



# Implementation of the Wastewater Treatment Division's Conceptual Planning and Cost Estimating Process Improvements

PRESENTED TO THE  
**METROPOLITAN WATER POLLUTION ABATEMENT ADVISORY COMMITTEE**  
JANUARY 25, 2017

# Substantial Participation Effort

- ▶ Technical Working Group, including MWPAAC representatives
- ▶ VMS Consultant Team
- ▶ WTD Project Planning and Delivery
- ▶ WTD Finance Section
- ▶ WTD Capital Systems Team
- ▶ Multiple briefings to RWQC and MWPAAC

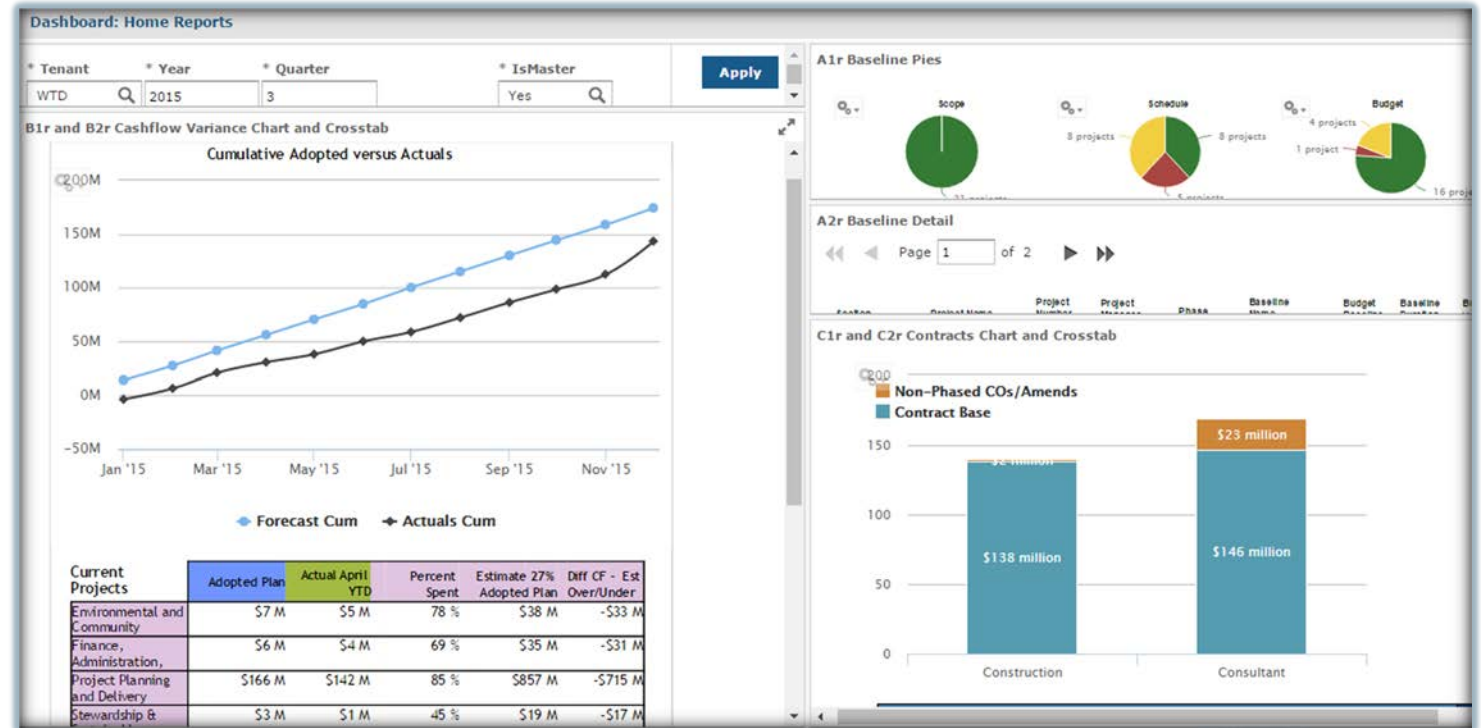
More than 100  
participants





# Primary Focus Areas

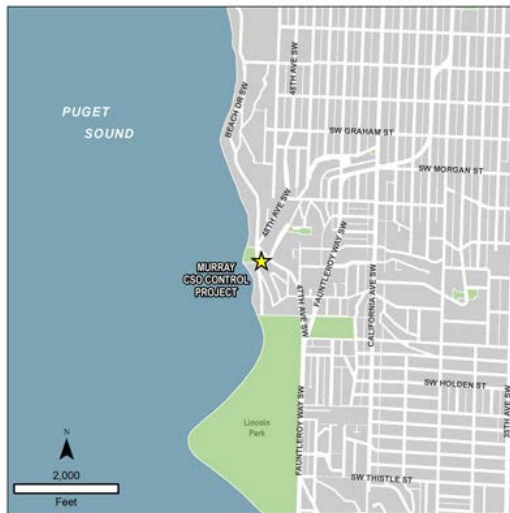
- Cost Estimating
- Trend Analysis
- Contingency
- Risk Management
- Project Formulation



