777,413)	($6,761,644,137)	$71,559,733	($0)	$71,559,733	$0	$71,559,733	($0)
74						$150,000,000					$3,092,008,489											
75																	Estimated Factors to make Final-Year Debt (the blue cells) almost zero:		3.20085321	0	2.46738435	

Scenario 2 - $1.8B Cost Option

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1		$9,938,660	2013 Property Tax Collections												Scenario A	Scenario B	DSWRESR!I3 gives the FERC "escalation rate"					
2		$7,013,377	2013 Water sale revenue Revenue												FERC Low Cost	FERC High Cost Estimate						
3		$6,102	2013 Impact Fee per ERU											Cost Estimate	$1,328,461,944	$1,750,908,555						
4		0.03309	GOPB 50-Year Household Growth Rate Projection										LPP O&M Costs (Column K)		$23,493,231	$62,867,794						
5		1.03309	GOPB 50-Year Household Growth Rate Projection, plus one.										LPP Power sale revenue (Column F)		$9,947,747	$72,005,740						
6		**1.040**	**<- enter 1 plus assumed interest rate on reserves**											**B**	**<- enter A or B (capitalized) for which Scenario you want to analyze**							
7			Q ∝ P^(-1/2) is the assumed demand curve, so revenues R = P^(1/2), so to increase R by a factor of "x" requires P to go up by a factor of "x^2".											$1,750,908,555	Loan Amount							
8		5.09324	If price rises by a factor > this, (Q_2060 under new water price) < (Q_2010 under current water price).											2064	year when all debt has to be paid back							
9			**Given unchanged impact fees:** (see Column P)											2015	initial year of spreadsheet							
10		3.57688	The factor by which water sale revenue need to increase to eliminate the debt by 2062, minus one											**10**	**<- enter number of initial payment-free years (can be zero); water rates & impact fees don't change during this time**							
11		4.57688	The factor by which water sale revenue need to increase to eliminate the debt by 2062.											**4%**	**<- enter interest rate**						**Total Expected Project Costs**	
12		20.94781	The factor by which water prices need to increase to eliminate the debt by 2062.											40	years allowed for paying back the loan						Cost w/ interest and O&M	$5,237,815,370
13		0.21849	The factor by which water demanded will change vs. base case when water prices rise enough to eliminate debt by 2062 (since revenue = PQ ∝ B5^(-2t) Q^(-2) Q = B5^(-2t) (1/Q)).											$2,591,772,381	Loan Amount after initial years of negative amortization						minus power sale revenue	**$5,237,815,370**
14			**Given unchanged water prices:** (see Column R)											130,945,384	Annual Debt Service							
15		2.75724	The factor by which Impact Fees need to increase to eliminate the debt by 2062, minus one.											If either this ->	$0	or this ->	$0	is not zero,				
16		3.75724	The factor by which Impact Fees need to increase to eliminate the debt by 2062.												click on this button ->	RECALCULATE	to make them zero.					
17		$22,927	2013 average Impact Fee per ERU, if Impact Fees increased as much as needed to eliminate the debt by 2062.											(This will ensure that R75 and T75 change in order to make Q73, S73, and hence U73 equal to zero.)								
18			**Given Split Between Impact Fees and Water Rates:** (see Column T)										**50%**	**<- enter Impact Fees' portion of Split financing**								
19		2.78844	The factor by which water sale revenue needs to increase to eliminate the debt by 2062.										**50%**	**Water Rates**								
20		7.77539	The factor by which water prices need to increase to eliminate the debt by 2062.																			
21		2.37862	The factor by which Impact Fees need to increase to eliminate the debt by 2062.							0.36	The factor by which water demanded will change vs. base case if water prices behave this way.											
22		$14,514	2013 average Impact Fee per ERU, if Impact Fees increased as much as needed to eliminate the debt by 2062.																			
23	Year	Property Taxes	Water sale revenue	Power sale revenue and Surcharges	Impact Fees	Real Estate sale revenue	LPP Power sale revenue	TOTAL REVENUES	Annual Debt Service on Existing Debt	Existing O&M Costs	Annual LPP Debt Service	LPP O&M Costs	Total Annual Debt Service	TOTAL EXPENSES	Net Annual Surplus (Deficit)	Cumulative Surplus (Deficit)	Repayment Option 1: Annual Surplus (Deficit) w/ Increased Water Rate sale revenue	Repayment Option 1: Cumulative Surplus (Deficit) w/ Increased Water Rate sale revenue	Repayment Option 2: Annual Surplus (Deficit) w/ Increased Impact Fees	Repayment Option 2: Cumulative Surplus (Deficit) w/ Increased Impact Fees	Repayment Option 3: Annual Surplus (Deficit) w/ 50/50 Split Between Impact Fees and Water Rates	Repayment Option 3: Cumulative Surplus (Deficit) w/ Split Between Impact Fees and Water Rates
24	2015	$10,267,571	$7,245,479	$2,381,597	$9,399,311	$15,000,000	$0	$44,293,958	$7,026,322	$13,231,636	$0	$0	$7,026,322	$20,257,958	$24,036,000	$24,036,000	$24,036,000	$24,036,000	$24,036,000	$24,036,000	$24,036,000	$24,036,000
25	2016	$10,607,367	$7,485,261	$2,460,414	$9,710,373	$15,000,000	$0	$45,263,415	$7,039,458	$13,669,525	$0	$0	$7,026,322	$20,695,847	$24,567,568	$49,565,008	$24,567,568	$49,565,008	$24,567,568	$49,565,008	$24,567,568	$49,565,008
26	2017	$10,958,409	$7,732,979	$2,541,839	$10,031,729	$15,000,000	$0	$46,264,956	$7,048,107	$14,121,906	$0	$0	$7,039,458	$21,161,364	$25,103,592	$76,651,201	$25,103,592	$76,651,201	$25,103,592	$76,651,201	$25,103,592	$76,651,201
27	2018	$11,321,068	$7,988,895	$2,625,959	$10,363,720	$15,000,000	$0	$47,299,643	$7,048,318	$14,589,258	$0	$0	$7,048,107	$21,637,365	$25,662,277	$105,379,526	$25,662,277	$105,379,526	$25,662,277	$105,379,526	$25,662,277	$105,379,526
28	2019	$11,695,728	$8,253,281	$2,712,863	$10,706,699	$15,000,000	$0	$48,368,571	$7,050,648	$15,072,077	$0	$0	$7,048,318	$22,120,395	$26,248,176	$131,627,702	$26,248,176	$131,627,702	$26,248,176	$131,627,702	$26,248,176	$131,627,702
29	2020	$12,082,788	$8,526,416	$2,802,643	$11,061,027	$15,000,000	$0	$49,472,874	$6,451,090	$15,570,874	$0	$0	$7,050,648	$22,621,522	$26,851,352	$158,479,054	$26,851,352	$158,479,054	$26,851,352	$158,479,054	$26,851,352	$158,479,054
30	2021	$12,482,657	$8,808,590	$2,895,394	$11,427,082	$15,000,000	$0	$50,613,723	$6,456,332	$16,086,178	$0	$0	$6,451,090	$22,537,268	$28,076,455	$186,555,509	$28,076,455	$186,555,509	$28,076,455	$186,555,509	$28,076,455	$186,555,509
31	2022	$12,895,760	$9,100,103	$2,991,214	$11,805,251	$15,000,000	$0	$51,792,328	$6,138,580	$16,618,536	$0	$0	$6,456,332	$23,074,868	$28,717,460	$215,272,969	$28,717,460	$215,272,969	$28,717,460	$215,272,969	$28,717,460	$215,272,969
32	2023	$13,322,534	$9,401,262	$3,090,206	$12,195,936	$15,000,000	$0	$53,009,938	$5,095,230	$17,168,512	$0	$0	$6,138,580	$23,307,092	$29,702,846	$244,975,815	$29,702,846	$244,975,815	$29,702,846	$244,975,815	$29,702,846	$244,975,815
33	2024	$13,763,431	$9,712,389	$3,192,473	$12,599,550	$15,000,000	$0	$54,267,843	$5,101,740	$17,736,688	$0	$0	$5,095,230	$22,831,918	$31,435,924	$276,411,739	$31,435,924	$276,411,739	$31,435,924	$276,411,739	$31,435,924	$276,411,739
34	2025	$14,218,920	$10,033,812	$3,298,125	$13,016,520	$0	$0	$40,567,377	$5,109,185	$18,323,668	$130,945,384	$0	$136,047,124	$154,370,793	($113,803,415)	$220,718,622	($77,913,696)	$256,608,341	($77,913,696)	$256,608,341	($77,913,696)	$256,608,341
35	2026	$14,689,482	$10,365,872	$3,407,274	$13,447,291	$0	$72,005,740	$113,915,659	$5,099,965	$18,930,074	$130,945,384	$62,867,794	$136,054,569	$217,852,438	($103,936,778)	$125,610,588	($66,859,320)	$200,013,355	($66,859,320)	$200,013,355	($66,859,320)	$200,013,355
36	2027	$15,175,618	$10,708,921	$3,520,035	$13,892,317	$0	$74,885,970	$118,182,861	$3,178,350	$19,556,548	$130,945,384	$65,382,506	$136,045,349	$220,984,403	($102,801,543)	$27,833,469	($64,497,039)	$143,516,850	($64,497,039)	$143,516,850	($64,497,039)	$143,516,850
37	2028	$15,677,841	$11,063,324	$3,636,527	$14,352,071	$0	$77,881,409	$122,611,172	$3,178,995	$20,203,755	$130,945,384	$67,997,806	$134,123,734	$222,325,295	($99,714,124)	($70,767,316)	($60,141,966)	$89,115,558	($60,141,966)	$89,115,558	($60,141,966)	$89,115,558
38	2029	$16,196,686	$11,429,455	$3,756,875	$14,827,040	$0	$80,996,665	$127,206,720	$3,188,875	$20,872,380	$130,945,384	$70,717,719	$134,124,379	$225,714,478	($98,507,758)	($172,105,766)	($57,625,995)	$35,054,185	($57,625,995)	$35,054,185	($57,625,995)	$35,054,185
39	2030	$16,732,701	$11,807,702	$3,881,205	$15,317,728	$0	$84,236,532	$131,975,868	$1,786,290	$21,563,133	$130,945,384	$73,546,427	$134,134,259	$229,243,820	($97,267,952)	($276,257,949)	($55,033,243)	($18,576,891)	($55,033,243)	($18,576,891)	($55,033,243)	($18,576,891)
40	2031	$17,286,455	$12,198,468	$4,009,650	$15,824,654	$0	$87,605,993	$136,925,220	$1,610,460	$22,276,746	$130,945,384	$76,488,284	$132,731,674	$231,496,705	($94,571,485)	($381,879,752)	($50,939,055)	($70,259,022)	($50,939,055)	($70,259,022)	($50,939,055)	($70,259,022)
