CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

Draft White Paper Discussion On:

Proposed Drinking Water Cost Assessment Model Assumptions on Physical Consolidation

July 14, 2023

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Executive Summary

The State Water Resources Control Board (State Water Board) is proposing an updated methodology for estimating potential modeled physical consolidation costs for Failing public water systems, At-Risk public water systems, state small water systems, and domestic wells. Non-consolidation options will be covered in detail in subsequent white papers. The proposed changes to the physical consolidation Cost Assessment Model include:

- Determine if physical consolidation is a viable model solution initially before looking at other potential solutions[1].
- Updating the criteria used to identify which water systems are included in the physical consolidation analysis. A core recommendation is to include large/medium Failing systems as possible Receiving systems[2] in the analysis.
- Updating the distance criteria used in the analysis to identify where potential physical consolidations may be viable for state small water systems and domestic wells.
- Update physical consolidation unit cost assumptions using internal and external quotes and resources (Appendix B).
- Apply inflation and other cost adjustments to the subtotal construction cost estimates.
- Increase physical consolidation cost viability thresholds based on the most recent State Water Board Intended Use Plan (IUP) and include a 20% buffer to accommodate uncertainty in the Model.
- Utilize new funding viability thresholds for state small water systems and domestic wells.
- Calculate additional costs for physical consolidation projects that meet the viability thresholds and then add to the summed total:
    - Treatment cost for model-selected Failing Receiving water systems.
    - Additional source costs for the Receiving system if it has a single source.
    - Additional “Other Essential Infrastructure” (OEI), Administrator, Technical Assistance (TA), and other additional costs as determined by the Model.

Compared to the 2021 Model, the proposed updated criteria result in consolidation being selected as a modeled long-term solution for 10% more Failing systems, 15% more At-Risk systems and 15% more state small water systems (based on inventory criteria), and 4% less domestic wells (based on inventory criteria) The cost difference between the two methodologies, Utilizing the same updated cost assumptions, the updated inventory, distance, and funding viability thresholds result in a just $89 M increase in the cost estimate from the 2021 Model criteria, despite the significant updates to the proposed criteria.

The focus of this white paper is to provide an overview of these proposed changes and updates to the physical consolidation component of the Cost Assessment Model and solicit public feedback. A summary of feedback received within the last year is summarized in Appendix D.

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[1] California Health and Safety Code section116769: (c) “The fund expenditure plan shall prioritize funding for the consolidation or extension of service, when feasible”.

[2] Receiving systems are water systems that will subsume and extend service to one or multiple Joining water systems.

It is important to note that the sole purpose of the Cost Assessment Model is to assist the State Water Board in making budget decisions for the Safe and Affordable Drinking Water Fund and informing other policy matters. The Cost Assessment Model will not be used to inform system or community-level decisions around drinking water solution implementation or funding allocations. The State Water Board recognizes that the ultimate solution in each case will involve more detailed investigation of each water system and should include the input of the community and other stakeholders.

Physical Consolidation Analysis Overview

The State Water Board has been tracking the performance of community water systems and K-12 schools since 2017 with Failing criteria and since 2021 with the results of the Risk Assessment. This analysis highlights that small water systems [3]disproportionally fail more frequently and are more likely to be At-Risk of failing to sustainability provide a sufficient amount of safe and affordable drinking water. Additionally, smaller water systems have less financial capacity and higher rates when compared to larger water systems. A core vision of the State Water Board's SAFER program is to promote physical consolidations where feasible to help achieve greater economies of scale and advance the goals of Human Right to Water.

In the proposed updates to the Cost Assessment Model, physical consolidation analysis is conducted in advance of any other modeled solution for Failing and At-risk systems to ensure that it is the first solution considered. If physical consolidation is not a viable modeled solution, the Cost Assessment Model will then identify an alternative long-term modeled solution that addresses the system's Failing criteria and/or risk drivers.

In the 2021 physical consolidation analysis component of the Cost Assessment Model, potential physical consolidation was identified using "Network Analysis" in GIS, as the shortest path along roadways from a joining system to the nearest receiving system.

In the proposed physical consolidation analysis, five different consolidation scenarios have been assessed to determine the potential physical consolidation methodology (Appendix C). The cost will be developed using updated unit cost and assumptions as summarized in the sections below.

> **STEP 1**: Identification of systems (inventory) to include in the modeled physical consolidation analysis as possible Receiving and Joining systems.
>
> **STEP 2**: Conduct GIS analysis to determine which Joining systems meet the physical consolidation distance criteria to possible Receiving systems.
>
> **STEP 3**: Calculate estimated modeled physical consolidation project costs for systems that meet the inventory and distance criteria.

[3] Small water systems are systems with 3000 service connections or less.

STEP 4: Determine if the modeled physical consolidation project cost estimate meets the Model's funding viability thresholds.

STEP 5: Model additional infrastructure needs for systems where physical consolidation meets the funding viability thresholds.

STEP 6: Systems where physical consolidation does not meet the inventory criteria, distance criteria, and/or funding viability threshold thresholds will move forward in the Cost Model to identify alternative modeled long-term solutions.

Step 1: Identification of Possible Receiving & Joining Systems

The physical consolidation analysis conducted within the Cost Assessment Model includes community water systems, non-transient non-community (NTNC) K-12 schools, state small water systems, and domestic wells. The analysis identifies potential one-to-one physical consolidations between two different systems. These systems are classified in the Model as either "Receiving" or "Joining" systems:

- **Receiving Systems**: Commonly larger public water systems that expand to subsume Joining systems and provide water supply to both of their customers.

- **Joining Systems**: Commonly smaller public water systems, state small water systems, and domestic wells that are dissolved into existing receiving public water systems and are no longer responsible for providing water to their own customers.

The Model requires the development of criteria for which water systems should be considered Receiving and Joining systems. The criteria used to determine which systems are included in the analysis is based on two categories: "**SAFER Status**" of the system and the system's size (Size = Population Served [2021 Model] and Number of Service Connections [Updated Model]).

The "**SAFER Status**" of water systems and domestic wells is based on the State Water Board's Failing criteria (public water systems only) and the results of the Risk Assessment (all system types). A brief definition of each **SAFER Status** is provided bellow:

- **Failing Water Systems**: community water systems and NTNC K-12 schools. Those systems were identified to be out of compliance for consistently failing to meet drinking water standards. Currently there are five failing criteria[4]: Primary MCL violation, Secondary MCL violation, E. coli violations, treatment technique violations, and monitoring & reporting violations. All Failing systems regardless of their Failing criteria are assessed for physical consolidation within the Model.

- **At-Risk Water Systems and Domestic Wells**: community water systems with up to 30,000 service connections and 100,000 population served, NTNC K-12 schools, state

[4] Failing Water Systems: https://www.waterboards.ca.gov/water_issues/programs/hr2w/docs/hr2w_expanded_criteria.pdf

small water systems, and domestic wells that are at-risk of failing to deliver safe and affordable drinking water. All At-Risk water systems and domestic wells are assessed for physical consolidation within the Model regardless of their risk drivers.

- **Potentially At-Risk Public Water Systems**: community water systems with up to 30,000 service connections and 100,000 population served, NTNC K-12 schools, potentially at-risk of failing to deliver safe and affordable drinking water.

- **Not At-Risk Public Water Systems**: community water systems, NTNC K-12 schools, that are not at-risk of failing to deliver safe and affordable drinking water.

- **Not Assessed Public Water Systems**: community water systems excluded from the Risk Assessment inventory with more than 30,000 service connections and 100,000 population served, those systems were added to the physical consolidation inventory and assessed as potential Receiving systems.

The Table 1 below summarizes the counts of water systems per SAFER Status.

Table 1: Number of Systems per SAFER Status[5]

System Type	Count of Systems
Failing Public Water Systems	381
At-Risk Public Water Systems	512
At-Risk State Small Water Systems	245
At-Risk Domestic Wells	81,596
Potentially At-Risk Public Water Systems	451
Not At-Risk Public Water Systems	1,702
Not Assessed Public Water Systems	161

The original 2021 Cost Assessment Model had narrow criteria for the systems included in the physical consolidation analysis. The State Water Board explored additional options for possible Joining and Receiving water system criteria (Appendix C). Table 2 summarizes the comparison of 2021 Cost Model's Joining and Receiving system inventory criteria to the State Water Board's recommended updated criteria. Compared to the 2021 Model criteria, the recommended updated criteria *increases* the number of potential Receiving systems and *decreases* the number of potential of Joining systems. As detailed in Appendix C, this ultimately results in a potentially larger number of modeled physical consolidations.

