



THE CITY OF NEW YORK  
INDEPENDENT BUDGET OFFICE

110 WILLIAM STREET, 14<sup>TH</sup> FLOOR  
NEW YORK, NEW YORK 10038  
(212) 442-0632 • FAX (212) 442-0350 • EMAIL: [iboenews@ibo.nyc.ny.us](mailto:iboenews@ibo.nyc.ny.us)  
<http://www.ibo.nyc.ny.us>

November 2008

**Increasing Costs of the Croton Filtration Plant at Mosholu**

**SUMMARY**

Faced with a court order to begin filtering water from the Croton watershed portion of the city's water supply, the city is constructing a water filtration plant under the Mosholu golf course in Van Cortland Park in the Bronx. In 2003, the Department of Environmental Protection (DEP) estimated the cost of constructing the Croton Filtration Plant at Mosholu to be \$992 million in constant 2003 dollars. Site preparation began in 2004 and plant construction started last year. Currently, plant construction costs are estimated to be \$2.2 billion, a 119 percent increase. Total costs for the project, which include amenities, such as parks, and mitigation measures, will exceed \$3.1 billion dollars.

The Croton Facility Monitoring Committee, which includes DEP, the Department of Parks and Recreation, local community boards and local elected officials, asked IBO to explain the "growth in the plant's estimated cost." IBO's expertise is in budgeting and economic analysis. Therefore its review of the Croton project did not constitute an audit nor did we conduct any review of the engineering or design of the plant.

The costs for the Croton plant have grown since the original estimates for several reasons: a more refined and somewhat expanded scope of work; delays in the bidding and awarding of the contracts; and, most importantly, significant increases in construction costs since the publication of the \$992 million (2003 dollars) estimate.

IBO's review of current cost estimates for the project shows:

- Construction cost more than doubled since the initial estimate in 2003 dollars was published.
- General construction cost escalation explains 45 percent of the increase in construction costs.
- A limited bidding pool probably also contributed to increased costs.
- Scope changes following bidding were not a substantial factor.
- Cost escalation was not unique to the Mosholu site and would have impacted alternative sites as well.

## INTRODUCTION

The decision to place the Croton Filtration Plant at Mosholu came after an extensive environmental impact statement (EIS) that examined and compared several alternative locations, including Eastview in Westchester County and a site along the Harlem River. Although there was initial resistance to locating the plant under the Mosholu golf course in Van Cortlandt Park, the EIS concluded that the Mosholu site was the best choice for several reasons. Among them, the \$992 million (2003 dollars) estimated construction cost was cheaper there than elsewhere, even including \$243 million in mitigation and amenities, which were much higher than the \$40–\$50 million required for these components at other sites.

## FINDINGS

***Growth in Costs at Croton.*** In 2003, plant construction costs for the Croton Filtration Plant were estimated at \$992 million in constant 2003 dollars, which included site preparation, tunneling, plant construction, and off-site work. In fiscal year 2009, estimates for these construction costs rose to \$2.17 billion, a 119 percent increase. Site preparation, now complete, cost \$120 million. The raw and treated water tunnels will cost about \$215 million. The most expensive components are the contracts for the construction of the water filtration plant that total \$1.67 billion. The estimate for off-site work at Jerome Park Reservoir and Hunts Point was recently updated and is now \$172 million (from \$40 million in 2003). One of the three off-site contracts has been awarded this fall, with the other two slated to be bid on this winter.

The EIS estimated the costs of the Croton plant, with mitigation and amenities included, at \$1.24 billion (2003 dollars). Today, comparable costs have nearly doubled to \$2.41 billion.

A number of components were omitted from the EIS estimate. First, the cost of reconstruction of the New Croton Aqueduct (NCA) was excluded because the work needs to be completed regardless of whether the filtration plant was built at Mosholu or at another site. Hence, DEP does not consider the NCA reconstruction costs as part of the Croton plant. DEP estimated that NCA reconstruction would cost \$55 million in 2003; today, the estimate is \$140 million. Secondly, the EIS estimate excluded costs for design and construction management, additional mitigation (including reconstruction of the Club House and security features), and inter-fund agreements (whereby capital funds are used to cover city operating costs, such as design or management staff). These costs were omitted entirely in the fiscal year 2003 estimates for Mosholu and the other sites, and now exceed \$525 million in fiscal year 2009.

Combining plant construction, mitigation and amenities, and omitted costs, the 2003 aggregate costs were estimated at \$1.29 billion. By fiscal year 2009 these costs had surged to \$3.08 billion, an increase of 138 percent.