41	2032	$17,858,535	$12,602,165	$4,142,346	$16,348,357	$0	$91,110,233	$142,061,636	$1,610,460	$23,013,975	$130,945,384	$79,547,816	$132,555,844	$235,117,635	($93,055,999)	($490,210,941)	($47,979,593)	($121,048,976)	($47,979,593)	($121,048,976)	($47,979,593)	($121,048,976)
42	2033	$18,449,547	$13,019,223	$4,279,433	$16,889,392	$0	$94,754,642	$147,392,237	$1,610,460	$23,775,602	$130,945,384	$82,729,728	$132,555,844	$239,061,175	($91,668,938)	($601,488,317)	($45,100,768)	($170,991,704)	($45,100,768)	($170,991,704)	($45,100,768)	($170,991,704)
43	2034	$19,060,118	$13,450,062	$4,421,057	$17,448,331	$0	$98,544,828	$152,924,417	$1,610,460	$24,562,435	$130,945,384	$86,038,917	$132,555,844	$243,157,197	($90,232,779)	($715,780,629)	($42,123,477)	($219,954,849)	($42,123,477)	($219,954,849)	($42,123,477)	($219,954,849)
44	2035	$19,690,896	$13,895,201	$4,567,368	$18,025,768	$0	$102,486,621	$158,665,855	$110,460	$25,375,307	$130,945,384	$89,480,474	$132,555,844	$247,411,626	($88,745,771)	($833,157,625)	($39,044,334)	($267,797,377)	($39,044,334)	($267,797,377)	($39,044,334)	($267,797,377)
45	2036	$20,342,549	$14,355,050	$4,718,521	$18,622,315	$0	$106,586,086	$164,624,522	$110,460	$26,215,080	$130,945,384	$93,059,693	$131,055,844	$250,330,618	($85,706,096)	($952,190,026)	($34,359,834)	($302,157,211)	($34,359,834)	($302,157,211)	($34,359,834)	($302,157,211)
46	2037	$21,015,768	$14,830,118	$4,874,677	$19,238,604	$0	$110,849,529	$170,808,696	$110,460	$27,082,645	$130,945,384	$96,782,081	$131,055,844	$254,920,571	($84,111,875)	($1,074,389,501)	($31,066,353)	($356,450,224)	($31,066,353)	($356,450,224)	($31,066,353)	($356,450,224)
47	2038	$21,711,266	$15,320,908	$5,036,000	$19,875,289	$0	$115,283,510	$177,226,973	$110,460	$27,978,922	$130,945,384	$100,653,364	$131,055,844	$259,688,130	($82,461,157)	($1,199,826,239)	($27,660,141)	($398,368,374)	($27,660,141)	($398,368,374)	($27,660,141)	($398,368,374)
48	2039	$22,429,781	$15,827,940	$5,202,662	$20,533,044	$0	$119,894,851	$183,888,277	$110,460	$28,904,859	$130,945,384	$104,679,499	$131,055,844	$264,640,202	($80,751,925)	($1,328,571,213)	($24,137,318)	($438,440,427)	($24,137,318)	($438,440,427)	($24,137,318)	($438,440,427)
49	2040	$23,172,075	$16,351,751	$5,374,839	$21,212,567	$0	$124,690,645	$190,801,877	$110,460	$29,861,440	$130,945,384	$108,866,679	$131,055,844	$269,783,963	($78,982,086)	($1,460,696,147)	($20,493,868)	($476,471,912)	($20,493,868)	($476,471,912)	($20,493,868)	($476,471,912)
50	2041	$23,938,934	$16,892,898	$5,552,715	$21,914,578	$0	$129,678,270	$197,977,396	$110,460	$30,849,678	$130,945,384	$113,221,346	$131,055,844	$275,126,868	($77,149,472)	($1,596,273,465)	($16,725,639)	($512,256,427)	($16,725,639)	($512,256,427)	($16,725,639)	($512,256,427)
51	2042	$24,731,172	$17,451,954	$5,736,477	$22,639,822	$0	$134,865,401	$205,424,826	$110,460	$31,870,621	$130,945,384	$117,750,200	$131,055,844	$280,676,665	($75,251,839)	($1,735,376,243)	($12,828,332)	($545,575,017)	($12,828,332)	($545,575,017)	($12,828,332)	($545,575,017)
52	2043	$25,549,628	$18,029,511	$5,926,321	$23,389,067	$0	$140,260,017	$213,154,544	$110,460	$32,925,351	$130,945,384	$122,460,208	$131,055,844	$286,441,403	($73,286,859)	($1,878,078,151)	($8,797,502)	($576,195,519)	($8,797,502)	($576,195,519)	($8,797,502)	($576,195,519)
53	2044	$26,395,171	$18,626,181	$6,122,447	$24,163,107	$0	$145,870,418	$221,177,324	$110,460	$34,014,986	$130,945,384	$127,358,616	$131,055,844	$292,429,446	($71,252,122)	($2,024,453,400)	($4,628,546)	($603,871,886)	($4,628,546)	($603,871,886)	($4,628,546)	($603,871,886)
54	2045	$27,268,696	$19,242,598	$6,325,064	$24,962,764	$0	$151,705,235	$229,504,357	$110,460	$35,140,682	$130,945,384	$132,452,961	$131,055,844	$298,649,487	($69,145,130)	($2,174,576,666)	($316,706)	($628,343,468)	($316,706)	($628,343,468)	($316,706)	($628,343,468)
55	2046	$28,171,129	$19,879,415	$6,534,386	$25,788,884	$0	$157,773,444	$238,147,259	$110,460	$36,303,632	$130,945,384	$137,751,079	$131,055,844	$305,110,555	($66,963,296)	($2,328,523,029)	$4,142,944	($649,334,262)	$4,142,944	($649,334,262)	$4,142,944	($649,334,262)
56	2047	$29,103,428	$20,537,307	$6,750,636	$26,642,345	$0	$164,084,382	$247,118,097	$110,460	$37,505,069	$130,945,384	$143,261,122	$131,055,844	$311,822,035	($64,703,938)	($2,486,367,888)	$8,755,500	($666,552,133)	$8,755,500	($666,552,133)	$8,755,500	($666,552,133)
57	2048	$30,066,580	$21,216,971	$6,974,042	$27,524,050	$0	$170,647,757	$256,429,400	$110,460	$38,746,266	$130,945,384	$148,991,567	$131,055,844	$318,793,677	($62,364,277)	($2,648,186,880)	$13,526,236	($679,687,981)	$13,526,236	($679,687,981)	$13,526,236	($679,687,981)
58	2049	$31,061,607	$21,919,128	$7,204,842	$28,434,934	$0	$177,473,667	$266,094,178	$110,460	$40,028,539	$130,945,384	$154,951,230	$131,055,844	$326,035,613	($59,941,435)	($2,814,055,790)	$18,460,608	($688,414,893)	$18,460,608	($688,414,893)	$18,460,608	($688,414,893)
59	2050	$32,089,563	$22,644,522	$7,443,280	$29,375,963	$0	$184,572,614	$276,125,942	$110,460	$41,353,248	$130,945,384	$161,149,279	$131,055,844	$333,558,371	($57,432,429)	($2,984,050,451)	$23,564,260	($692,387,229)	$23,564,260	($692,387,229)	$23,564,260	($692,387,229)
60	2051	$33,151,539	$23,393,922	$7,689,609	$30,348,134	$0	$191,955,519	$286,538,723	$110,460	$42,721,797	$130,945,384	$167,595,250	$131,055,844	$341,372,892	($54,834,169)	($3,158,246,638)	$28,843,034	($691,239,684)	$28,843,034	($691,239,684)	$28,843,034	($691,239,684)
61	2052	$34,248,660	$24,168,124	$7,944,090	$31,352,479	$0	$199,633,739	$297,347,091	$0	$44,135,638	$130,945,384	$174,299,060	$131,055,844	$349,490,542	($52,143,450)	($3,336,719,954)	$34,302,976	($684,586,296)	$34,302,976	($684,586,296)	$34,302,976	($684,586,296)
62	2053	$35,382,089	$24,967,946	$8,206,992	$32,390,062	$0	$207,619,089	$308,566,178	$0	$45,596,268	$130,945,384	$181,271,022	$130,945,384	$357,812,674	($49,246,496)	($3,519,435,248)	$40,060,798	($671,908,950)	$40,060,798	($671,908,950)	$40,060,798	($671,908,950)
63	2054	$36,553,028	$25,794,238	$8,478,596	$33,461,982	$0	$215,923,852	$320,211,696	$0	$47,105,236	$130,945,384	$188,521,863	$130,945,384	$366,572,483	($46,360,787)	($3,706,573,445)	$45,902,053	($652,883,255)	$45,902,053	($652,883,255)	$45,902,053	($652,883,255)
64	2055	$37,762,718	$26,647,876	$8,759,187	$34,569,377	$0	$224,560,807	$332,299,964	$0	$48,664,142	$130,945,384	$196,062,738	$130,945,384	$375,672,264	($43,372,300)	($3,898,208,682)	$51,943,898	($627,054,687)	$51,943,898	($627,054,687)	$51,943,898	($627,054,687)
65	2056	$39,012,442	$27,529,764	$9,049,065	$35,713,420	$0	$233,543,239	$344,847,929	$0	$50,274,639	$130,945,384	$203,905,247	$130,945,384	$385,125,270	($40,277,341)	($4,094,414,371)	$58,193,261	($593,943,613)	$58,193,261	($593,943,613)	$58,193,261	($593,943,613)
66	2057	$40,303,524	$28,440,837	$9,348,535	$36,895,324	$0	$242,884,968	$357,873,189	$0	$51,938,433	$130,945,384	$212,061,457	$130,945,384	$394,945,275	($37,072,086)	($4,295,263,032)	$64,657,314	($553,044,044)	$64,657,314	($553,044,044)	$64,657,314	($553,044,044)
67	2058	$41,637,334	$29,382,061	$9,657,917	$38,116,342	$0	$252,600,367	$371,394,021	$0	$53,657,290	$130,945,384	$220,543,916	$130,945,384	$405,146,590	($33,752,569)	($4,500,826,122)	$71,343,476	($503,822,330)	$71,343,476	($503,822,330)	$71,343,476	($503,822,330)
68	2059	$43,015,284	$30,354,435	$9,977,537	$39,377,769	$0	$262,704,382	$385,429,407	$0	$55,433,030	$130,945,384	$229,365,672	$130,945,384	$415,744,087	($30,314,680)	($4,711,173,847)	$78,259,425	($445,715,798)	$78,259,425	($445,715,798)	$78,259,425	($445,715,798)
69	2060	$44,438,837	$31,358,988	$10,307,735	$40,680,941	$0	$273,212,557	$399,999,058	$0	$57,267,538	$130,945,384	$238,540,299	$130,945,384	$426,753,221	($26,754,163)	($4,926,374,964)	$85,413,107	($378,131,323)	$85,413,107	($378,131,323)	$85,413,107	($378,131,323)
70	2061	$45,909,501	$32,396,786	$10,648,860	$42,027,241	$0	$284,141,059	$415,123,448	$0	$59,162,756	$130,945,384	$248,081,911	$130,945,384	$438,190,051	($23,066,604)	($5,146,496,566)	$92,812,742	($300,443,833)	$92,812,742	($300,443,833)	$92,812,742	($300,443,833)
71	2062	$47,428,836	$33,468,929	$11,001,275	$43,418,095	$0	$295,506,702	$430,823,836	$0	$61,120,695	$130,945,384	$258,005,187	$130,945,384	$450,071,267	($19,247,431)	($5,371,603,859)	$100,466,840	($211,994,747)	$100,466,840	($211,994,747)	$100,466,840	($211,994,747)
72	2063	$48,998,451	$34,576,554	$11,365,352	$44,854,979	$0	$307,326,970	$447,122,306	$0	$63,143,431	$130,945,384	$268,325,395	$130,945,384	$462,414,210	($15,291,904)	($5,601,759,918)	$108,384,204	($112,090,332)	$108,384,204	($112,090,332)	$108,384,204	($112,090,332)
73	2064	$50,620,011	$35,720,834	$11,741,479	$46,339,415	$0	$319,620,049	$464,041,787	$0	$65,233,107	$130,945,384	$279,058,411	$130,945,384	$475,236,902	($11,195,114)	($5,837,025,429)	$116,573,946	$0	$116,573,946	$0	$116,573,946	$0
74						$150,000,000					$5,237,815,370											
75																	Estimated Factors to make Final-Year Debt (the blue cells) almost zero:		3.57687786	0	2.75724373	

