Bond Refunding

Overview of Decision Aids

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The herd instinct among forecasters makes sheep look like independent thinkers.

- Edgar Fiedler

Trying to predict the future is like trying to drive down a country road at night with no lights while looking out the back window.

- Peter F. Drucker

Behavioral Finance

Rules of Thumb

- Arbitrary Heuristics or Rules of Thumb
  - 3-5% NPV Savings
  - A bird in hand is worth two in the bush.
- Alternative Consideration
  - Call Option Retained may be worth more than 3-5% NPV Savings.
- Human decision processes contain traits that bias our thought process away from a purely rational approach.
- Decision makers gravitate toward heuristics or rules of thumb to make decisions rather than a strict rigid rule of optimization.

Municipal Bond Refinancing

- Similar in some respects to home mortgage refinancing, but with some very significant differences.
  - Similarities
    - Pay off old debt with new debt.
    - Entails transaction costs.
  - Key Differences
    - IRS only permits one advance refunding, “one bite at the apple”.
    - Issuers cannot directly retire bonds before the call date.

What is a Refunding?

- Refunding - A current or advance refunding is a payoff of existing debt with the proceeds of a new bond issue.
  - Current Refunding – bonds are currently callable.
  - Advance Refunding – bonds with a future call date, necessitates the deposit of sufficient proceeds in an escrow account to retire the principal on the upcoming call date and to fund the interim interest payments, thereby legally defeasing the bonds.

Prudent Considerations

1. *Are material savings present from a refunding opportunity? What are the nominal savings and net present values savings as a percentage of the bonds to be refunded?*
2. *Given that only one advance refunding is permitted, should the refunding be undertaken now or should it be deferred for potentially higher future savings?*

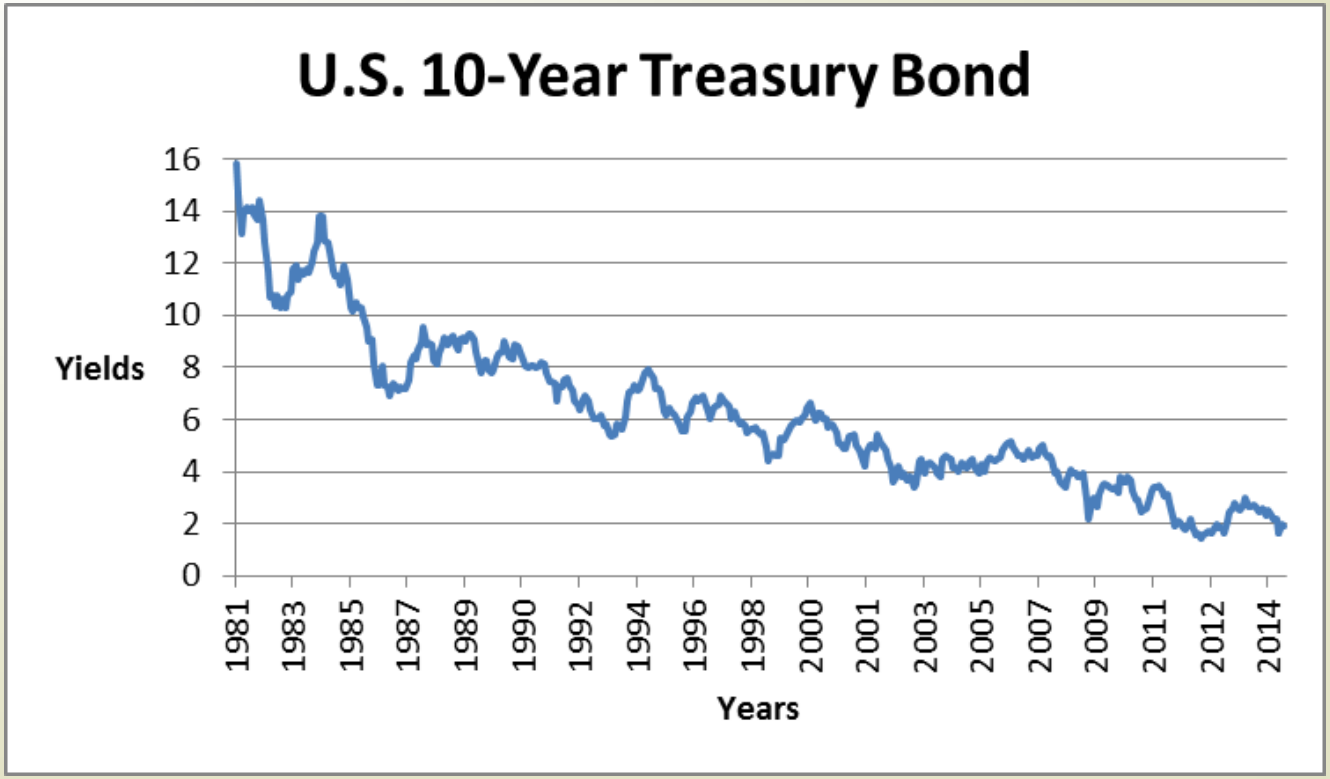
Now or Later?