[5] Failing list of systems is from January 1, 2023, and the Risk Assessment results are based on the 2023 Risk Assessment.

Table 2: Recommended Updates to the Model's Joining & Receiving System Criteria

	2021 Criteria	Preliminary Count of Systems[6]	Recommended Updated Criteria	Preliminary Count of Systems[7]
Joining System Criteria:				
Failing Public Water Systems	Population ≤ 3,300.	346	≤ 1,000 service connections.	345
At-Risk Public Water Systems	Population ≤ 3,300.	463	≤ 500 service connections.	444
Potentially At-Risk, Not At-Risk, Not Assessed Public Water Systems	Excluded	N/A	Excluded	N/A
State Small Water Systems	At-Risk for water quality only	699	Combined At-Risk	245
Domestic Wells	At-Risk for water quality only	99,814	Combined At-Risk[8]	81,596
Receiving System Criteria:				
Failing Public Water Systems	Excluded	N/A	***Largest System >*** 1,000 service connections.	36
At-Risk Public Water Systems	Excluded	N/A	***Largest System >*** 500 service connections.	68
Potentially At-Risk, Not At-Risk, Not Assessed Public Water Systems	Population > 3,300.	578	***Largest System >*** 500 service connections.	697
State Small Water Systems	Excluded	N/A	Excluded	N/A
Domestic Wells	Excluded	N/A	Excluded	N/A

Step 2: Determine Which Systems Meet Modeled Physical Consolidation Distance Criteria to Possible Receiving System

The Cost Model's physical consolidation analysis includes a spatial GIS analysis to identify if the inventory potential Joining and Receiving systems determined in Step 1 meet physical consolidation *distance* criteria. The GIS analysis identifies two different types of physical consolidations:

- **Intersect**: Where the Joining system or domestic well is physically located within the service area boundary of a potential Receiving system.

- **Route**:
    - **Public Water System or State Small Water System**: Where the Joining system is physically located within a maximum distance from the service area boundary of a potential Receiving system.
    - **Domestic Well**: Where the Joining domestic well is either along the modeled route of a potential public water system[9] physical consolidation (route-intersect); or within a maximum distance from the boundary of a potential Receiving system.

The 2021 Cost Assessment Model selected the potential Receiving system in the physical consolidation analysis based on the shortest distance to a potential Joining system.[10] The maximum distance for public water systems was 3 miles from the boundary of a potential Receiving system to the centroid of the potential Joining system. The 2021 Cost Assessment Model used a maximum distance of 0.38 miles from the possible Receiving community water system's boundary for Joining state small water systems. For state small water systems and domestic wells, the previous model only considered the domestic wells that intersected with an existing water system boundary and those that could be picked up along the pipeline route between Receiving and Joining community water systems.

For the updated 2024 Cost Assessment Model, the State Water Board recommends continuing to identify intersect Joining systems and maintain the use of the Model's maximum distance criteria for public water systems (3 miles). However, the updated Cost Assessment Model proposes a lower route distance criterion for state small water systems, 0.38 to 0.25 miles

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[6] The 2021 Cost Model physical consolidation inventory criteria was applied to water systems using the Failing list of systems from January 1, 2023, and the Risk Assessment results are based on the 2023 Risk Assessment.

[7] The recommended updated Cost Model physical consolidation inventory criteria was applied to water systems using the Failing list of systems from January 1, 2023, and the Risk Assessment results are based on the 2023 Risk Assessment.

[8] The Risk Assessment methodology developed for state small water systems and domestic wells is focused on identifying areas where groundwater is at high-risk of containing contaminants that exceed safe drinking water standards, is at high-risk of water shortage, and where there is high socioeconomic risk. For more information visit the [2023 Risk Assessment Dashboard](https://gispublic.waterboards.ca.gov/portal/apps/dashboards/4f7795ba4349464f9883827ad2e6b67a): https://gispublic.waterboards.ca.gov/portal/apps/dashboards/4f7795ba4349464f9883827ad2e6b67a

[9] State small water system physical consolidation routes were excluded from this analysis.

[10] The 2021 Model selected the shortest route option, rather than the largest possible Receiving water system option to generate a more conservative cost estimate because pipeline costs tend to be the largest component of physical consolidation costs.

based on observed consolidation projects that have been implemented in California that include state small water systems and domestic wells. Also, for domestic wells, in addition to including wells picked-up along the pipeline route, the updated model will also include domestic wells that are either intersecting the boundary of a Receiving system or within a 0.25-mile buffer from a Receiving system boundary. See distance criteria summarized in the Table 3 below.

Table 3: Updates to the Route Distance Criteria for Physical Consolidation Analysis

	2021 Cost Model	Recommended Updated Criteria
Public Water Systems	Maximum route distance = 3 miles	Maximum route distance = 3 miles
State Small Water Systems	Maximum route distance = 0.38 miles	Maximum route distance = 0.25 miles
Domestic Wells	***Route-Intersect:*** along the modeled route of a potential public water system modeled physical consolidation.	• ***Route-Intersect:*** along the modeled route of a potential public water system modeled physical consolidation. • Maximum distance = 0.25 miles

The State Water Board evaluated additional options to develop the recommendations summarized in the table below See Appendix C for more details on the selection process.

Table 4: Comparison of Systems that Meet the Intersect & Route Distance Criteria

	2021 Criteria	Preliminary Count of Systems	Recommended Updated Criteria	Preliminary Count of Systems
Joining System Criteria:				
Failing Public Water Systems	Population ≤ 3,300.	138 (40%)	≤ 1,000 service connections.	173 (50%)
At-Risk Public Water Systems	Population ≤ 3,300.	193 (42%)	≤ 500 service connections.	250 (56%)
Potentially At-Risk, Not At-Risk, Not Assessed Public Water Systems	Excluded	N/A	Excluded	N/A
State Small Water Systems	At-Risk for water quality only	231 (33%)	Combined At-Risk	118 (48%)
Domestic Wells	At-Risk for water quality only	35,057 (35%)	Combined At-Risk	25,634 (31%)

	2021 Criteria	Preliminary Count of Systems	Recommended Updated Criteria	Preliminary Count of Systems
Receiving System Criteria:				
Failing Public Water Systems	Excluded	N/A	***Largest System*** ≥ 1,000 service connections.	26 (32%)
At-Risk Public Water Systems	Excluded	N/A	***Largest System*** ≥ 500 service connections.	32 (89%)
Potentially At-Risk, Not At-Risk, Not Assessed Public Water Systems	Population > 3,300	341 (59%)	***Largest System*** ≥ 500 service connections.	320 (46%)
State Small Water Systems	Excluded	N/A	Excluded	N/A
Domestic Wells	Excluded	N/A	Excluded	N/A

Systems included in the Cost Assessment Model that do not meet the Joining and Receiving system inventory or distance criteria will then move forward in the Cost Assessment Model for evaluation of alternative possible modeled long-term solutions, i.e., treatment, technical assistance etc. **These model solutions will be further explored in the next 2023 Cost Assessment Model workshops.**

Step 3: Calculate Estimated Physical Consolidation Project Costs

The estimated cost for physical consolidation is determined for the water systems and domestic wells that meet both the inventory criteria in Step 1 and the distance criteria in Step 2. The Cost Assessment Model will then apply cost assumptions to each modeled physical consolidation to develop a cost estimate. The State Water Board has conducted significant research and outreach to recommend updates to the cost components included in the Cost Assessment Model. Table 5 below summarizes the list of components used in the physical consolidation cost estimate and highlights the key differences between the 2021 Cost Assessment Model and the recommended updates. **Appendix B provides a detailed summary of how the State Water Board developed the recommended cost component updates.**