Appendix E

WCWCD Water Demand with LPP Debt

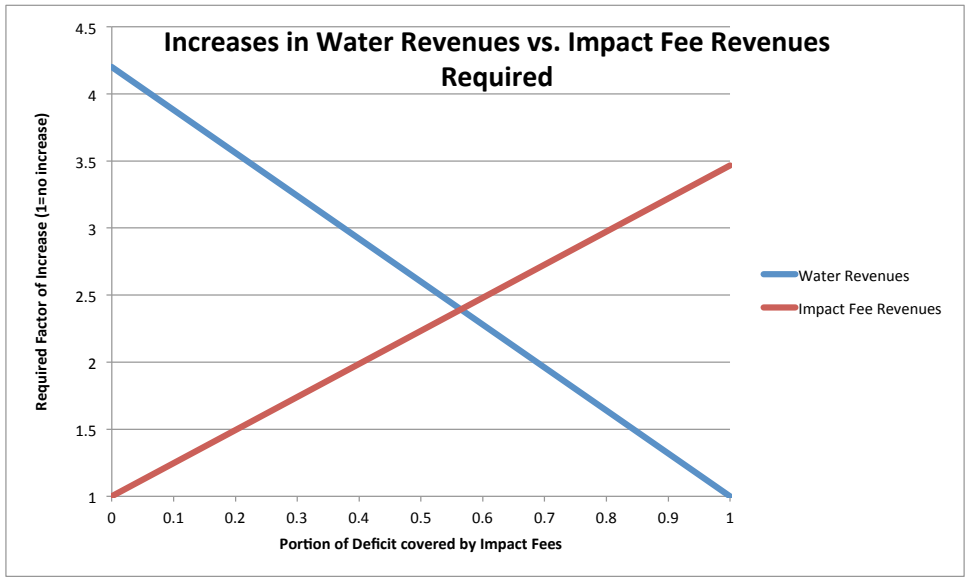
Year	Current Supply	Supply with LPP	Base Per Capita Use (GPCD)	Assumed Conservation from 2005	Per Capita Use with Conservation (GPCD)		Total Projected Water Demand (ac-ft/yr)	First Scenario: Total Demand with Increased Water Prices (ac-ft/yr)	First Scenario: Total Demand with Increased Water Prices and Impact Fees (ac-ft/yr)	First Scenario: GPCD With Increased Water Prices	First Scenario: GPCD with Increased Water Rates and Impact Fees	Second Scenario: Total Demand with Increased Water Prices (ac-ft/yr)	Second Scenario: Total Demand with Increased Water Prices and Impact Fees (ac-ft/yr)	Second Scenario: GPCD With Increased Water Prices	Second Scenario: GPCD with Increased Water Rates and Impact Fees
2009	82,010	82,010	294.3	0%	294.3	55408	*45,739*	*10,888*	*17,589*	70.1	113.2	*9,994*	*16,403*	64.3	105.5
2010	82,010	82,010	294.3	1%	291.4	54854	*45,282*	*10,779*	*17,413*	69.4	112.0	*9,894*	*16,239*	63.7	104.5
2020	130,840	151,010	294.3	5%	279.6	87646	*61,621*	*14,669*	*23,696*	66.6	107.5	*13,463*	*22,099*	61.1	100.3
2030	130,840	151,010	294.3	9%	267.8	124648	*84,164*	*20,035*	*32,365*	63.8	103.0	*18,389*	*30,183*	58.5	96.0
2040	130,840	199,840	294.3	12%	259.0	162359	*107,842*	*25,671*	*41,471*	61.7	99.6	*23,562*	*38,675*	56.6	92.9
2050	130,840	199,840	294.3	16%	247.2	196517	**130,859**	*31,151*	*50,322*	58.8	95.1	*28,591*	*46,929*	54.0	88.7
2060	130,840	199,840	294.3	18%	241.3	232576	**157,252**	*37,433*	*60,472*	57.4	92.8	*34,358*	*56,394*	52.7	86.5
	Red = some water from LPP is actually used (total demand > 130,840 acre-feet)						**192%**	*46%*	*74%*			*42%*	*69%*	**<- 2060 demand as a fraction of 2010 demand**	
	Blue = no water from LPP is actually used because water's so expensive that > 130,840 acre-feet are not demanded														
	Blue Italic = no water from LPP is actually used because water's so expensive that > 82,010 acre-feet (2010's supply) are not demanded														
	Source: 2011 LPP Water Needs Assessment														