Given that some industry professionals have cautioned that advance refundings merely accelerate interest savings at the expense of forgoing greater savings in the future, does a net present savings total provide enough information for management to make a refinancing timing decision?

Other Tools

- In addition to the calculation of NPV savings, consider:
  - Opportunity Cost Index (OCI) Calculation
    - Divides NPV savings now by NPV savings at the first call date using some historical average of the yield curve.
  - Refunding Efficiency (RE) Calculation
    - Net Present Value Savings / Loss in Option Value

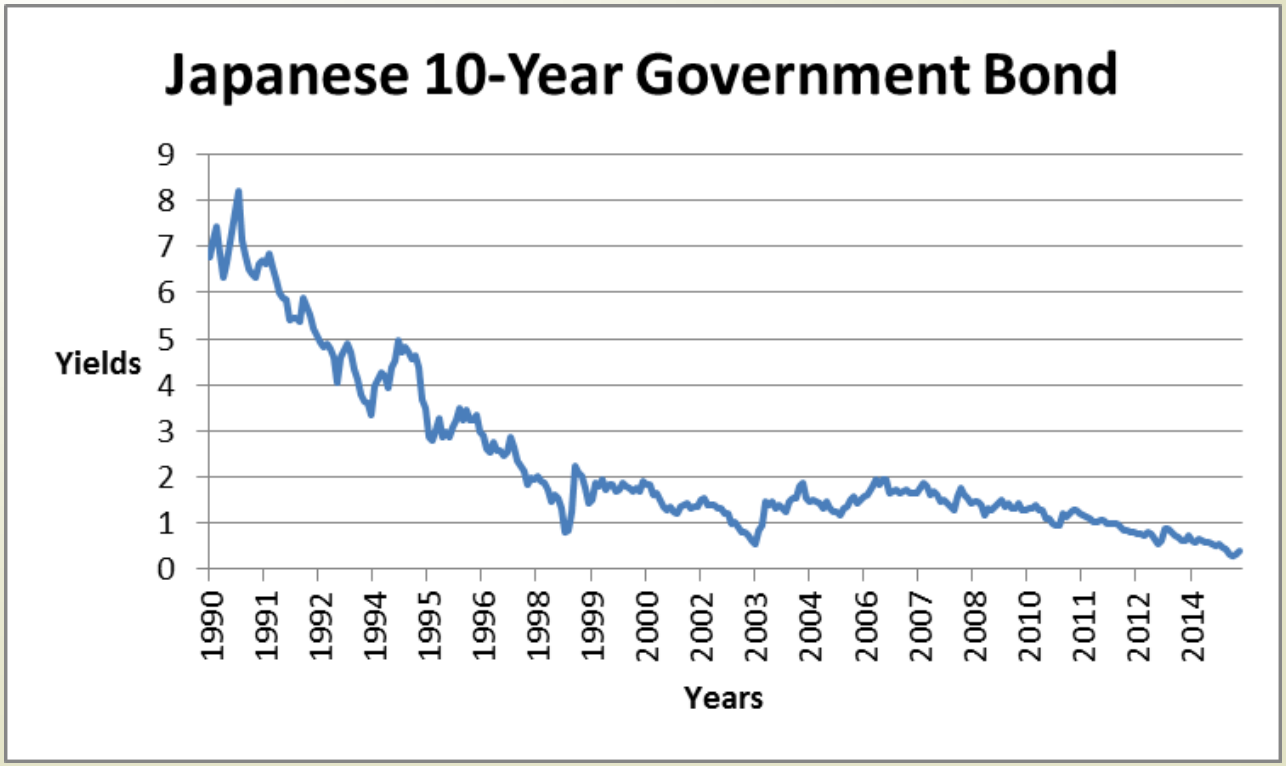
Anchoring



Anchoring – In the absence of any solid information, past yields are likely to act as anchors for expectations of future yields.

- Given the multi-decade downward trend in rates, are advance refundings on average suboptimal?

Sticky Expectations



Cognitive Dissonance – Mental conflict that people experience when they are presented with evidence that their beliefs or assumptions are wrong.

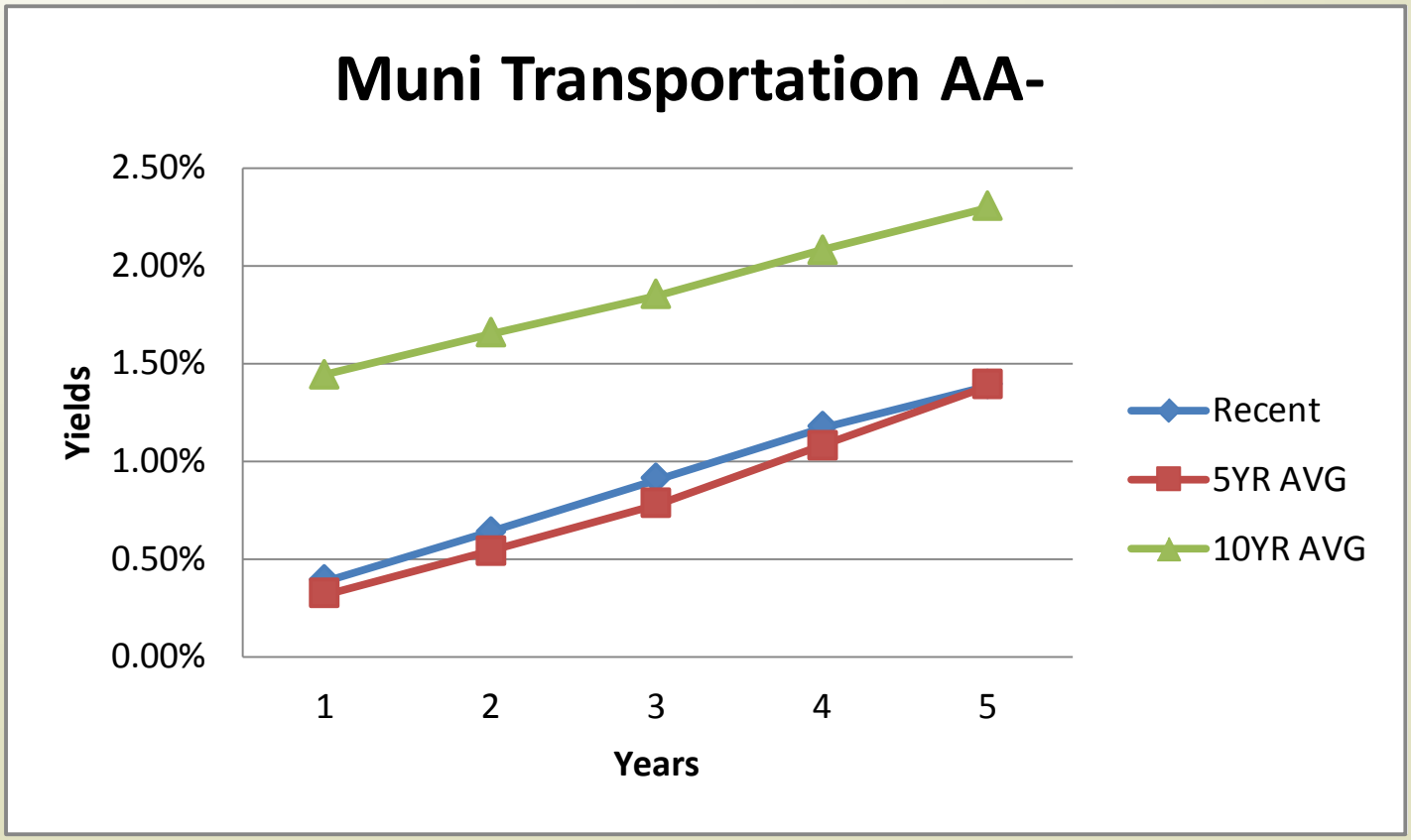
- How many issuers are evaluating or back-testing refunding decisions?