1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 26

- [illegible]



This diagram illustrates the operation of a combined sewer system during a rainstorm. It shows a residential neighborhood with houses and trees. A red car is on a street adjacent to a stormwater runoff area. A large, blue, segmented pipe labeled "COMBINED SEWER" runs underground. A cutaway view of this pipe shows it is filled with water. A label "CSO STORAGE PIPE OR TANK (cutaway view)" points to a section of the pipe where water is being stored. Further along, a "DIVERSION STRUCTURE (cutaway view)" is shown, which directs the excess flow into a storage pipe or tank. A label "Flows beyond capacity are diverted to storage pipe or tank" explains this process. The diverted flow is then shown being pumped to a "TO PUMP STATION (pumping at maximum capacity)".





# Cost Estimating Improvements

- ▶ 50+ Pilot project trials
- ▶ Basis-of-estimate and one-page estimate summary documents required of all WTD capital project teams
- ▶ Improved cost models that adequately reflect project complexity



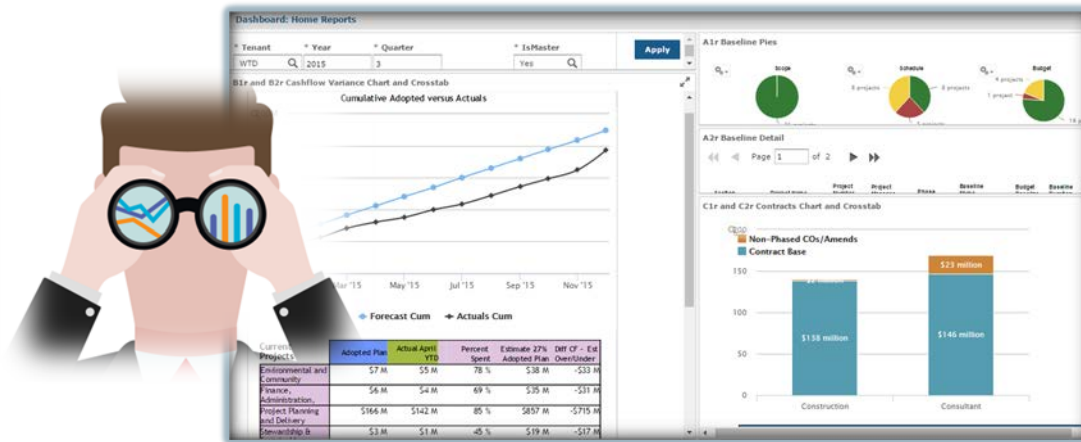
**King County**  
Department of Natural Resources and Parks  
Wastewater Treatment Division

**Project Planning and Delivery Section**  
**BASIS OF ESTIMATE**

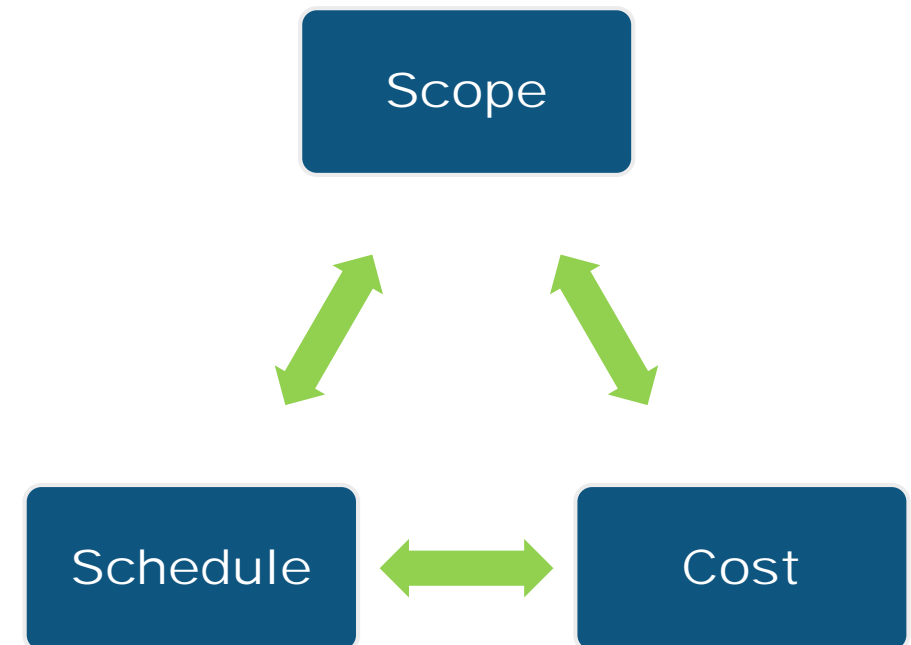
Project Name	
Project Number	
Date Prepared	
Requested by	
Prepared by	
Estimate Classification	
Estimate Purpose	
Estimate ID (Version)	
Project Manager	
Project Control Engineer	
Cc or Distribution List	