Table 5: Key Differences in Physical Consolidation Cost Estimate Components Between 2021 Cost Model and Recommended Updates

Model Cost Components	2021 Physical Consolidation Model	2021 Cost Estimate ($)	Recommended Update	Recommended Cost Estimate ($)
Pipeline ($/Lf)	Included	$155	Included	$220
Connection Fees ($/Joining system service connection)	Averaging connection fees for systems with service connection ≥ 3,000	$6,200	Averaging connection fees for Receiving systems for each scenario	**Public Water Systems** = $5,250 **SSWS** = $5,438 **DW** = $4,230
Service Line Cost ($/Project)	Included for intersect Joining systems. Excluded for route Joining systems	$5,000	Included for both intersect and route Joining systems	$6,200
Backflow Prevention	Excluded[11]	N/A	Excluded	N/A
Administrative Cost ($/Project)	Excluded for SSWSs, DWs, and systems with service connection < 15	$100,000	Included for all Failing and At-Risk systems, except At-Risk Domestic wells	15% of total construction cost.
CEQA Cost ($/Project)	Excluded for SSWSs, DWs, and systems with service connection < 15	$85,000	Included for all Failing and At-Risk systems, except At-Risk DWs	**Intersect** systems = $25,000 **Route** systems = $100,000
Treatment Cost	Excluded	N/A	Included for Failing Receiving systems due to	Apply BAT[12] Capital and O&M[13] per failing analyte. (*excluded from*

[11] Backflow was proposed in the November 2021 White Paper as a part of Other Essential Infrastructure but removed due to public feedback.

[12] Best available technology (BAT).

[13] Operations and maintenance (O&M).

Model Cost Components	2021 Physical Consolidation Model	2021 Cost Estimate ($)	Recommended Update	Recommended Cost Estimate ($)
			water quality issues	*physical consolidation funding viability determination*)
Additional Source	Excluded	N/A	Included for Receiving systems with single source of water supply.	Additional cost for well or intertie if system relies on one source. (*excluded from physical consolidation funding viability determination*)
Contingency	Included	20% Total Estimated Cost	Included for all Failing and At-Risk systems, except At-Risk DWs	20% Total cost
Inflation	Not Included[14]	N/A	Included for all systems regardless of size and type	3% Total cost
Planning & Construction	Not Included[15]	N/A	Included for all systems regardless of size and type	10% Total cost
Regional Multiplier	Not Included [16]	N/A	Included for all systems regardless of size and type	Rural Counties (0%) Urban Counties (+32%) Suburban Counties (+30%)

[14] Inflation was applied to the Drought Infrastructure Cost Assessment in the 2022 Risk Assessment, not for the consolidation analysis in the 2021 Risk Assessment.

[15] Inflation was applied to the Drought Infrastructure Cost Assessment in the 2022 Risk Assessment, not for the consolidation analysis in the 2021 Risk Assessment.

[16] The 2021 Cost Assessment model didn't adjust the physical consolidation cost for regional variance, however other long-term solutions were adjusted, such as treatment and other essential infrastructure.

The State Water Board conducted a preliminary estimate applying the recommended cost component assumptions to the water systems and domestic wells that met the physical consolidation distance criteria in Step 2. Table 6 summarizes the estimated costs comparing the 2021 Model results (using the 2021 inventory and distance criteria) to the recommended updated model (using the recommended inventory and distance criteria). **The recommended updates to the inventory and distance criteria result in a total estimated cost difference of $1,649 M less when compared to the old Model's criteria. This is due to (1) more large Joining systems in the old model (significantly drives-up costs); and (2) smaller inventory of state small water systems and domestic wells.**

Table 6: Preliminary Physical Consolidation Cost Estimate for All Joining Systems Meeting Distance Criteria Using the Recommended Model Updates Compared to the 2021 Model Criteria

	# of *Joining* Systems Assessed for Distance Criteria (Step 1)		# of *Joining* Systems Meeting Distance Criteria (Step 2)		Total Estimated Cost for All Systems Meeting Distance Criteria (Step 3)[17]	
	2021 Model	Recommended Update	2021 Model	Recommended Update	2021 Model	Recommended Update
Failing Public Water Systems	346	345	138 (40%)	173 (50%)	**$1,088 M**	**$580 M**
At-Risk Public Water Systems	463	444	193 (42%)	250 (56%)	**$1,863 M**	**$916 M**
At-Risk State Smalls	699	245	231 (33%)	118 (48%)	**$103 M**	**$78 M**
At-Risk Domestic Wells	99,814	81,596	35,057 (35%)	25,634 (31%)	**725 M**	**$557 M**
TOTAL:	101,322	82,630	35,619 (35%)	26,175 (32%)	**$3,780 M**	**$2,131 M**

[17] The recommended updated physical consolidation component cost assumptions were applied to both Step 2 results for comparison purposes.

Step 4: Determine if Physical Consolidation Cost Estimates Meet Model Funding Viability Thresholds

In the 2021 Cost Assessment Model, when physical consolidation was determined as one of the top two selected solutions for public water systems, the Model would examine whether the cost meets either of the following funding viability thresholds: (1) total capital costs less than $500,000; or (2) capital costs per connection less than $60,000. These funding viability thresholds were determined based on funding priorities outlined in the 2020-21 Intended Use Plan. The 2022-23 Intended Use Plan[18] has increased the maximum project funding thresholds for public water systems to: (1) total capital costs less than $6 million; or (2) capital costs per connection less than $80,000.

The State Water Board's internal Cost Model workgroup comprised of Division of Drinking Water and Division of Financial Assistance staff, recommended inflating the Intended Use Plan funding viability thresholds in the Cost Model to account for inherent limitations in modeling physical consolidation costs. The State Water Board explored two options, adding 10% and 20% to the Intended Use Plan funding viability thresholds. The results of this analysis are detailed in Appendix C. Based on feedback from the State Water Board's internal workgroup's review of the different options, the 20% adjustment is recommended. This was due to the minimal differences in the number of physical consolidations and total cost between the two options.

For state small water systems and domestic wells where physical consolidation was determined to be physically possible in the 2021 Cost Assessment Model, a funding viability threshold was not applied. This is because the 2021 Cost Assessment Model, only included At-Risk state small water systems and domestic wells that were along the route of a potential modeled consolidation of two public water systems. Therefore, the cost of "picking up" the state small water system and/or domestic well was added to the cost of the public water system consolidation estimate.

For the recommended updates for the Cost Assessment Model, the State Water Board is proposing incorporating new funding viability thresholds for state small water systems and domestic wells. The State Water Board recommends a funding viability threshold of maximum $2 million for consolidation of state small water systems and $150,000 for a domestic well. These recommendations were developed by the State Water Board's internal workgroup after exploring three maximum viability thresholds for domestic wells: $100,000, $150,000, and $200,000 (Appendix C). No additional options were explored for state small water systems. These recommendations are based on observed consolidation projects across the state. Table 7 below summarizes the analyzed funding thresholds by systems size and type:

[18] Clean Water State Revolving Fund Intended Use Plan Draft, State Fiscal Year 2022-2023: https://www.waterboards.ca.gov/water_issues/programs/grants_loans/docs/2022/dwsrf-iup-sfy2022-23-final.pdf

It is important to note that these recommended funding viability thresholds for state small water systems and domestic wells were developed for the Cost Assessment Model only and are not included in the 2023-24 Intended Use Plan. The Division of Financial Assistance does not currently employ funding viability thresholds for consolidation projects for individual state small water systems and domestic wells. Actual funding decisions are typically made based on project-level costs addressing clusters of households.