Premium Coupons & Yield Curve Roll

The premium couponing structure common in the tax-exempt municipal market means that future refunding opportunities are highly probable and the curve roll effect over time drives greater and greater refinancing savings in a steady rate environment.

Funding Curve

Year	Recent	5YR AVG	10YR AVG
1	0.39%	0.32%	1.44%
2	0.64%	0.54%	1.65%
3	0.91%	0.78%	1.85%
4	1.17%	1.08%	2.08%
5	1.39%	1.39%	2.30%



Opportunity Cost Index

- *Opportunity Cost Index (OCI)* = Current NPV Savings / Future Potential Savings
  - Considers the potential savings in the future using some average interest rate environment.
  - Calculated by dividing the current net present value savings by the NPV savings if the refunding is performed at the call date.
  - Methodology gives perspective on how much of the potential savings is lost to the negative arbitrage associated with the refunding escrow and accounts for the roll down the yield curve benefits.
    - Forward yield curve modeled at the call date could be higher or lower than the current prevailing rates.

Refunding Efficiency

- *Refunding Efficiency* (RE) = Net Present Value Savings / Loss in Option Value
- Considers the theoretical value of the call option, accounting for potentially upward and downward interest rate paths from current levels.
- The option value is how much could be saved based on the potential paths of interest rates, which gives some indication of how much the present opportunity captures the theoretical value of the option.
- Option value may be calculated using a binomial (interest rate tree) pricing model, consider the option value as savings derived from an average of the high and low values of future interest rate environments, not the maximum potential value or even the most probable value based on recent interest rate levels.

Decision Aids

- What are the current NPV savings as a percentage of the refunded bonds?
- How do the savings compare to the value of the call option as calculated by Refunding Efficiency? How much of the potential value is captured today?
- Factoring in the benefits of waiting to the first call date as shown in an OCI calculation; including the curve roll effect and elimination of the negative arbitrage associated with the refunding escrow, how do the current savings compare to the potential savings in the future if the yield curve is held constant or rates return to some prescribed historical average?

Scenario Analysis

- Helpful to calculate the breakeven rise in rates to make the issuer indifferent between an advance refunding and waiting until the call date.
- Breakeven rise in rates will account for both the elimination of the negative arbitrage and the benefit of the additional curve roll down effect.
- If the breakeven rise in rates seems unlikely or probable, then this may be additional support for the conclusions drawn from OCI and RE calculations.

Problems/Challenges

- Refunding Efficiency results showing efficiency above 100%. Indicates that a non-standard formula is being utilized that is exaggerating the savings potential.
- Arbitrage yields used as the discount rate in lieu of true interest costs incorporating costs of issuance or multiple discount rates for each maturity.
    - Lower discount rates upwardly distort the NPV savings.
- Savings efficiency calculations that compare the current savings now relative to the current savings without the negative arbitrage. Calculations of little value, tend to consistently show high ratios of savings and may not incorporate the curve roll and future rate environment.
- Unrealistic escrow yield assumptions.