# Trend Analysis

- Integrate all of our existing tracking and reporting processes to better capture and communicate changes over a project's lifecycle

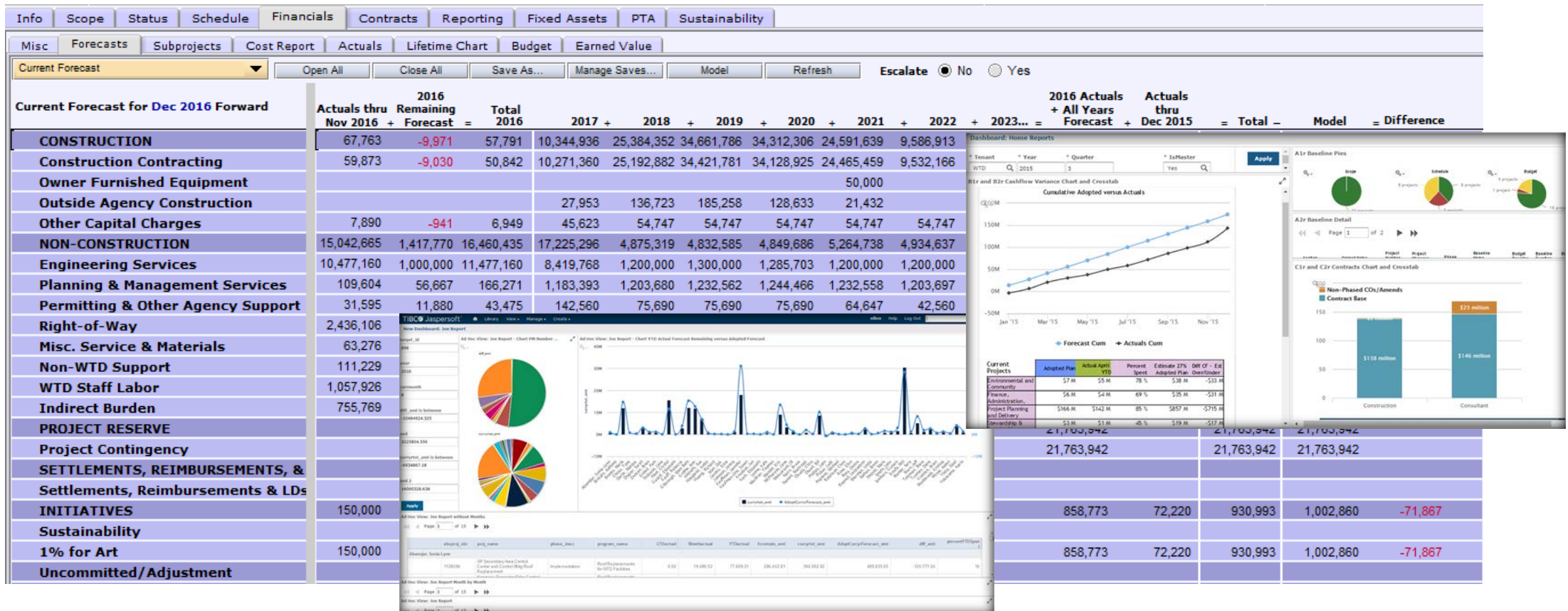


- 10+ Pilot project trials





# Integrating Trend Data



# Contingency

- Use AACEI best practices to differentiate between:
  - Project Contingency
  - Allowances for Indeterminates (AFI)
  - Construction Change Order Allowance
  - Management Reserve (for out of scope)