Table 7: Recommended Updates to the Cost Assessment's Funding Viability Thresholds for Modeled Consolidation Projects

	2021 Funding Viability Thresholds	Updated 2023-24 IUP Funding Thresholds	Recommended Funding Viability Thresholds for Cost Model
Public Water System *> 75 service connections*	• Total Capital Cost < $500,000 • Cost Per Connection < $60,000	Cost Per Connection < $80,000	**Cost Per Connection < $96,000** **(*20% IUP adjustment*)**
Public Water System *< 75 service connections*	• Total Capital Cost < $500,000 • Cost Per Connection < $60,000	Total Capital Cost < $6 million	**Total Capital Cost < $7.2 million** **(*20% IUP adjustment*)**
State Small Water System	N/A	N/A	**< $2,000,000**
Domestic Well	N/A	N/A	**Cost per Domestic Well < $150,000**

The State Water Board conducted a preliminary assessment to estimate the number of Failing and At-Risk water systems and domestic wells that meet both the recommended updated physical consolidation *distance* criteria from Step 2 and the project *funding viability thresholds* recommended in the table above (Step 4). A comparison of the preliminary cost estimates using the 2021 Model inventory and distance criteria and the recommended updated criteria is provided in Table 8. Compared to the 2021 Model, the updated criteria result in 10% more Failing systems, 15% more At-Risk systems and 15% more state small water systems (based on inventory criteria), and 4% less domestic wells (based on inventory criteria) selected for physical consolidation as a modeled long-term solution. **The cost difference between the two methodologies, Utilizing the same updated cost assumptions, the updated inventory, distance, and funding viability thresholds result in a $89 M increase in the cost estimate from the 2021 Model criteria.** The State Water Board explored additional options for Steps 2 through 4, which are summarized in Appendix C.

Table 8: Preliminary Molded Physical Consolidation Cost Estimates Utilizing Updated Distriance Criteria, Cost Assumptions, and Funding Viability Threhsolds

	# of *Joining* Systems Meeting Distance Criteria (Step 2)		Total Estimated Cost for All Systems Meeting Distance Criteria (Step 3)		# of Systems where Consolidation Project Meets Project Funding Viability Thresholds (Step 4)		Total Estimated Cost for Systems Meeting Distance Criteria & Funding Viability Thresholds (Step 4)	
	2021 Model	**Recommended Update**	**2021 Model**	**Recommended Update**	**2021 Model**	**Recommended Update**	**2021 Model**	**Recommended Update**
Failing *Joining* Public Water Systems	138 (40%)	173 (50%)	$1,088 M	$580 M	134 (39%)	**169 (49%)**	$407 M	**$550 M**
At-Risk *Joining* Public Water Systems	193 (42%)	250 (56%)	$1,863 M	$916 M	190 (41%)	**248 (56%)**	$727 M	**$900 M**
At-Risk *Joining* State Smalls	231 (33%)	118 (48%)	$103 M	$78 M	231 (33%)	**118 (48%)**	$103 M	**$78 M**
At-Risk *Joining* Domestic Wells	35,057 (35%)	25,634 (31%)	$725 M	$557 M	35,040 (35%)	**25,480 (31%)**	$722 M	**$520 M**
TOTAL:	**35,619 (35%)**	**26,175 (32%)**	**$3,780 M[19]**	**$2,131 M**	**35,595 (35%)**	**26,015 (31%)**	**$1,959 M**	**$2,048 M**

[19] The recommended updates to the inventory and distance criteria result in a total estimated cost difference of $1,649 M less when compared to the old Model's criteria. This is due to (1) more large Joining systems in the old model (significantly drives-up costs); and (2) smaller inventory of state small water systems and domestic wells.

Step 5: Model Additional Infrastructure/Admin Needs for Systems Where Physical Consolidation is Selected by the Model

When the proposed Cost Assessment Model indicates that physical consolidation is viable, then additional costs may be added to enhance water system sustainability and to address water quality issues, source capacity issues, and aging infrastructure**. It is important to understand that none of the additional costs will be used to analyze the model funding viability thresholds for physical consolidation.**

Treatment Cost

In the 2021 Cost Assessment Model, Failing systems were excluded from being Receiving systems, therefore, no treatment cost was considered to remediate water quality issues in the model. However, in the proposed model when the physical consolidation model includes Receiving water systems that are failing due to water quality issues, then a cost estimate for treatment will be estimated for those systems. The model will utilize estimated source production and select Best Available Technologies (BAT) based on the system's violating analyte/s. Due to the State Water Board's incomplete current treatment facility data, the Model will assume new treatment is needed. Modeled treatment will be sized to accommodate both Joining and Receiving systems' combined service connections.

Additional Source Cost

When a potential physical consolidation project involves a Receiving community water system with a single source of water supply, then an additional cost for a backup source will be estimated by the Model. The cost estimate for the new source will incorporate the modeled needs for the total number of customers between the Receiving system and Joining system. The modeled new source type will be determined based on the Receiving system's current source type. If the sole source of the Receiving system is a well, then an additional cost of constructing a new well will be estimated by the Cost Model. However, if the source is surface water, then an intertie with a nearby Receiving system will be evaluated if possible.

Other Essential Infrastructure (OEI)

Many Failing and At-Risk public water systems have aging infrastructure. Upgrading and replacing them is essential to improve water quality issues and increase the overall reliability of those water systems. In the 2021 Cost Assessment Model, OEI needs were developed based on the Kern County case study analysis[20] and developing statewide assumptions. In the 2024 Cost Assessment Model, OEI will be identified based on system and location-specific information, aligned with the Senate Bill 552 drought

[20] Attachment C2: Kern County Case Study Analysis: https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c2.pdf

resiliency infrastructure requirements. Updates to the OEI included in the Model will be explored in subsequent 2023 Cost Assessment Model workshops.

Additional Costs

Depending on the water system and their identified challenges, the Cost Assessment Model may add additional costs for the systems where physical consolidation is the selected modeled solution. Additional costs may include technical assistance, administrator, etc. These additional costs will be explored in subsequent 2023 Cost Assessment Model workshops.

Step 6: Model Alternative Long-term Solutions for Systems Where Physical Consolidation is Not Selected

Systems where physical consolidation does not meet the physical and/or funding threshold criteria/thresholds will move forward in the Cost Model to identify alternative modeled long-term solutions. Subsequent 2023 Cost Assessment Model workshops will explore how the Cost Assessment Model will match identified challenges to possible long-term and short-term solutions. These workshops will also cover recommended updates to the component cost assumptions and calculation methods in the Model.

Desired Public Feedback and Next Steps

Desired Feedback

The State Water Board is committed to engaging the public and key stakeholder groups to solicit feedback and recommendations on the proposed physical consolidation GIS methodology, cost assumptions, and Cost Model viability thresholds. The received feedback will help refine the physical consolidation components of the Cost Model over time. Feedback is due on August 14, 2023. Feedback may be submitted directly to (DDW-SAFER-NAU@waterboards.ca.gov).

The State Water Board will continue to host public workshops to provide opportunities for stakeholders to learn about and contribute to the Cost Model re-build process. Stakeholders are encouraged to sign-up for the SAFER Program's email list-serve[21] to receive notifications of when these public workshops are scheduled to occur.

The State Water Board is specifically seeking public feedback on the following:

Methodology for Physical Consolidation Analysis in the Cost Model: solicit feedback on how the model identifies the systems to be assessed for physical consolidation, criteria for Joining and Receiving systems, the maximum distance between Joining and Receiving systems, and funding viability thresholds.

[21] SAFER Program Email List-Serve: https://www.waterboards.ca.gov/safer/

Updates to the Physical Consolidation Component Cost Assumptions: solicit feedback on the inclusion of new cost components, cost adjustments, and updated cost assumptions detailed in Appendix B.

Elevation Difference Cost Adjustments: Elevation difference between Joining and Receiving systems can trigger water pressure issues that can affect several things, such as water consumption rates, number of water fixtures, and height of water in the water storage tank. Fluctuating pressure can be avoided by installing booster pumps that force water to travel to higher elevations. In actual construction projects, elevation difference is assessed between any two points in the distribution systems using hydraulic modeling applications, modeling tools allow to simulate different scenarios and select the optimum solution based on site specific details. After internal discussion with expert field staff, the State Water Board is soliciting feedback on applying an additional 5% on top of the pipeline cost, whenever the elevation difference between Receiving and Joining systems is ± 50 ft. This additional cost should cover the need for any booster pumps, and/ or pressure reducing valves.