Appendix F

WCWCD Debt Repayment: Water Rates vs. Impact Fees

	Water Revenues	Impact Fee Revenues
0	4.20085321	1
1	1	3.467384349

2.26 If Water Revenues rise by a factor > this, Q_2060 < Q_2010.



Appendix G

Repayment Scenario Supporting Formulas

by Gabriel A. Lozada, 9/28/15

1. Paths of Demand, Price, and Revenue when Elasticity is −1/2

Suppose the demand for water is given by

$$Q_t = \alpha \beta^t P_t^{-1/2} \tag{1}$$

where Q is quantity demanded, P is price, β is one plus the projected population growth rate, and t denotes the date. Assume price is constant:

$$P_t \equiv P \quad \text{for all } t.$$

Then

$$\begin{aligned} Q_t &= \alpha \beta^t P^{-1/2} \\ Q_0 &= \alpha P^{-1/2} \quad \text{so} \\ Q_t &= Q_0 \beta^t \quad \text{(which grows at rate } \beta\text{) and} \\ \text{total revenue } Q_t P_t &= Q_0 \beta^t P = Q_0 P \beta_t \quad \text{(which grows at rate } \beta\text{).} \end{aligned}$$

Now suppose there is a new situation, denoted by $\widehat{\ }$, and suppose we have discovered that the needed total revenue in the new situation is γ times the total revenue of the old situation:

$$\boxed{\widehat{Q_t P_t} = \gamma \cdot Q_t P_t}. \tag{2}$$

Suppose as before that

$$\begin{aligned} \widehat{P_t} &\equiv \widehat{P} \quad \text{for all } t. \quad \text{and} \\ \widehat{Q_t} &= \alpha \beta^t \widehat{P}^{-1/2}. \end{aligned}$$

Then as before, both $\widehat{Q_t}$ and $\widehat{Q_t P_t}$ grow at rate β, and also $\widehat{Q_t} = \widehat{Q_0} \beta^t$.

From (2),

$$\begin{aligned} \widehat{Q_t P_t} &= \gamma Q_t P_t \\ \widehat{Q_0} \beta^t \cdot \widehat{P} &= \gamma Q_0 \beta^t \cdot P \\ \widehat{Q_0} \cdot \widehat{P} &= \gamma Q_0 \cdot P \\ \alpha \widehat{P}^{-1/2} \cdot \widehat{P} &= \gamma \alpha P^{-1/2} \cdot P \\ \widehat{P}^{1/2} &= \gamma P^{1/2} \\ \boxed{\widehat{P} &= \gamma^2 P}. \end{aligned} \tag{3}$$

Using (3), $\widehat{Q_t} = \widehat{Q_0}\beta^t = \alpha\widehat{P}^{-1/2}\beta^t = \alpha(\gamma^2 P)^{-1/2}\beta^t = \gamma^{-1}\alpha P^{-1/2}\beta^t = \gamma^{-1}Q_t$, so

$$\boxed{\widehat{Q_t} = Q_t/\gamma}\,. \tag{4}$$

Note that in the spreadsheet (worksheets "First Scenario" and "Second Scenario"), $\widehat{Q_tP_t} = Q_tP_t + \texttt{B10} \cdot Q_tP_t = (1 + \texttt{B10})Q_tP_t$, so the value of γ in (2) is $1 + \texttt{B10}$ in the spreadsheet; this is `B11` and `B19`.

The answer to the question "when is $\widehat{Q}_{2060} < Q_{2010}$?" is, using (4), when

$$\begin{aligned} Q_{2060}/\gamma &< Q_{2010} \\ Q_{2010}\beta^{2060-2010}/\gamma &< Q_{2010} \\ \beta^{50} &< \gamma\,. \end{aligned}$$

This underlies `B8`.

2. Deriving Cost and Benefit Flows from their Present Values given in pages 5-3 to 5-6 of the Draft Socioeconomics and Water Resource Economics Study Report

This section derives relationships used in the spreadsheet tab "DSWRESR," whose name is the first letters of the "Study Report" named in the title of this section.

The Study Report describes the flows of costs and benefits from 2020 to 2060 (see for example Table 2-1 on page 2-2) in terms of the present value (in 2010) of those flows. Here we derive the implied magnitude of such a flow in our assumed initial year of operation, 2026.

Let the Study Report's "escalation rate" (the rate of real cost or benefit increases per year) be ϵ. The Study Report provides the value of ϵ but it provides no further information about how the Study Report authors assumed costs and benefits changed over time. In the absence of this information, the best we can do is to assume that their sequence of costs (or benefits)

$$\{c_{2020}, c_{2021}, c_{2022}, \ldots, c_{2060}\}$$

is equal to

$$\{c_{2020}, (1+\epsilon)c_{2020}, (1+\epsilon)^2 c_{2020}, \ldots, (1+\epsilon)^{40} c_{2020}\}\,.$$

Let the Study Report's discount rate be r and let the present value in 2020 of this sequence be denoted by PV_{2020}. Then

$$PV_{2020} = \sum_{t=0}^{40} \frac{(1+\epsilon)^t\, c_{2020}}{(1+r)^t} = \frac{1 - \left(\frac{1+\epsilon}{1+r}\right)^{41}}{1 - \left(\frac{1+\epsilon}{1+r}\right)}\, c_{2020}\,,$$

$$c_{2020} = \frac{1 - \left(\frac{1+\epsilon}{1+r}\right)}{1 - \left(\frac{1+\epsilon}{1+r}\right)^{41}} PV_{2020}\,, \text{ and}$$

$$c_{2026} = (1+\epsilon)^6 c_{2020} = (1+\epsilon)^6 \frac{1 - \left(\frac{1+\epsilon}{1+r}\right)}{1 - \left(\frac{1+\epsilon}{1+r}\right)^{41}} PV_{2020}\,.$$

Since $PV_{2010} = PV_{2020}/(1+r)^{10}$ because the only thing which happens to these flow costs between 2010 and 2020 is discounting, we have

$$c_{2026} = (1+\epsilon)^6 (1+r)^{10} \frac{1 - \left(\frac{1+\epsilon}{1+r}\right)}{1 - \left(\frac{1+\epsilon}{1+r}\right)^{41}} PV_{2010}\,. \tag{5}$$

If we are correct in assuming that the Study Report authors used $c_t = (1+\epsilon)^{t-2020} c_{2020}$ then (5) would give the same answer for c_{2020} regardless of the values of ϵ and r. However, the values which (5) gives for c_{2020} for the two "no pump storage" cases, Tables 5-1 and 5-2 (spreadsheet columns C and J, rows 12–19), slightly differ; so do the values which (5) gives for c_{2020} for the two "pump storage" cases, Tables 5-3 and 5-4 (spreadsheet columns C and J, rows 29–37). Therefore, the Study Report authors must not have used $c_t = (1+\epsilon)^{t-2020} c_{2020}$, but something slightly different. There is no way to know what that was (for example, the text "2024" does not appear in the report), so in column N, averages of the c_{2020} values derived from (5) for the two "no pump storage" cases given in the Study Report were calculated, and this average was used for the "no pump storage" c_{2020} in the rest of the spreadsheet. Similarly, in column N, averages of the c_{2020} values derived from (5) for the two "pump storage" cases given in the Study Report were calculated, and that average was used for the "pump storage" c_{2020} in the rest of the spreadsheet.