Main		Contingency		Contingency Help			
Contingency Levels are at the Start of Listed Phase				Change Order Allowance			
Contingency		Gate 3 (Project = 15% Design = 15% Change Order = 10%)		10 %			
(Phase Selected on Info Tab = Final Design)				Allowance for Indeterminates			
				15 %			
				Project Contingency			
				15 %			
<b>Contingency Analysis</b>							
		Forecast %	Forecast Amount	Input	Calculated	Difference	% Over/Under Calculated
Change Order Allowance		10%	\$12,141,721	10%	\$12,149,564	-\$7,843	-0%
Allowance for Indeterminates		14.8%	\$15,689,222	15%	\$15,870,963	-\$181,741	-1%
Project Contingency		14.7%	\$32,000,000	15%	\$32,645,913	-\$645,913	-2%
Total Contingency			\$59,830,943		\$60,666,440	-\$835,497	-1%
Phase		Project 1 Contingency	Allowance for 2 Indeterminates	Change Order 3 Allowance			
Planning/New - Gate 1		30%	25%	10%			
Preliminary Design - Gate 2		25%	20%	10%			
Gate 3		15%	15%	10%			
Final Design		10%	10%	10%			
Implementation		5%	0%	10%			
				1. Percentage is applied to total project cost not including Project Contingency. 2. Percentage is applied to Construction only. 3. Percentage is applied to Construction and Allowance for Indeterminates.			

Updates to existing WTD matrices and PRISM cost models were completed



# Risk Management

- ▶ Risk management scalability for different types of projects
- ▶ Standardize risk management tools and techniques
- ▶ Continue pilot project trials
- ▶ New pilots added in 2017



Asset  
Management  
Work Requests



Large Capital  
Projects



Complex, High-  
Risk Capital  
Projects

Scalable Cost, Trend and Risk Practices

# Risk Adjusted Cost Model

The model is a program average over the last 10 years using the input fields below as criteria. It is a guideline only, and does not automatically affect your budget in any way. Project managers are the final arbiters of whether or not a project needs funding in particular line items.

Model Input	
Construction Contracts	\$105,727,991
Mitigation Construction Contracts	
Owner Furnished Equipment	\$0
<b>Construction Total</b>	<b>\$105,727,991</b>
Allowance for Indeterminates	\$15,841,536 15 %
Change Order Allowance*	\$12,145,178 10 %

\*Change Order values are based on

Main Contingency Contingency Help

Type of Project  
Add Conveyance

Construction Management ☒ Consultant ☐ In-House

Design Engineering ☒ Consultant ☐ In-House

If To Be Determined is selected on Design Engineering and/or Construction Management, the Model will use Consultant.

Operations Support ☒ West ☐ East ☐ Both ☐ N/A

	Level				Justification
Design Engineering	<input type="radio"/> Low	<input type="radio"/> Routine	<input type="radio"/> Moderate	<input checked="" type="radio"/> High	
Construction Management	<input type="radio"/> Low	<input checked="" type="radio"/> Routine	<input type="radio"/> Moderate	<input type="radio"/> High	
Operations Support	<input type="radio"/> Low	<input type="radio"/> Routine	<input checked="" type="radio"/> Moderate	<input type="radio"/> High	
Project Management	<input type="radio"/> Low	<input type="radio"/> Routine	<input checked="" type="radio"/> Moderate	<input type="radio"/> High	
Project Control	<input type="radio"/> Low	<input checked="" type="radio"/> Routine	<input type="radio"/> Moderate	<input type="radio"/> High	
Permitting/RE	<input checked="" type="radio"/> Low	<input type="radio"/> Routine	<input type="radio"/> Moderate	<input type="radio"/> High	
Permitting Fees	<input type="radio"/> Low	<input checked="" type="radio"/> Routine	<input type="radio"/> Moderate	<input type="radio"/> High	
Community Relations	<input type="radio"/> Low	<input checked="" type="radio"/> Routine	<input type="radio"/> Moderate	<input type="radio"/> High	<input type="radio"/> N/A
Environmental	<input type="radio"/> Low	<input checked="" type="radio"/> Routine	<input type="radio"/> Moderate	<input type="radio"/> High	<input type="radio"/> N/A