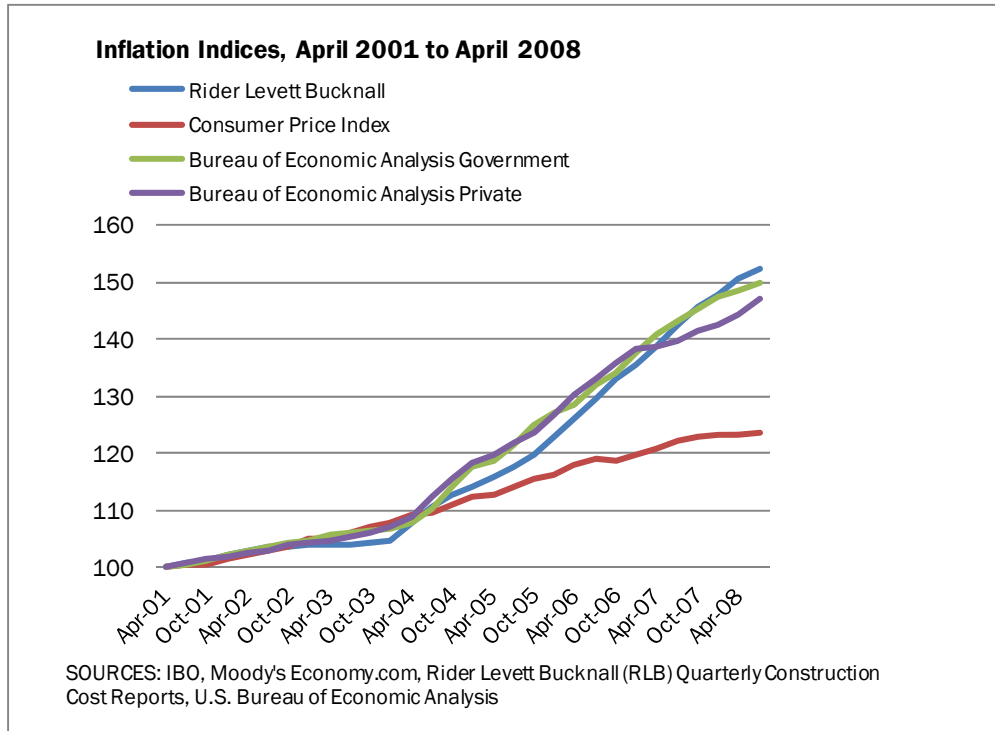
<b>Growth in Costs at Croton, by Project Detail, Using DEP Cost Estimates</b>				
<b>Project Detail</b>	<b>Contracts</b>	<b>2003 Estimate</b>	<b>FY 2009 Estimate</b>	<b>Percentage Change</b>
<b>Construction Costs Included in EIS</b>				
Site Prep	CRO-311	\$117,097,856	\$119,538,421	2.1%
Tunnel	CRO-313	169,707,038	214,820,230	26.6%
Plant	CRO-312G, CRO-312H, CRO-312P, CRO-312E1/E2	665,251,587	1,665,774,688	150.4%
Off-Site	CRO-312OS, CRO-312HP, CRO- 312FM	40,406,438	171,676,000	324.9%
Subtotal (Construction Costs in EIS)		\$992,462,918	\$2,171,809,339	118.8%
<b>Other Costs Included in EIS</b>				
Mitigation and Amenities Total		\$243,000,000	\$243,168,154	0.1%
Subtotal (Costs Included in EIS)		\$1,235,462,918	\$2,414,977,494	95.5%
<b>Costs Not Included in EIS</b>				
NCA Reconstruction Total		\$55,485,000	\$140,394,223	153.0%
Design and Construction Management		No initial	326,908,161	
Additional Mitigation (Club House and First Tee)		breakdown	106,833,520	
Interfund Agreements		provided	91,732,540	
Subtotal (Costs Not Included in EIS)		\$55,485,000	\$665,868,444	
<b>TOTAL</b>		<b>1,290,947,918</b>	<b>3,080,845,937</b>	<b>138.6%</b>
SOURCES: IBO; Department of Environmental Protection				
NOTES: *Plant includes CRO-312G, General; CRO-312H, HVAC; CRO-312E1&E2, Electric; and CRO-312P, Plumbing				
**Off-site includes CRO-312OS, Off-site at Jerome Park Resvr; CRO-312HP, Upgrades to Hunts Point; and CRO-312FM, Force Main to Hunts Point				

**Measuring Construction Inflation.** Driven by inflation, the cost of construction has grown rapidly in New York in recent years. Inflation, a rise in general level of prices of goods and services over a period of time, explains in part the rising costs of the Croton plant. Generally, an index is used to measure inflation. The index measures the change in the cost of a fixed “basket” of goods and services at two points in time, controlling for changes in quality over time. The most widely used gauge of inflation, the Consumer Price Index (CPI), published monthly by the U.S. Department of Labor, tracks the cost of a set of consumer goods and services, such as housing, food, energy, and clothing.