For construction costs the situation is the same except that the years of construction in the Study Report were 2016 to 2019. So

$$PV_{2016} = \sum_{t=0}^{3} \frac{(1+\epsilon)^t c_{2016}}{(1+r)^t} = \frac{1 - \left(\frac{1+\epsilon}{1+r}\right)^4}{1 - \left(\frac{1+\epsilon}{1+r}\right)} c_{2016}\,,$$

$$c_{2016} = \frac{1 - \left(\frac{1+\epsilon}{1+r}\right)}{1 - \left(\frac{1+\epsilon}{1+r}\right)^4} PV_{2016}\,, \text{ and}$$

$$c_{2015} = c_{2016}/(1+\epsilon)\,.$$

Let the present value for our spreadsheet, in which construction starts in 2015, be denoted by PV'_{2015}, and let our discount rate be r'. The Study Report gives

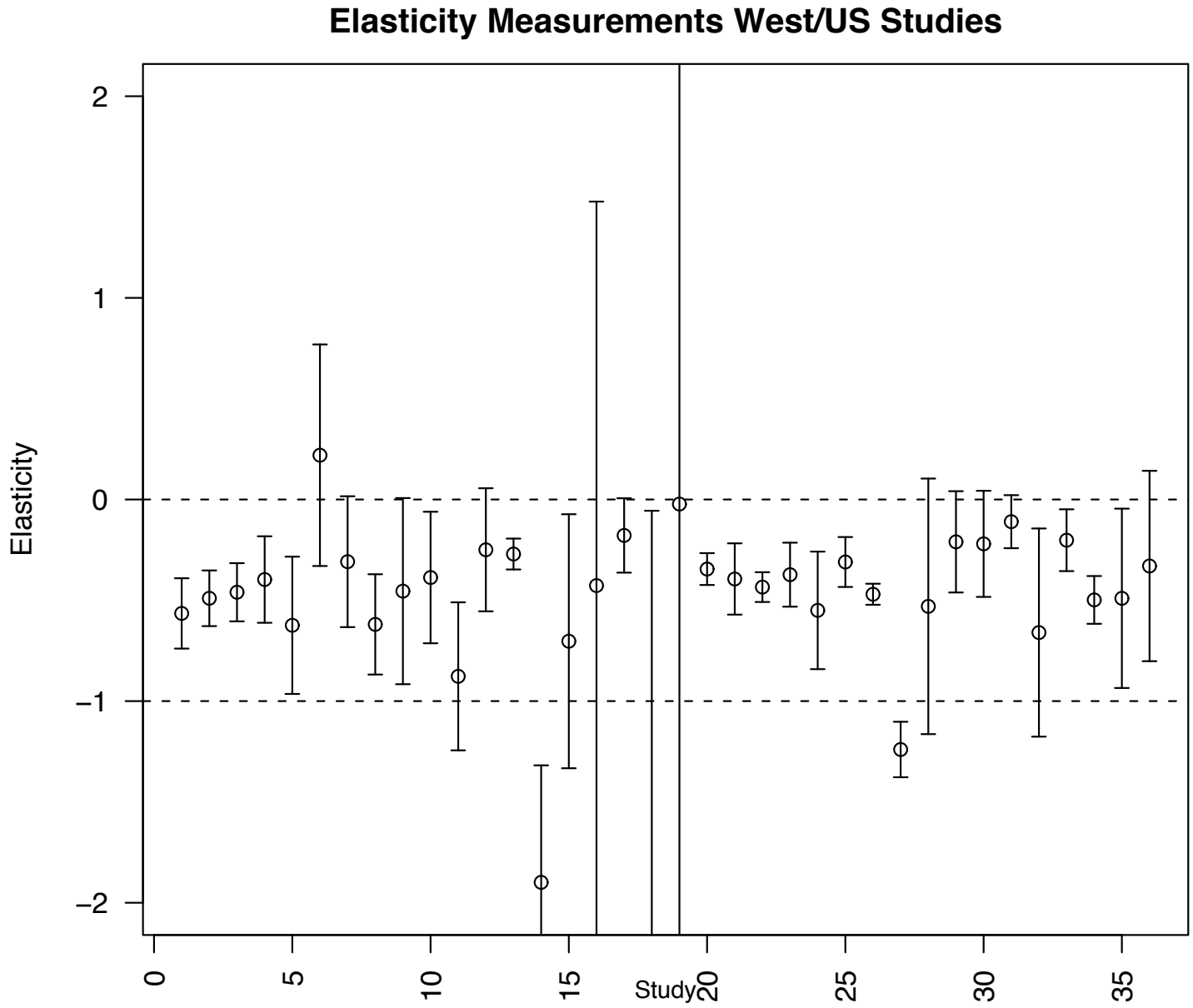
PV_{2010}. We have

$$
\begin{aligned}
PV'_{2015} &= \sum_{t=0}^{3} \frac{(1+\epsilon)^t\, c_{2015}}{(1+r')^t} = \frac{1-\left(\frac{1+\epsilon}{1+r'}\right)^4}{1-\left(\frac{1+\epsilon}{1+r'}\right)}\, c_{2015} \\
&= \frac{1-\left(\frac{1+\epsilon}{1+r'}\right)^4}{1-\left(\frac{1+\epsilon}{1+r'}\right)}\, \frac{c_{2016}}{1+\epsilon} \\
&= \frac{1-\left(\frac{1+\epsilon}{1+r'}\right)^4}{1-\left(\frac{1+\epsilon}{1+r'}\right)}\, \frac{1}{1+\epsilon}\, \frac{1-\left(\frac{1+\epsilon}{1+r}\right)}{1-\left(\frac{1+\epsilon}{1+r}\right)^4} PV_{2016} \\
&= \frac{1-\left(\frac{1+\epsilon}{1+r'}\right)^4}{1-\left(\frac{1+\epsilon}{1+r'}\right)}\, \frac{1}{1+\epsilon}\, \frac{1-\left(\frac{1+\epsilon}{1+r}\right)}{1-\left(\frac{1+\epsilon}{1+r}\right)^4} (1+r)^6\, PV_{2010}\,. \qquad (6)
\end{aligned}
$$

As before, if we are correct in assuming that the Study Report authors used $c_t = (1+\epsilon)^{t-2016}\, c_{2016}$ then (6) would give the same answer for c_{2016} and PV'_{2015} regardless of the values of ϵ and r. However, the values which (6) gives for PV'_{2015} for the two "no pump storage" cases, Tables 5-1 and 5-2 (spreadsheet columns D and K, row 16) differ by about one-half of one percent; so do the values which (6) gives for PV'_{2015} for the two "pump storage" cases, Tables 5-3 and 5-4 (spreadsheet columns D and K, row 33). Therefore, the Study Report authors must not have used $c_t = (1+\epsilon)^{t-2016}\, c_{2016}$, but something very slightly different. There is no way to know what that was (for example, the text "2017" does not appear in the report), so in column O, averages of the PV'_{2015} values derived from (6) for the two "no pump storage" cases given in the Study Report were calculated, and this average was used for the "no pump storage" PV'_{2015} in the rest of the spreadsheet. Similarly, in column O, averages of the PV'_{2015} values derived from (6) for the two "pump storage" cases given in the Study Report were calculated, and that average was used for the "pump storage" PV'_{2015} in the rest of the spreadsheet.