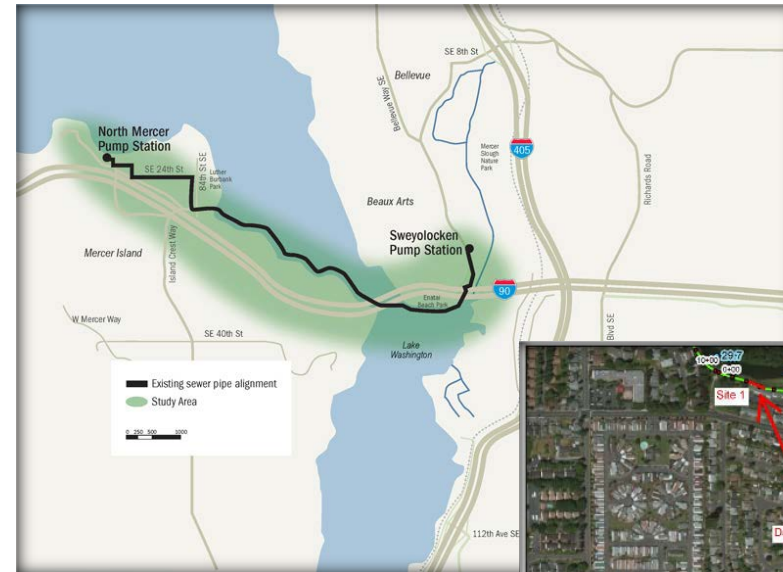
New scalable approach with project complexity factors programmed into WTD's cost model



# Project Formulation

“Understanding that problems and potential needs do not have enough information to be described as formal projects, **implement a Project Formulation Program.**”

Purpose is to better evaluate project requests



## NEED + PLAN + ADJUST + DEFINE = PROJECT





# WTD Implementation Phase Begins

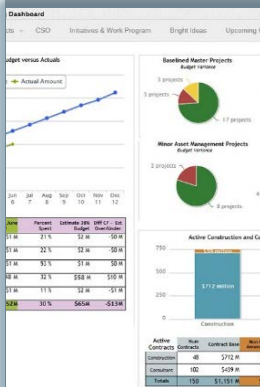


Implementation and training on **process improvements**

A screenshot of a financial report interface. It shows a 'Current Forecast for Dec 2016 Forecast' and a table comparing 'Actuals vs. Budget' for 2016 and 2017. The table includes categories like CONSTRUCTION, NON-CONSTRUCTION, and PROJECT RESERVE.

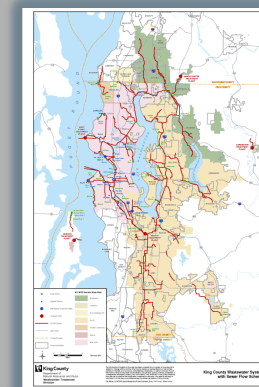
	Actuals vs. Budget	2016	2017
CONSTRUCTION			
Construction Contracting	99,373	-8,159	91,214
Owner Furnished Equipment			
Outside Agency Construction			
Other Capital Charges	7,846	-341	8,187
NON-CONSTRUCTION			
Engineering Services	18,475,385	1,847,738	16,627,647
Planning & Management Services	139,094	56,607	82,487
Permitting & Other Agency Support	31,538	11,808	19,730
Right of Way	2,438,188	9,391	2,447,579
Misc. Service & Materials	55,278	24,153	31,125
Non-WTD Support	11,125	85,208	-74,083
WTD Staff Labor	1,881,846	147,252	1,734,594
Indirect Burden	758,783	107,538	651,245
PROJECT RESERVE			
Project Contingency			
SETTLEMENTS, REIMBURSEMENTS, & LIABILITIES			
Settlements, Reimbursements & Liab.			
INITIATIVES			
Initiatives	19,838	19,838	0
1% for Art	132,033	132,033	0
Uncommitted/Adjustment			

Enhancements to WTD's **PRISM** program, project and contract management system



Training on new PRISM functionality

- Risk adjusted cost model
- Budget and forecasting modules
- Reporting and performance metrics



Enhancements to WTD's **Tabula** conveyance system cost estimating tool

# Continuous Process Improvement



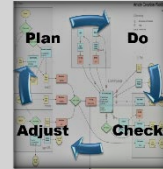
## AACEI

- Alignment with industry **Total Cost Management** best practices
- Estimating
- Risk
- Trend
- Contingency



## Pilot Projects

- To inform process improvements and incorporate lessons learned
- **Trend Analysis**
- Scalable **Risk Management**
- Project **Formulation**



## Streamlining

- Coordination with WTD's **Capital Streamlining**
- Lean process improvements



## CPMWG

- King County's **Capital Project Management Work Group**
- Sharing scalable conceptual cost estimating approaches, guidelines, tools and templates



# Questions?

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