Next Steps

The State Water Board intends to host two more public workshops to provide opportunities for stakeholders to learn about and contribute to the State Water Board's efforts to develop a more robust Cost Assessment Model for public water systems, state small water systems, and domestic wells. Future workshops will explore underlying cost assumptions associated with each potential model solution included in the Cost Assessment Model. These two workshops will cover the following:

- Modeled treatment methodologies and cost assumptions.
- Complementary long-term solutions and emergency solutions cost assumptions.

Appendix A: GIS Methodology

Data Sources Used:

- North American Premium Street Map[22]
- Service Area Boundary Layer (SABL) water49 database shapefile[23]
- Missing Service Area Boundary Layer locational data merged with SABL layer called "SABL+"[24] (see Public Water Systems, Step 1)
- List of all community water systems and NTNC schools with SAFER Status last updated on 01/01/23[25]
- Domestic well (DW) and State Small Water System (SSWS) Combined Risk Map provided by Groundwater Ambient Monitoring and Assessment Program (GAMA).[26]

Public Water System: Closest Route Receiving System Analysis:

Step 1: Add Missing Systems to the Service Area Boundary Layer (SABL)

1. The service area boundary of water systems is used as the primary locational reference for all water systems included in the analysis. The SABL Shapefile includes most public water systems, however there are systems in the physical consolidation inventory missing from the dataset. Those missing systems (217) are given an estimated service area to incorporate them into the analysis.
2. The estimated service area starts from a single point of locational data tied to each system. These point locations can come from a variety of sources such as well locations, facility locations, or physical addresses.
3. In ArcPro, to merge two layers together, they need to be in the same layer format. The SABL layer is a polygon layer while the missing points are a point layer. To convert the missing points into polygons a 1-mile buffer is created around each point using the "Create Buffer" tool in ArcPro.
    a. The 1-mile distance was chosen as an approximation to the potential service area of each point since most of the missing systems are small water systems.

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[22] StreetMap Premium - North America | ArcGIS Hub https://hub.arcgis.com/content/d3c77c670f924bd189befa4af4a9ca3c/about

[23] System Area Boundary Layer (SABL) Look-up Tool (ca.gov) https://gispublic.waterboards.ca.gov/portal/apps/webappviewer/index.html?id=272351aa7db14435989647a86e6d3ad8

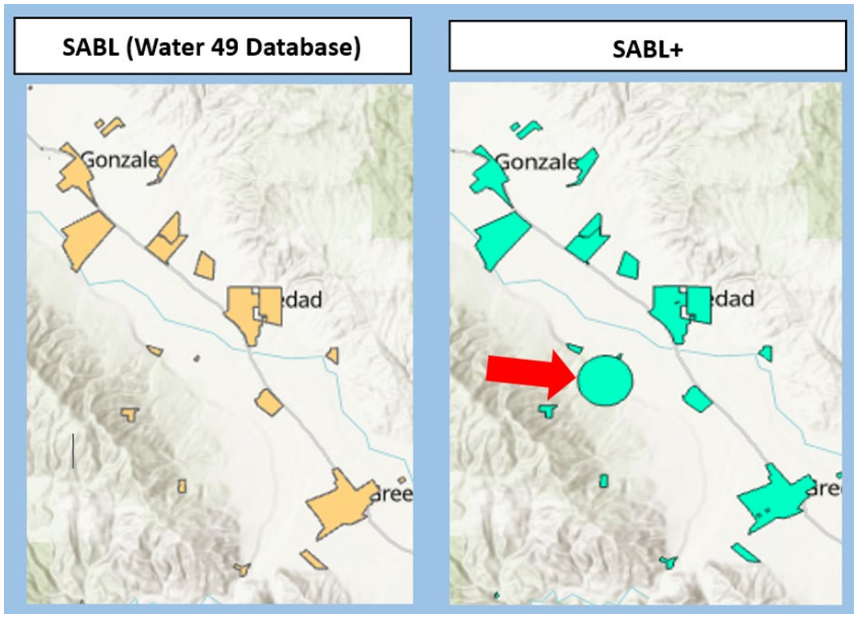
[24] SABL_PLUS_ (ca.gov) https://gispublic.waterboards.ca.gov/portal/home/item.html?id=0e4c019a46454725b058edd90538732a

[25] Drinking Water - SAFER Dashboard Failing and At-Risk Drinking Water Systems - Datasets - California Open Data https://data.ca.gov/dataset/safer-failing-and-at-risk-drinking-water-systems

[26] Hosted/Combined_Risk_Domestic_Wells_and_State_Small_Water_Systems (FeatureServer) (ca.gov) https://gispublic.waterboards.ca.gov/portalserver/rest/services/Hosted/Combined_Risk_Domestic_Wells_and_State_Small_Water_Systems/FeatureServer

4. The SABL layer is then merged with these missing locations into a new layer that will be referred to as the “SABL+ layer” moving forward.

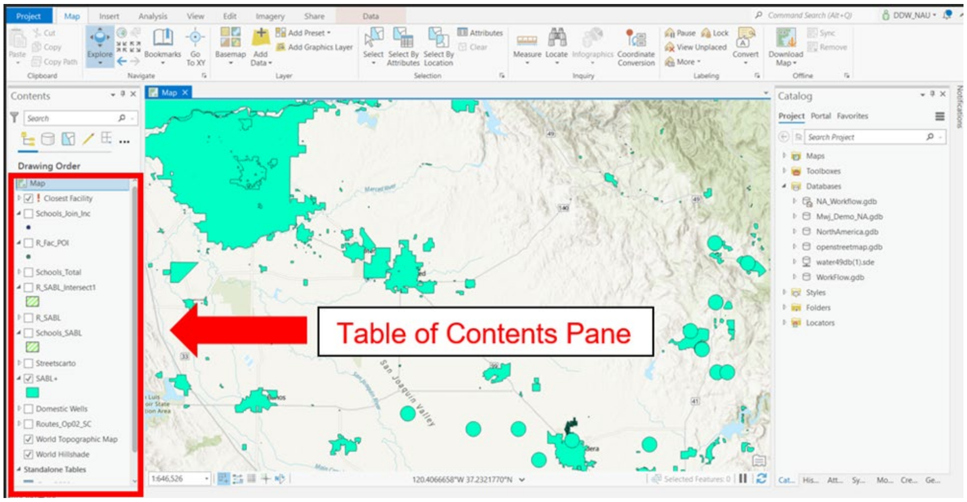
Figure 1: Visual comparison of the Standard SABL layer to the SABL+ layer. Note the addition of the estimated water system boundary for the missing system (see red arrow)



Step 2: Define Receiving and Joining Systems

1. Define Receiving and Joining systems based on the physical consolidation inventory criteria.
2. Utilize the master excel sheet of all community water systems and NTNC schools pulled from the SAFER Dashboard to determine list of possible Receiving and Joining systems using defined inventory criteria. The dataset includes the necessary datapoints needed for this: PWSID, number of service connections, and SAFER status.
3. In excel using filters, select the lists of Joining and Receiving systems.
    a. Example Joining: Risk status = At-Risk and service connections < 500.
4. Select Joining systems and create a CSV. by saving the specific tab you are on as a CSV. or comma separated value file.
5. Select Receiving systems and create a CSV. by saving the specific tab you are on as a CSV. or comma separated value file.
6. Upload into ArcPro by dragging and dropping those CSV. files into the “Table of Contents” pane.

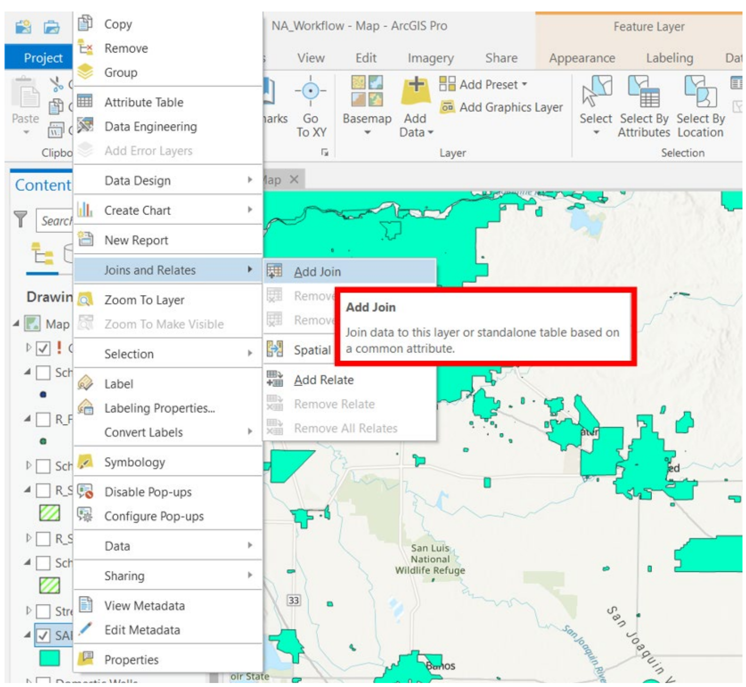
Figure 2: "Table of Contents" pane within the standard ArcPro user interface. This pane is typically found on the left-hand side under the "Drawing Order" ribbon.