However, the CPI is not appropriate for measuring the increase in construction costs because the “basket” it tracks does not represent the inputs (steel, concrete, and skilled labor) used in construction. Instead, IBO considered three indices that measure construction price growth: 1) Rider Levett Bucknall Index (RLB); 2) U.S. Bureau of Economic Analysis Index for public construction and 3) U.S. Bureau of Economic Analysis Index for private construction.

These three construction indices, along with the CPI for comparison, are shown in the graph (all four are indexed to 2001). The CPI shows the slowest growth of the four, about 19 percent from 2003 through July 2008. The three construction indices move closely together over the entire period; the RLB National Construction Index grew almost 50 percent between 2003 and July 2008. For the construction indices, growth remained steady from 2001 to 2004 (consistent, in fact, with the CPI), before a significant breakout in April 2004 when construction costs began to

grow more rapidly. Around this time, there were significant increases in the cost of materials, including structural steel, concrete, copper and fuel (which hit record levels earlier this year although they have now fallen back). Additionally, the worldwide building boom and the national and international demand for construction supplies are also responsible for this growth.



**Construction Inflation in New York City.** IBO considered whether the national construction indices were representative of the construction market in New York City. First, trends in growth of wages in the city's construction sector have been similar to national trends, supporting use of a national index. Additionally, the growth in the RLB index nationally is similar to the growth in costs for the city from 2004 to 2008, according to the New York Building Congress, which represents the design, construction, and real estate industries. The Building Congress does not prepare a formal index that IBO could use. Consequently, IBO considered other national indices as well as data on New York City in determining that the RLB index was appropriate for estimating construction cost growth at Croton.

**Construction Inflation at the Croton Filtration Plant.** IBO found that construction inflation accounts for 45 percent of the increase in plant construction between the 2003 and 2009 estimates and 54 percent of the increase in all costs included in the EIS.

In order to adjust each contract for construction inflation, IBO applied the RLB inflation index through the midpoint of each contract.<sup>1</sup> Using this standard methodology, IBO found that though planned costs for site preparation and tunneling were higher than estimated in the EIS, they were lower than they would be if contract prices had matched general construction inflation. As these two contracts were the earliest to be bid on, it is expected that the actual bids would both be closer to the 2003 estimate and less influenced by rapid construction inflation in the last couple of years.

However, the contracts that comprise plant construction more than doubled since 2003. Cost growth consistent with the construction inflation index would account for about 40 percent of that growth. These contracts were bid in the summer of 2006 during a period of high construction activity in the city and rapid cost inflation.

The cost for the off-site work has more than quadrupled since 2003 and only 24 percent of the increase can be explained by inflation. The fiscal year 2009 figures are DEP estimates as only one of three contracts for off-site has been bid to date.

The escalation to midpoint for parks and amenities also shows an inflation adjustment although these projects are still priced the same by DEP in fiscal year 2009 as they were in the EIS. Assuming inflation has affected the costs of these projects, the fixed amount allocated will likely result in smaller scale projects unless additional funding is forthcoming.

<b>Growth in Plant Construction Costs at Croton, by Contract, Using IBO Restated Estimates</b>					
<b>Contract</b>	<b>Description</b>	<b>2003 DEP Estimate</b>	<b>Escalation to Construction Midpoint</b>	<b>2009 DEP Planned</b>	<b>Share of Increase Due to General Escalation</b>
<b>Costs Included in EIS</b>					
CRO-311	Site Prep	\$117,097,856	\$138,539,103	\$119,538,421	
CRO-313	Tunnel	169,707,038	259,113,556	214,820,230	
	Plant	665,251,587	1,057,502,578	1,665,774,688	39.2%
	Off-site	40,406,438	71,649,066	171,676,000	23.8%
	Construction Subtotal	\$992,462,918	\$1,526,804,304	\$2,171,809,339	45.3%
<b>Other Costs Included in EIS</b>					
	Mitigation and Amenities Subtotal	\$243,000,000	\$356,612,213	\$243,168,154	
<b>TOTAL for Costs Included in EIS</b>		<b>\$1,235,462,918</b>	<b>\$1,883,416,517</b>	<b>\$2,414,977,494</b>	<b>54.9%</b>
SOURCES: IBO; Department of Environmental Protection					
NOTES: *For Mitigation and Amenities, costs inflated to start of current fiscal year.					
**IBO projections made using the Rider Levett Bucknell (RLB) National Construction Index. For midpoints later than July 2008, RLB Index grown at 2 percent per quarter (average quarterly growth from July 2006 to July 2008). For 2003 estimates with no contract level detail, but numerous construction midpoints, 2003 estimate allocated to contracts based on 2009 shares and grown accordingly.					