Technical Considerations

- Call option includes both its intrinsic and time value.
- Time and interest rate volatility raise the value of the call option, or more simply, increase potential savings.
- Advance refunding escrows typically reduce the savings.
- Advance refundings miss the benefit of additional curve roll.
- Inappropriate discount rates generally upwardly distort present value savings.

Advance Refunding Justifications

- High percentage RE and OCI calculations.
- Debt service savings critically needed in current fiscal year, political/budgetary pressure.
    - Represents a tradeoff of smaller current savings versus potentially larger future savings.
- Small debt maturity may not be currently attractive individually, but is of insufficient size to be independently refunded in the future and there are no plans for future new money issuances.
- Short time frame to the call date and Federal Reserve is in the process of incrementally raising rates.

Conclusion

- Underwriters and Financial Advisors can make calculations to aid in the timing decision, but management should undertake to understand the inputs of these calculations and should at times dictate what is reasonable.
- Risk that the savings may diminish or be eliminated by a yield curve shift before the issuer can come to market. Financial advisor and bond counsel costs incurred are a waste of the issuer's financial resources.
- No clear decision rule for management.
  - **Not prudent to undertake a refinancing based solely on a NPV savings threshold of 3-5%.**
  - **Advisable for issuers to consider savings as both a percentage of the call option value and the potential savings in a future interest rate environment.**
- Given the long term downward trend of interest rates since the 1980s, it is worth considering how often greater savings could have been achieved with current- rather than advanced-refundings.
  - **Back-test previous advance refundings to calculate savings/loss associated with waiting to the call.**
- Pattern of suboptimal timing decisions by an issuer or the market in general suggests that there may be a systemic proclivity toward paying higher debt service costs than necessary.

Helpful References

- http://kalotay.com/news/kalotay-helps-massachusetts-create-new-refunding-guidelines
- http://www.massbondholder.com/sites/default/files/files/Massachusetts%20Refunding%20Guidelines%20April%202013_1.pdf

Decision Aids

(Refund now or later?)

Opportunity Cost Index			
			Reference
Advance Refunding NPV Savings	$	1,531,557	A
Future Refunding @ 5YR AVG Rates	$	2,189,002	B
Future Refunding @ 10YR AVG Rates	$	1,645,173	C
OCI 5YR AVG Rates		70%	A/B
OCI 10YR AVG Rates		93%	A/C

Refunding Efficiency			
			Reference
Advance Refunding NPV Savings	$	1,278,281	A
Option Value Change	$	1,591,614	B
Refunding Efficiency		80%	A/B

Amortization Table

GARVEE Series 2008

Dated	12/18/08
Callable	3/1/19

Period Ending	Principal	Interest	Debt Service	Bonds Outstanding
3/1/2009		4,272,911	4,272,911	425,000,000
9/1/2009		10,535,944	10,535,944	425,000,000
3/1/2010	30,295,000	10,535,944	40,830,944	394,705,000
9/1/2010		9,930,044	9,930,044	394,705,000
3/1/2011	31,505,000	9,930,044	41,435,044	363,200,000
9/1/2011		9,170,419	9,170,419	363,200,000
3/1/2012	33,025,000	9,170,419	42,195,419	330,175,000
9/1/2012		8,388,544	8,388,544	330,175,000
3/1/2013	34,585,000	8,388,544	42,973,544	295,590,000
9/1/2013		7,560,894	7,560,894	295,590,000
3/1/2014	36,245,000	7,560,894	43,805,894	259,345,000
9/1/2014		6,681,019	6,681,019	259,345,000
3/1/2015	38,000,000	6,681,019	44,681,019	221,345,000
9/1/2015		5,716,644	5,716,644	221,345,000
3/1/2016	39,930,000	5,716,644	45,646,644	181,415,000
9/1/2016		4,693,481	4,693,481	181,415,000
3/1/2017	41,975,000	4,693,481	46,668,481	139,440,000
9/1/2017		3,607,638	3,607,638	139,440,000
3/1/2018	44,150,000	3,607,638	47,757,638	95,290,000
9/1/2018		2,468,575	2,468,575	95,290,000
3/1/2019	46,425,000	2,468,575	48,893,575	48,865,000
9/1/2019		1,249,919	1,249,919	48,865,000
3/1/2020	48,865,000	1,249,919	50,114,919	-
Total	425,000,000	144,279,148	569,279,148	

Current Refunding Scenario

(What if bonds were currently callable?)