Step 3: Create Joining and Receiving Primary Layers

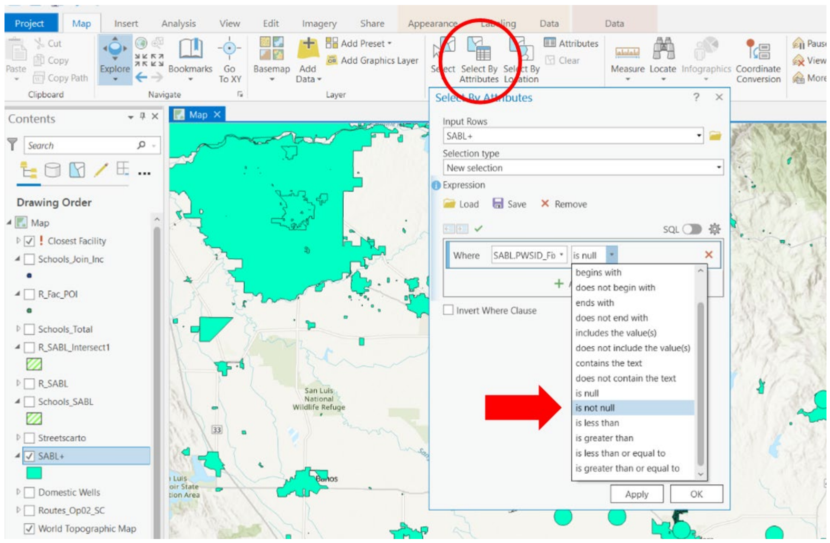
1. Use the "Add Join" tool to the SABL+ layer connecting the Receiving system CSV.

Figure 3: location of the "Add Join" tool within ArcPro. Right click the selected layer then under the "Joins and Relates" pop up menu click "Add Join" to bring the "Add Join" tool menu.



2. After adding a join from the Receiving CSV. to the SABL+ layer there should be new fields now attached to the SABL+ layer's attribute table.
3. One of these fields should be the PWSIDs from the Receiving CSV. which will be referenced as "RPWSID" in these instructions.
4. Use the "Select by Attributes" tool on the SABL+ layer and select for all records where "RWPSID = Not Null".

Figure 4: location of the "Select by Attributes" tool within ArcPro. The tool is in the top ribbon under "Map". Here the selected feature is any record within the SABL+ layer where the PWSID of joined systems "is Not Null".

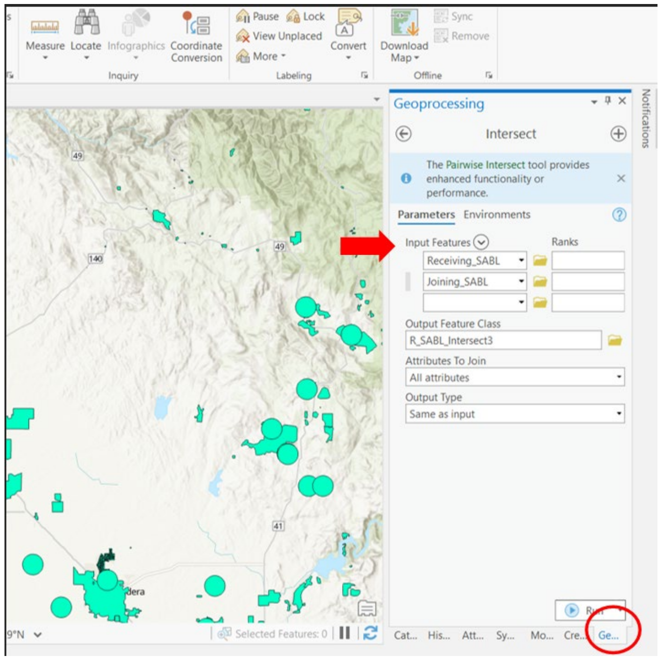


5. This should select only records where a RPWSID is available, all systems in the Receiving CSV. This creates the "Recieving_SABL" dataset.
6. Repeat steps 1 through 5 for the Joining systems CSV.
    a. The PWSIDs from this file will be referenced as "JPWSID" in these instructions. And the resulting dataset of "Joining_SABL" is created.

Step 4: Intersecting Joining and Receiving System's Service Area Boundaries

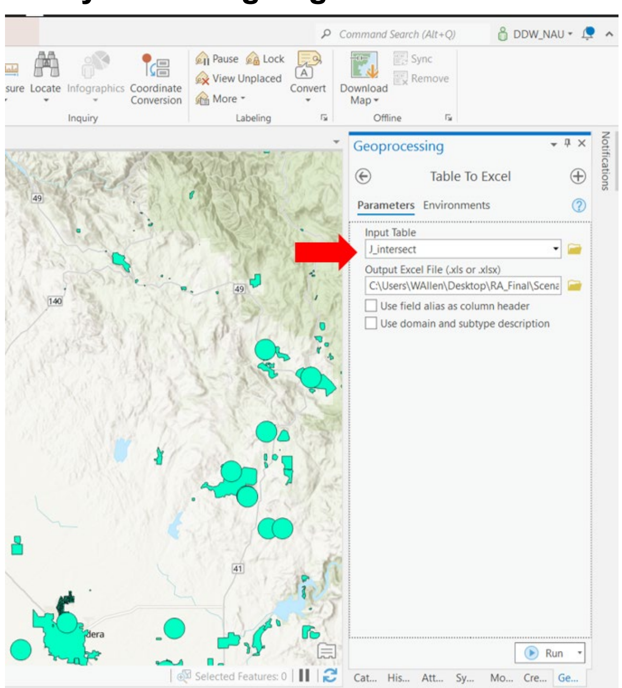
1. Use the "Intersect tool" on the "Joining_SABL" layer to intersect with the "Receiving_SABL" layer.

Figure 5: "Intersect" tool in ArcPro. The two layers "Joining_SABL" and "Receiving_SABL" layers are used as the "Input features" for the tool.



2. Use "Table to Excel" function on the new intersecting layer and save as "J_Intersect".

Figure 6: "Table to Excel" tool in ArcPro. The "J_Intersect" layer is being used as the "Input Table" or the layer that is going to be used in the tool.