Appendix H

Survey of Water Price Elasticity Publications, Gail Blattenberger, PhD



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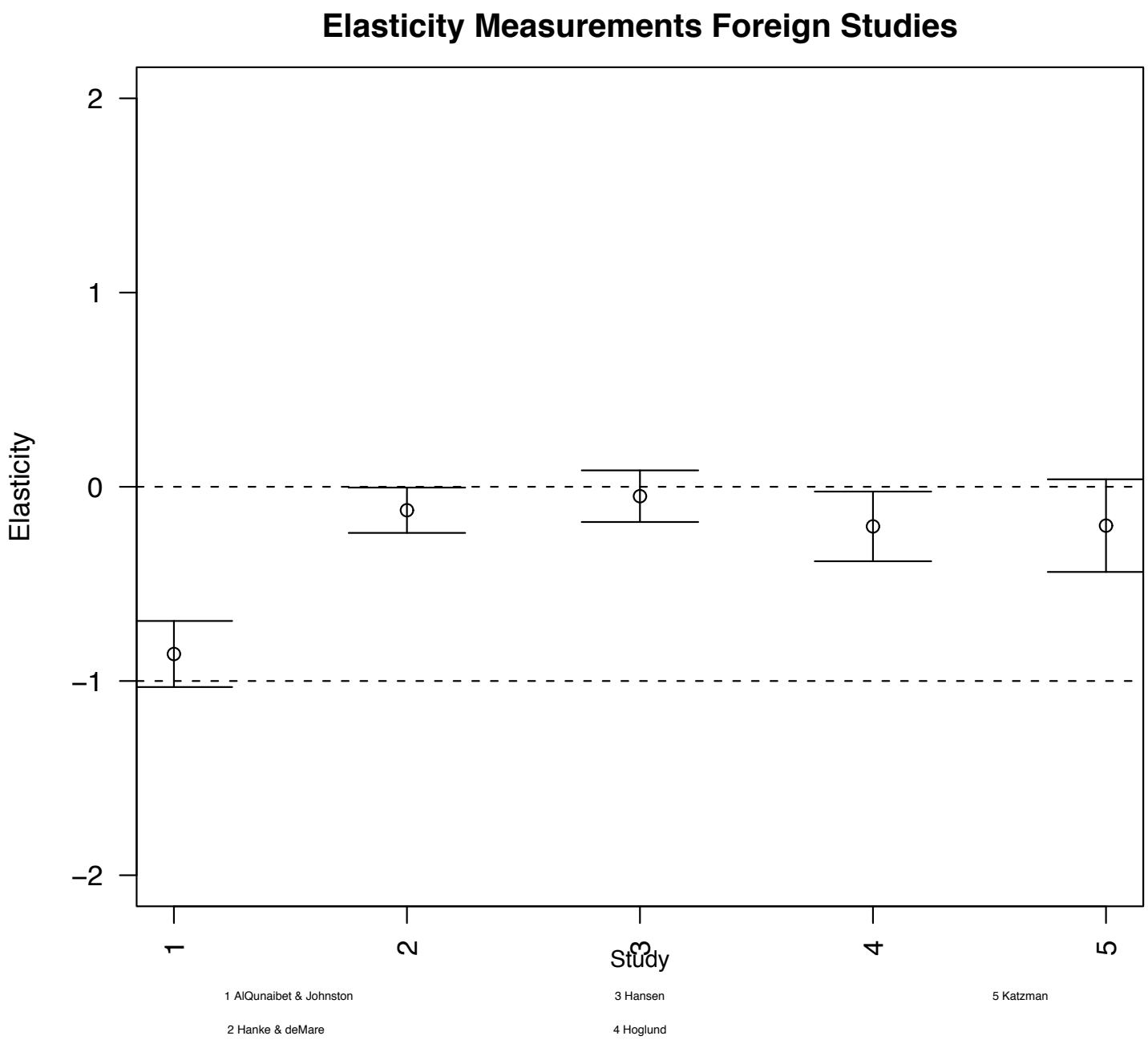
34 Williams
35 Young
36 Young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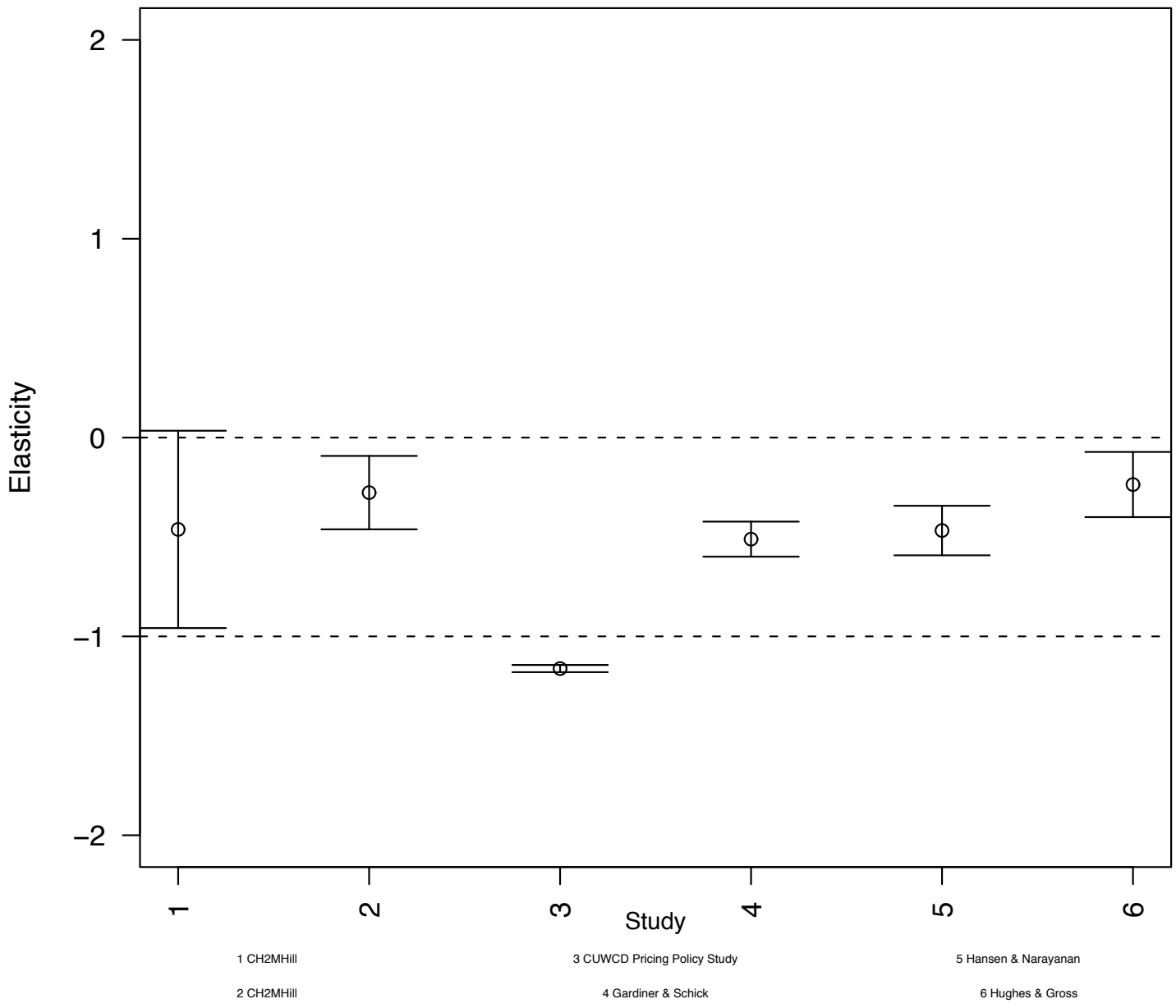
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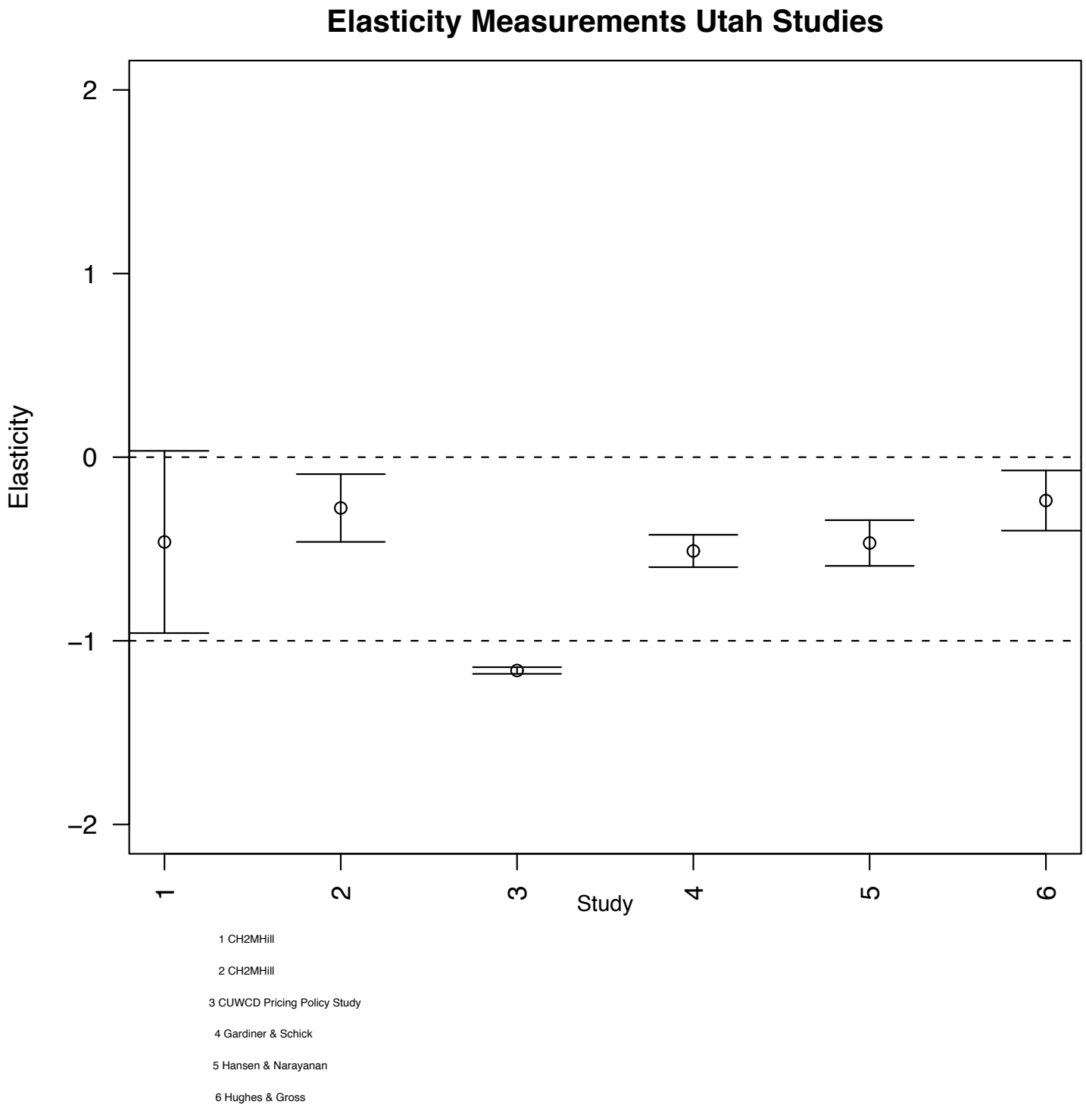
6 Hughes & Gross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4 Gardiner & Schick
5 Hansen & Narayanan
6 Hughes & Gross