Current Refunding Scenario at 3/1/19 Call Date, Rates Unchanged									
	Existing Bonds			Refunding Bonds					
				A				B	A-B
	Coupon	Principal	Interest	Prior Debt Service	Coupon	Principal	Interest	Refunding Debt Service	Savings
3/1/2019				-48,865,000				-49,013,865	
9/1/2019			1,249,919	1,249,919			95,577	95,577	1,154,342
3/1/2020	5.12%	48,865,000	1,249,919	50,114,919	0.39%	49,013,865	95,577	49,109,442	1,005,477
									2,159,818
Existing Bonds TIC	5.17%								
Refunding Bonds TIC	0.39%								
Nominal Savings	$ 2,159,818								
NPV Savings	$ 2,153,673								
NPV Savings % Par	4.41%								
Cost of Issuance	$ 148,865								

Advance Refunding Scenario

(Refund now?)

Advance Refunding Scenario at 3/1/15, Rates Unchanged

	Existing Bonds				Refunding Bonds					
	Coupon	Principal	Interest	A Prior Debt Service	Coupon	Principal	Interest	B Refunding Debt Service	A-B Savings	Annual DS Savings
3/1/2015				-48,865,000				-56,186,239.7		
9/1/2015			1,249,919	1,249,919			365,557	365,557	884,362	
3/1/2016			1,249,919	1,249,919	0.39%	1,750,000	368,969	2,118,969	-869,051	15,311
9/1/2016			1,249,919	1,249,919			365,557	365,557	884,362	
3/1/2017			1,249,919	1,249,919	0.64%	1,750,000	365,557	2,115,557	-865,638	18,724
9/1/2017			1,249,919	1,249,919			359,957	359,957	889,962	
3/1/2018			1,249,919	1,249,919	0.91%	1,775,000	359,957	2,134,957	-885,038	4,924
9/1/2018			1,249,919	1,249,919			351,881	351,881	898,038	
3/1/2019			1,249,919	1,249,919	1.17%	1,775,000	351,881	2,126,881	-876,962	21,076
9/1/2019			1,249,919	1,249,919			341,497	341,497	908,422	
3/1/2020	5.11580%	48,865,000	1,249,919	50,114,919	1.39%	49,136,240	341,497	49,477,737	637,182	1,545,604
									1,605,639	1,605,639

Cost of Issuance	$ 285,000
Existing Bonds TIC	5.17%
Refunding Bonds TIC	1.36%
Nominal Savings	$ 1,605,639
NPV Savings	$ 1,531,557
NPV Savings % Par	3.13%
Escrow Requirement	$ 55,901,240
Escrow IRR	1.41%

Escrow Requirements

(Legal defeasance escrow funding requirements.)

Escrow Requirements

	Interest	Principal Redeemed	Total
9/1/2015	1,249,919		1,249,919
3/1/2016	1,249,919		1,249,919
9/1/2016	1,249,919		1,249,919
3/1/2017	1,249,919		1,249,919
9/1/2017	1,249,919		1,249,919
3/1/2018	1,249,919		1,249,919
9/1/2018	1,249,919		1,249,919
3/1/2019	1,249,919	48,865,000	50,114,919
			58,864,350

Escrow Funding Requirement

Type of Security	Maturity	Par	Rate			Escrow Cash Flow
					3/1/2015	55,901,240
Zero Coupon	9/1/2015	1,246,425	0.07%	1,246,425	9/1/2015	-1,249,919
Zero Coupon	3/1/2016	1,237,497	0.25%	1,237,497	3/1/2016	-1,249,919
Zero Coupon	9/1/2016	1,226,694	0.47%	1,226,694	9/1/2016	-1,249,919
Zero Coupon	3/1/2017	1,216,008	0.69%	1,216,008	3/1/2017	-1,249,919
Zero Coupon	9/1/2017	1,205,438	0.91%	1,205,438	9/1/2017	-1,249,919
Zero Coupon	3/1/2018	1,195,929	1.11%	1,195,929	3/1/2018	-1,249,919
Zero Coupon	9/1/2018	1,187,920	1.28%	1,187,920	9/1/2018	-1,249,919
Zero Coupon	3/1/2019	47,385,329	1.41%	47,385,329	3/1/2019	-50,114,919
		55,901,240		**55,901,240**		
IRR	1.41%					