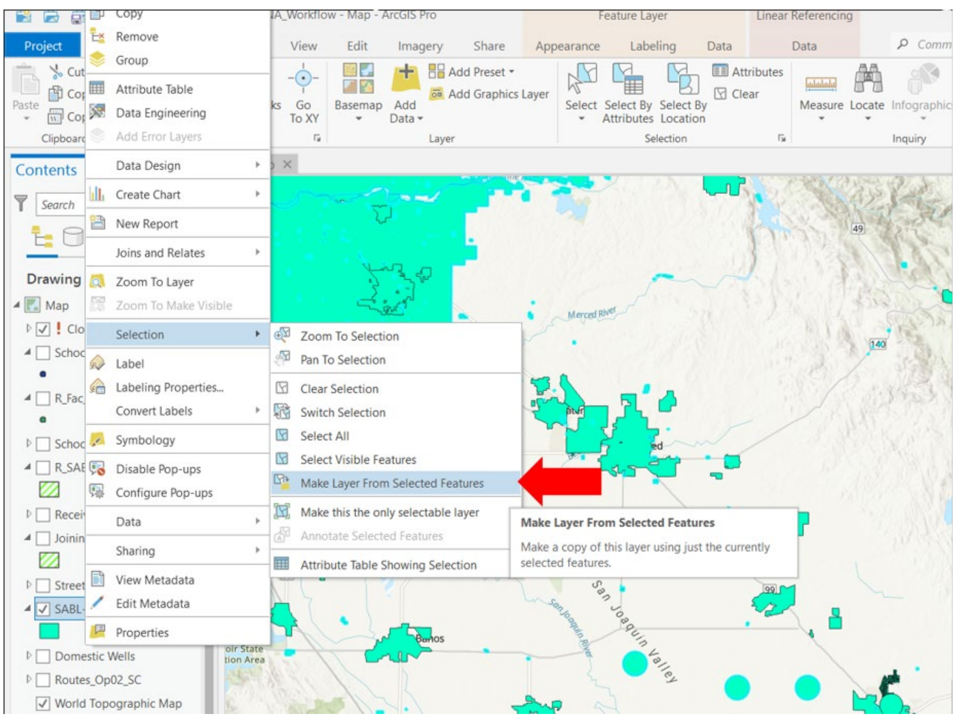


3. From the excel sheet produced; filter for the list of the unique Joining systems involved in intersecting with a Receiving system by taking all the JPWSIDs and saving them into a CSV.
4. Upload the CSV into ArcPro under the same label, “Join_Intersect”.

Step 5: Remove Intersecting Joining Systems from the Route Analysis Inventory

1. Use “add join” to the “Joining_SABL” layer to connect it to the “Join_Intersect” CSV.
2. The Joining systems that were intersecting directly with the Receiving system’s boundaries will have new attributes from this join to indicate this.
3. Use the “Select by Attributes” tool on the “Joining_SABL” layer and select for all records where the joined CSV.’s new field “JPWSID = Null”
4. Produce a new layer from selection labeled “Joining_No_Int”.

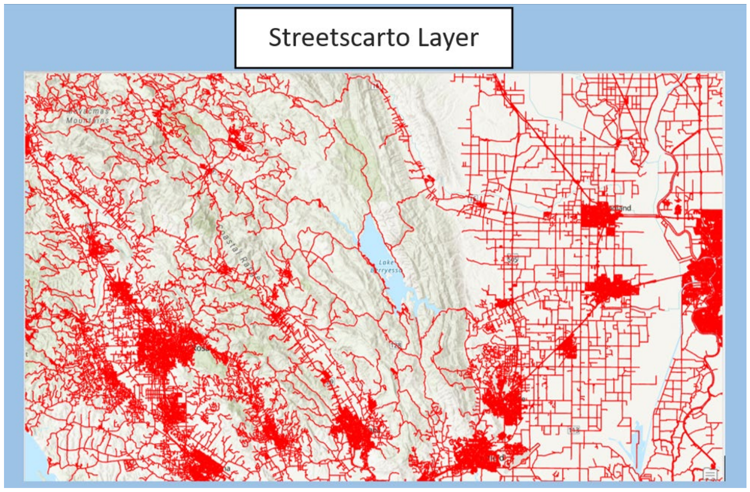
Figure 7: "Make Layer from Selected" tool location in ArcPro. Right click the selected layer then under the “Selection” pop up menu click “Make feature from Selected Features” (red arrow)



Step 6: Create Receiving Points of Interest Layer for Route Analysis

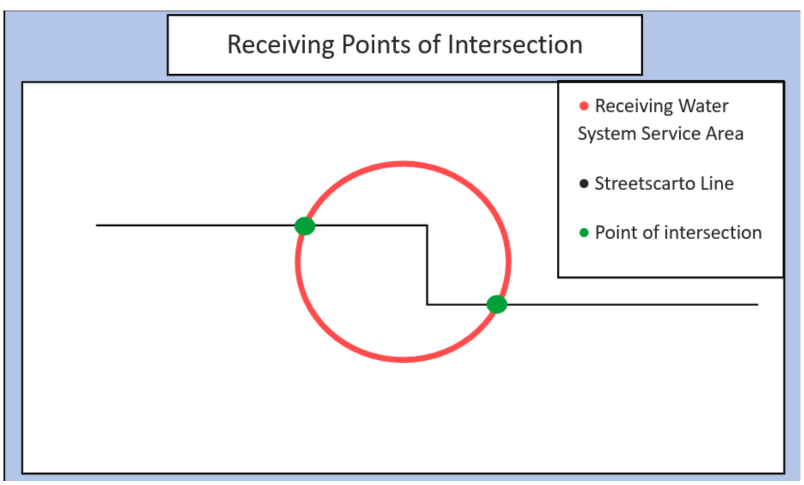
1. Connect North American Geodatabase and import the multiline layer labeled as: “Streetscarto.” This layer includes all digitized roads within California.

Figure 8: "Streetscarto" Layer. This layer is provided through the North American Premium Street Maps provided by ESRI



2. Intersect this layer with the "Receiving_SABL" layer and specify the output to produce 'Points'. This will give you all the point locations where the outer edge of the Receiving water system's area boundary intersects with a road.
3. Label as "Rec_POI"

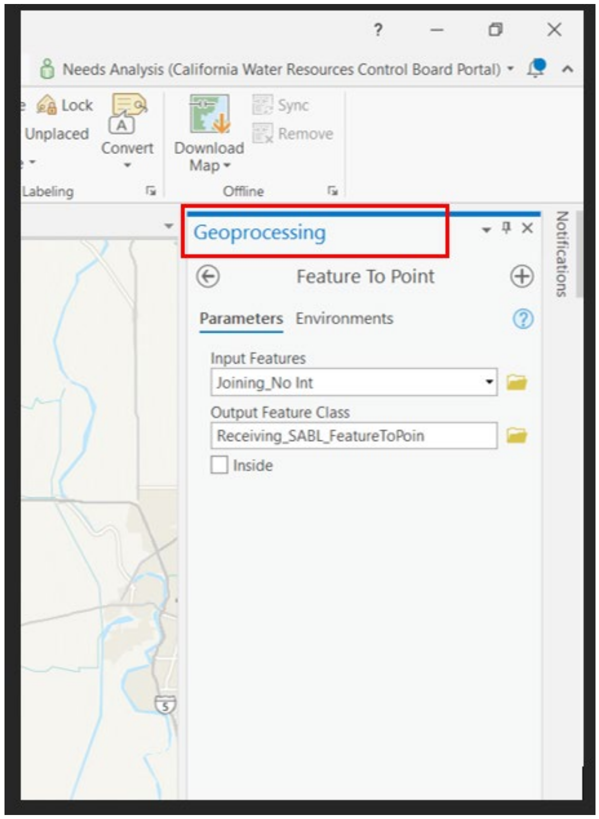
Figure 9: Graphic describing how Receiving system "Points of Interest" are generated. Those points are created when a line from the streetscarto layer intersects with the outer edge of a Receiving system's service area boundary. They represent the "connection point" of a potential consolidation route from the center of a joining system to the Receiving system.



Step 7: Generating Joining Systems Centroids

1. Use "Feature to Point" tool on the "Joining_No_Int" layer to convert it to a series of point locations at the center of each Joining system.