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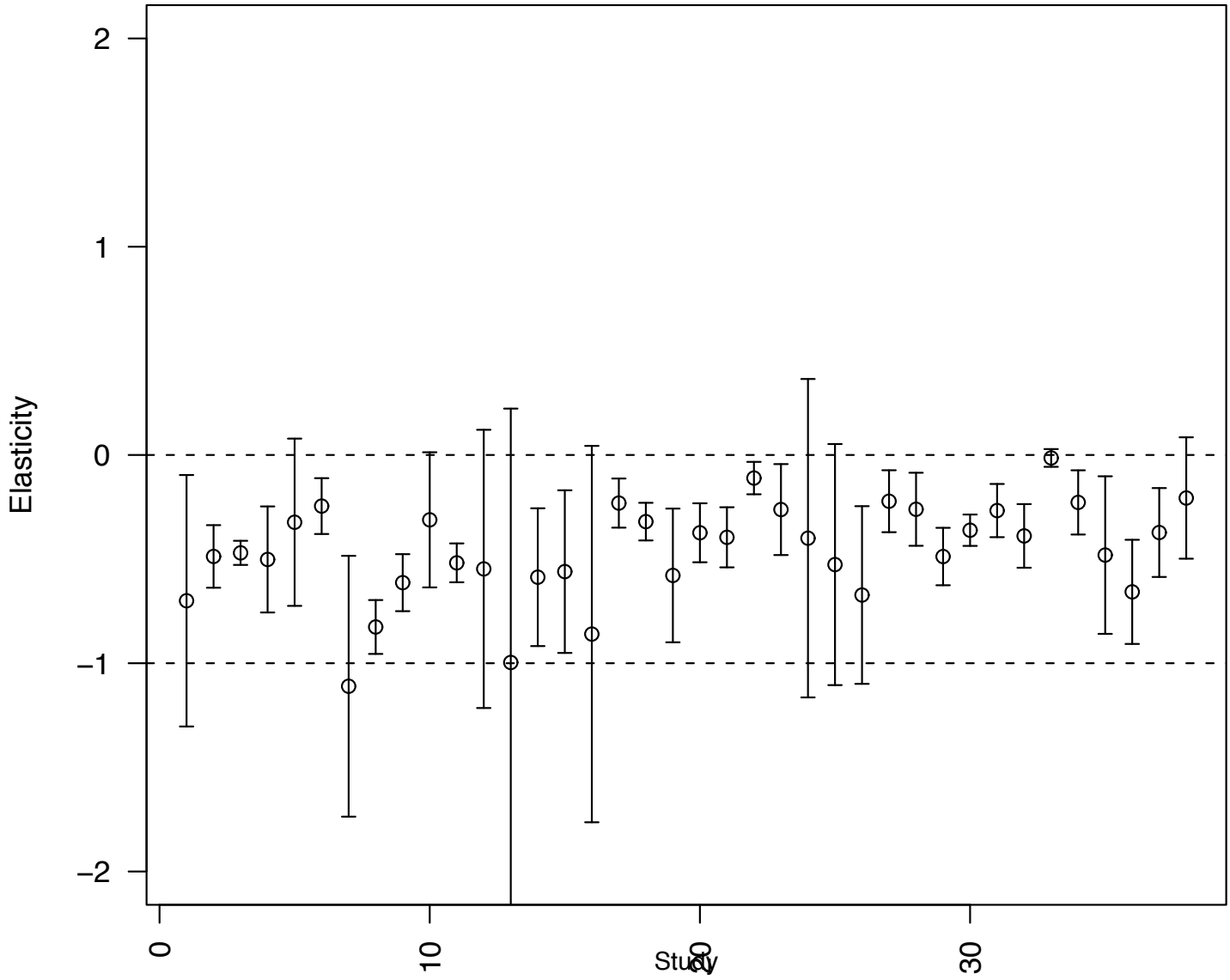

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5 Cochrane & Cotton
6 Danielson
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8 Deller, Chicoine, & Ramamurthy
9 Foster & Beattie
10 Fourt
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12 Gottlieb
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14 Grima
15 Hogarty & Mackay
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17 Howe & Lineweaver
18 Martin & Wilder
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23 Schneider & Whitlach
24 Stevens, Miller, Willis
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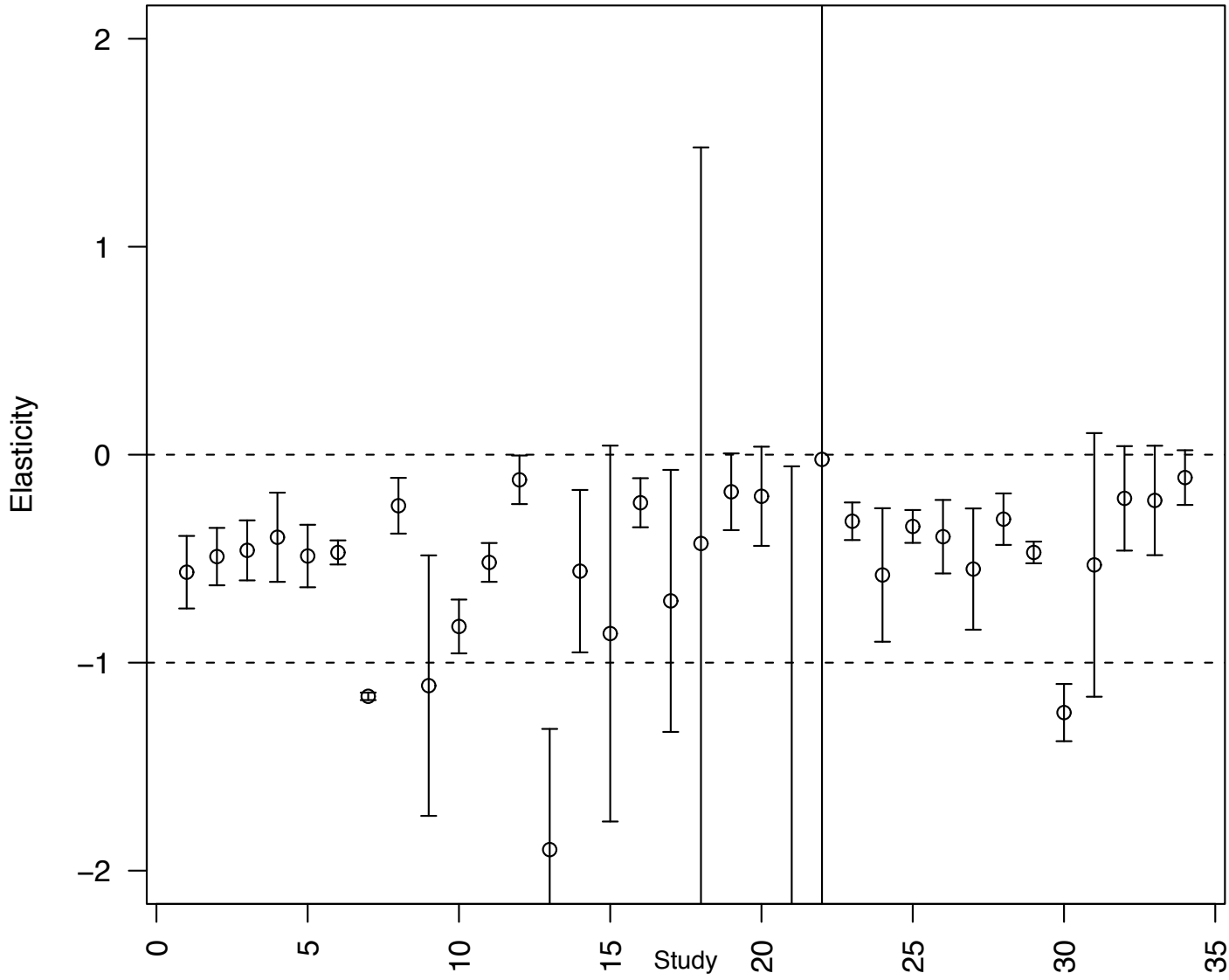