Future Refunding at Call Date

(Opportunity Cost Index - What if you wait?)

Future Current Refunding Scenario at 3/1/19 Call Date, Rates at 5-Year Average

	Existing Bonds				Refunding Bonds				
				A				B	A-B
	Coupon	Principal	Interest	Prior Debt Service	Coupon	Principal	Interest	Refunding Debt Service	Savings
3/1/2019				-48,865,000				-49,013,865	
9/1/2019			1,249,919	1,249,919			78,422	78,422	1,171,496.57
3/1/2020	5.12%	48,865,000	1,249,919	50,114,919	0.32%	49,013,865	78,422	49,092,287	1,022,631.57
									2,194,128.13
Existing Bonds TIC	5.17%								
Refunding Bonds TIC	0.32%								
Nominal Savings	$ 2,194,128								
NPV Savings	$ 2,189,002								
NPV Savings % Par	4.48%								
Cost of Issuance	$ 148,865								

Future Current Refunding Scenario at 3/1/19 Call Date, Rates at 10-Year Average

	Existing Bonds				Refunding Bonds				
				A				B	A-B
	Coupon	Principal	Interest	Prior Debt Service	Coupon	Principal	Interest	Refunding Debt Service	Savings
3/1/2019				-48,865,000				-49,013,865	
9/1/2019			1,249,919	1,249,919			352,900	352,900	897,018.92
3/1/2020	5.12%	48,865,000	1,249,919	50,114,919	1.44%	49,013,865	352,900	49,366,765	748,153.92
									1,645,172.84
Existing Bonds TIC	5.17%								
Refunding Bonds TIC	1.44%								
Nominal Savings	$ 1,645,173								
NPV Savings	$ 1,628,088								
NPV Savings % Par	3.33%								
Cost of Issuance	$ 148,865								

Refunding Efficiency

Kalotay Analytics
A DIVISION OF ANDREW KALOTAY ASSOCIATES, INC.

Refunding+™

206.20140717

PVDate	3/1/2015
Price	
Coupon	

Fee (%)	0.35
CurveType	Muni
Cash	

157101952

Refunded	143676240
Dated	12/18/2008
Maturity	3/1/2020
Coupon	5.12
_Daycount	30_360
_Frequency	Semiannual
_Method	Muni
_Issue	
_First	
_Last	
_Face	48,865,000
_ExDays	
_PayDay	
_Redemption	

Call	159030168
Type	American
Delay	0
Date	3/1/2019
CallPrice	100
_FirstPar	
_Freq	Semiannual
_LastPar	

_Sink	0
Date	Amount

157101776

Refunding	158512952
Dated	3/1/2015
Maturity	3/1/2020
Coupon	1.42
_Daycount	30_360
_Frequency	Semiannual
_Method	Muni
_Issue	
_First	
_Last	
_Face	56,353,757
_ExDays	
_PayDay	
_Redemption	

Call	0
Type	None
Delay	0
Date	
CallPrice	100
_FirstPar	
_Freq	Semiannual
_LastPar	

_Sink	0
Date	Amount

Report	
PVDate	3/1/2015
Savings	1,278,281
OptionLoss	1,591,614
Efficiency	80.31
OldPV	57,632,037
NewPV	56,353,757
OldCall	1,206,515
OldAdvRef	385,099
OldOption	1,591,614
NewOption	0
NegativeArb	299,529
RefCoupon	1.42
RefundingFace	56,353,757
FairRefPrice	100.00
YTC	1.423
YTM	1.423