**Construction Inflation at Other Sites.** The increased cost at Mosholu due to inflation is not unique to that site. It would likely have occurred at the other sites as well because of their geographic proximity. The general cost escalation driven by markets for labor and materials would have applied equally to all of them. Assuming cost increases consistent with the construction inflation index through the expected midpoint of construction, Mosholu construction costs would have been \$1.5 billion. Based on IBO's estimates, the costs would be \$1.9 billion at Eastview (with Kensico City Tunnel) or \$2.5 billion (using the New Croton Aqueduct), and \$1.9 billion at Harlem River.

Furthermore, the part of the Croton project which saw the greatest growth in cost, the water filtration plant, was similar in design to the other sites; thus it is likely that Eastview and Harlem River would also have seen similar growth in plant construction costs. The three sites differed most in that Mosholu required extensive site preparation (because the plant is underground), while longer distances from the aqueducts required longer raw and treated water tunnels at

Eastview and Harlem River. These differences likely offset each other, though neither the tunneling nor site preparation costs grew beyond construction inflation at Mosholu.

<b>Comparison of Original Estimates and Projected Costs</b>		
<i>Dollars in millions</i>		
	<b>Fiscal Year 2003</b>	<b>Construction Midpoint</b>
Mosholu	\$992.0	\$1,526.8
Eastview NCA	1,546.0	2,455.8
Eastview KCT	1,196.0	1,899.9
Harlem River	1,174.0	1,864.9

SOURCES: IBO; Department of Environmental Protection  
 NOTES: \*Adjustments made using Rider Levett Bucknell (RLB) National Construction Index. Mosholu estimate based on individual contract escalation to midpoint. Eastview and Harlem River escalation to July 2009, the construction midpoint for the plant at Mosholu. If the entire Mosholu estimate were escalated to July 2009 the projection would be \$1,576 million, or \$50 million more than escalation by contract.

**Other Factors Behind Increased Costs.** Since construction inflation explains less than half the increase in costs at Croton, IBO considered other possible drivers, including changes in scope, change orders, number of bidders, and bidding environment.

DEP states that significant refinements of the design and estimates made after the initial conceptual design used in the EIS explain why actual bids turned out far higher than first anticipated. However, the estimate for the conceptual design included a 30 percent design contingency, meaning that the cost increase attributable to refining the design was well in excess of 30 percent of the initial estimate. On the other hand, few change orders have been registered for these contracts to date, suggesting that the design at bidding was realistic and complete and presumably substantially different from the conceptual design used in the EIS cost estimates.

The number of bidders for a contract can impact the cost as greater competition generally yields lower bids. The general construction contract for the plant (currently \$1.3 billion dollars) had only two bidders, which may have contributed to higher costs. It's worth noting that the bid took place in 2006 as construction activity in the city reached boom levels which resulted in a sellers' (bidders') market. Further, after negotiations with the city, the lowest bidder on that contract withdrew and the city awarded the contract to the second bidder at \$200 million higher than the lowest bidder.

The early contracts saw growth below the rate of inflation in the RLB cost index. These contracts were smaller than for the plant construction itself, which meant that more firms had the capacity to handle the work and they were bid early in the process, before construction activity in the city increased greatly. It is likely that the remaining contracts for off-site work, also for smaller scale projects, are likely to attract more bidders as the construction market in New York City slows, which may temper the growth of those costs in the future.

**Other Questions.** Despite an examination of the impact of inflation and other factors on cost increases, questions still remain about what is driving the costs of construction at Mosholu.

Namely, how much of the cost increase was due to design changes after the EIS, especially as the EIS allowed for 30 percent design contingency. Was construction cost escalation higher in New York City than the inflation measured by the national indices? While growth in wage rates in the city was similar to those in the U.S. overall, the limited number of New York firms qualified to bid on a project of this scale created a sellers' market. Can the city's capital planning process be improved? Developing budgets on conceptual designs rather than detailed designs creates risk for large variances. DEP did not make any allowance for construction inflation in their 2003 constant-dollar estimates, although practices in this area vary among city agencies. Could better forecasting of construction cost growth reduce variances on future projects without establishing a "floor" for bids that might prove to be too high?

---

<sup>1</sup> For future construction midpoints, IBO projected growth of the RLB index at a rate of 2 percent a quarter, the average quarterly rate for the last eight quarters in the index. When downloaded, the index was available from April 2001 to July 2008 and the projection was based on inflation from October 2006 through July 2008.