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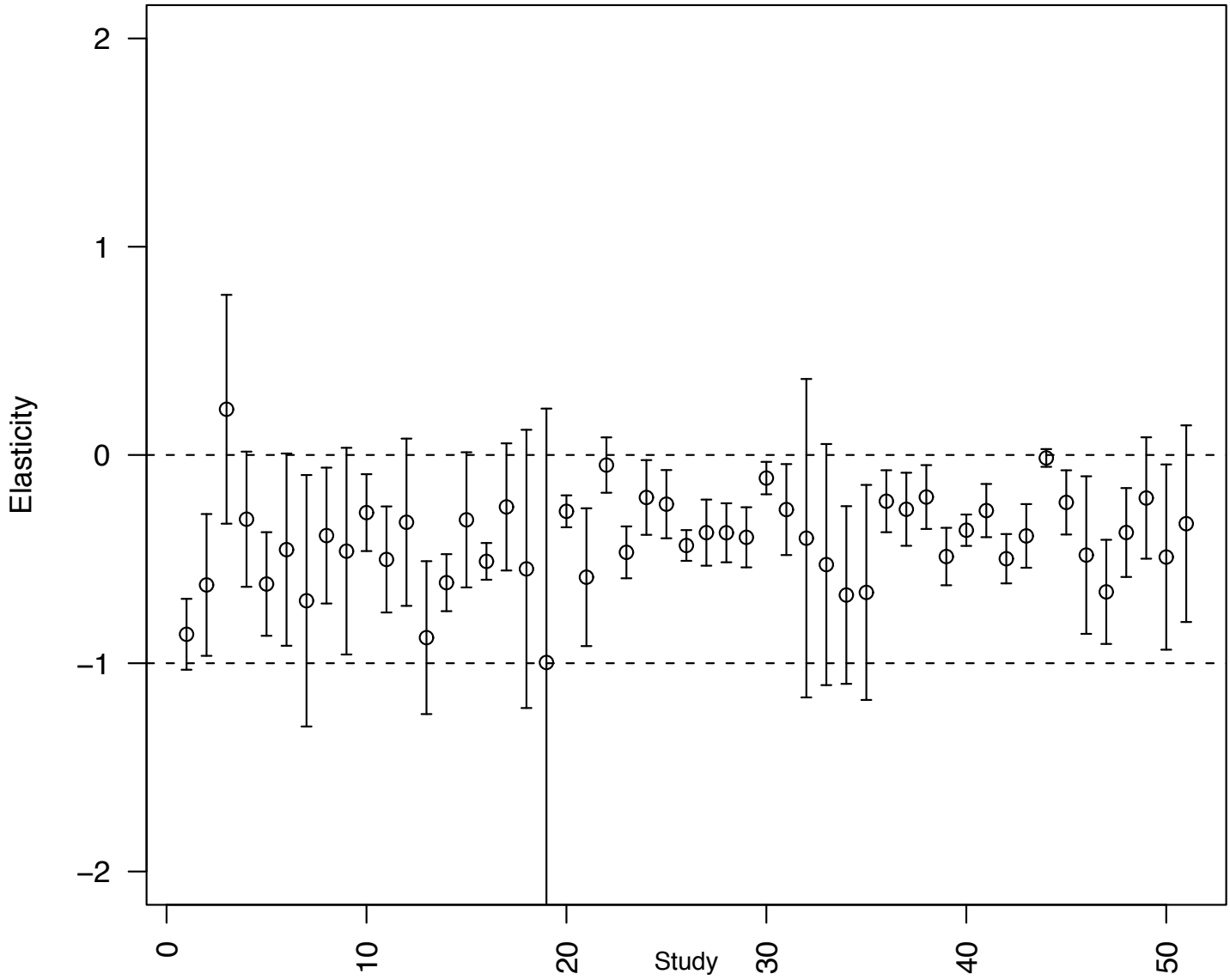

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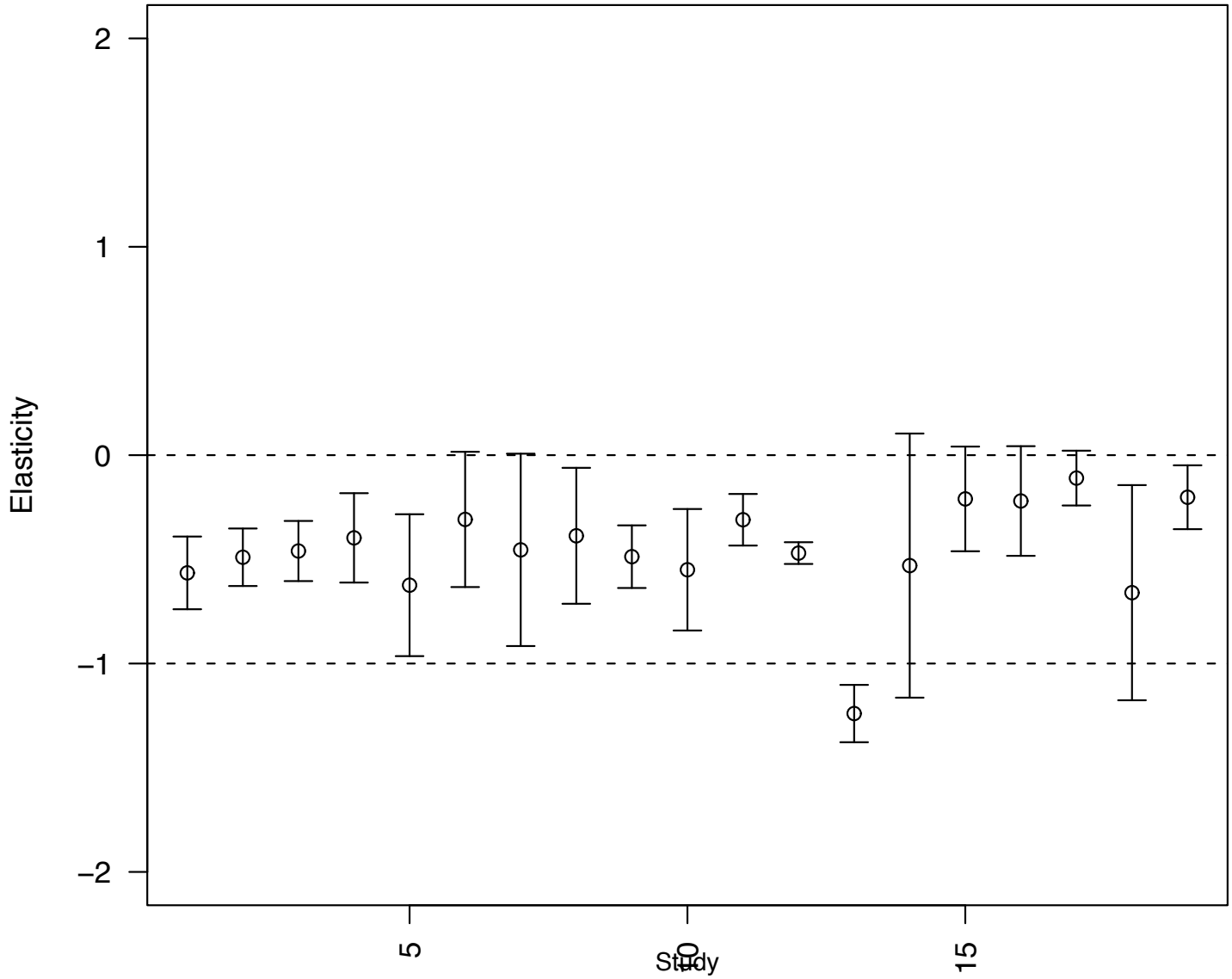

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15 Renwick & Archibald
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17 Renwick & Archibald
18 Timmins
19 Weber

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