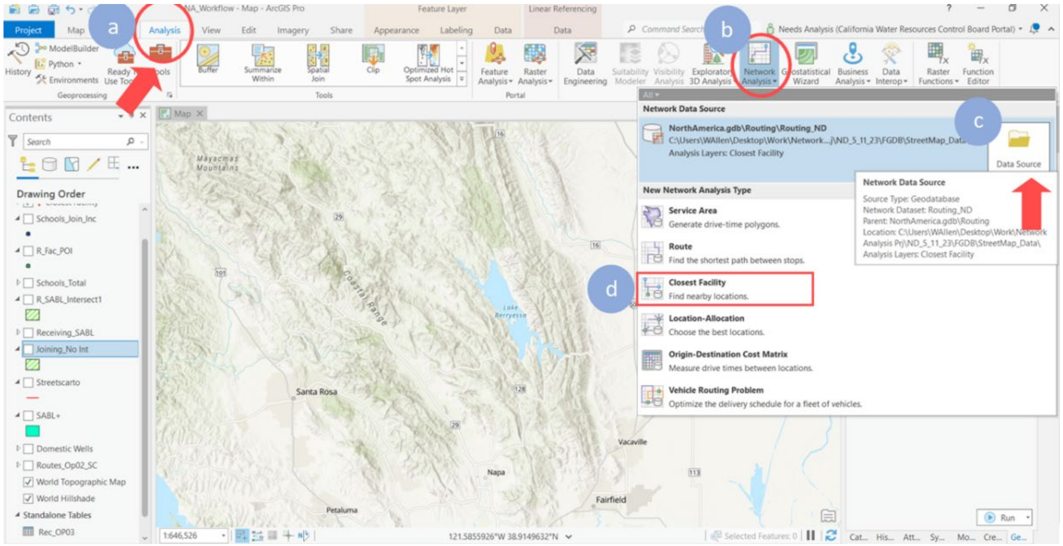
Figure 10: "Feature to Point" tool location in ArcPro. The "Joining_No_Int" layer is being use as the input feature to convert from a polygon to a single point.



Step 8: Network Analysis Tool Set-Up

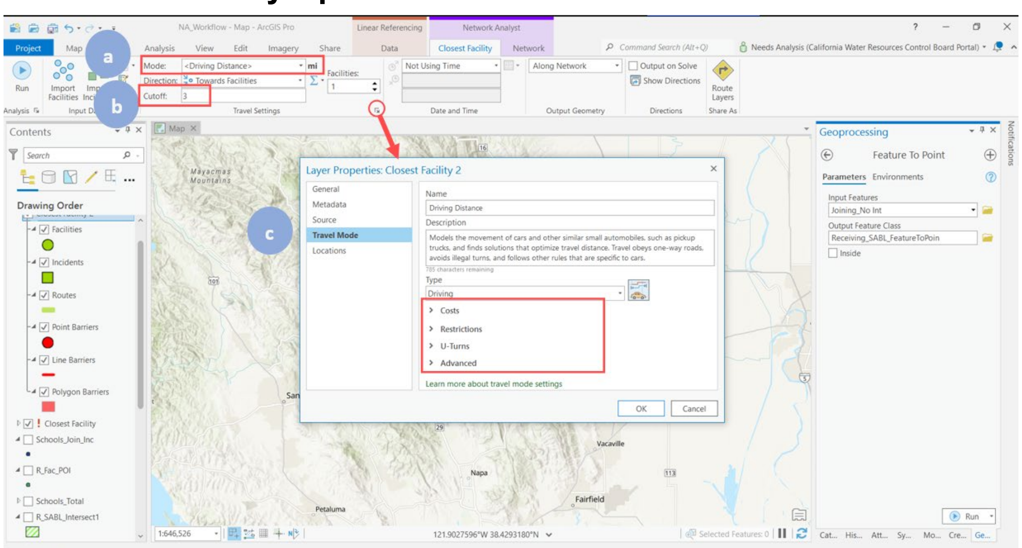
1. In the top ribbon select the tab "Analysis"
2. Then select "Network Analysis"
3. Set the data source to the "Northamerican Gdb".
4. Then select "New Network Analysis Type" for option "Closest Facility".

Figure 11: Location of the Network Analyst tool. (a) Under the analysis tab in the top ribbon (b) select the tab "Network Analyst" (C) manually select the NorthAmerican.gdb as the "Network Data Source" (d) select "Closest Facility" as the "New Network Analysis Type".



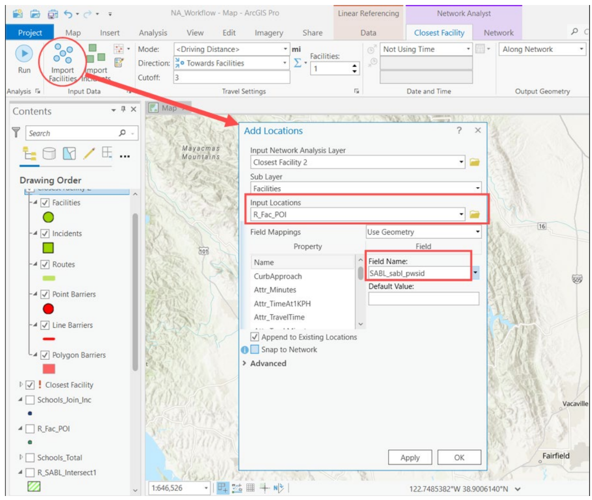
5. Set "Closest Facility Options" as:
    a. Mode: "Driving Distance"
    b. Cutoff: "3"
    c. Under "Travel Mode":
        i. Travel cost: miles
        ii. Uncheck all restrictions except "Driving an automobile."
        iii. Uncheck "Use Hierarchy"

Figure 12: Closest Facility Options



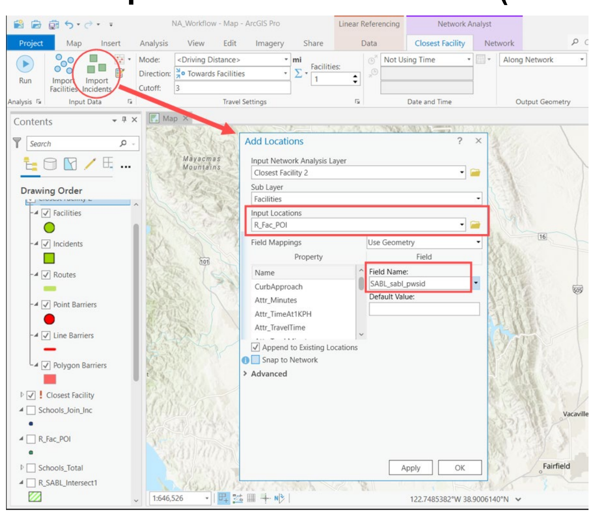
6. Use the “Import Facilities” function in as seen in fig 13 to upload the receiving locations along the route analysis. Click on “Import Facilities” to open the “Add Locations” menu. Here select the “Rec_POI” layer for “Import Locations” and use the PWSID as the field name. Once done click ok.

Figure 13: Location of the “Import Facilities” function (red circle).



7. Use the “Import Incidents” function in as seen in fig 14 to upload the receiving locations along the route analysis. Click on “Import Incidents” to open the “Add Locations” menu. Here select the “Joining_No_Int” layer for “Import Locations” and use the PWSID as the field name. Once done click ok.

Figure 14: Location of the “Import Incidents” function (red circle).



8. Hit “Run” button.

Step 9: Generate Excel Output

1. Once the routes have been produced, use "Table to Excel" function on the "routes" layer to get an excel sheet copy of all available routes between Receiving and Joining systems.
2. Compile both routes and intersecting relationships between Joining and Receiving systems into one excel sheet that is organized by unique Joining system PWSID.
3. Data points included in final sheet include:
    a. J PWSID
    b. J Status
    c. J Population
    d. J Federal Classification
    e. J Service Connections
    f. J SAFER status
    g. J County
    h. R PWSID
    i. R Status
    j. R Population
    k. R Federal Classification
    l. R Service Connections
    m. R SAFER status
    n. R County
    o. Routing Distance (Miles)
    p. Routing Distance (Feet)

Public Water Systems: Largest Receiving System Analysis

Selecting by largest system is a manual process due to limitations with the network analysis tool.

The set-up for this process is the same as the closest route analysis, so begin by repeating steps 1-6 listed above:

- **Step 1**: Add Missing Systems to the Service Area Boundary Layer (SABL)
- **Step 2**: Define Receiving and Joining Systems
- **Step 3**: Create Joining and Receiving Primary Layers
- **Step 4**: Intersecting Joining and Receiving System's Service Area Boundaries
- **Step 5**: Remove Intersecting Joining Systems from the Route Analysis Inventory
- **Step 6**: Create Receiving Points of Interest Layer for Route Analysis

Afterwards, follow the following steps in order.

Step 7: Create Buffer Intersect

1. Create a 3-mile buffer around Joining Incidents using the "Create Buffers" tool. Label as "Join_Buffer"

Figure 15: Diagram of the Joining Buffer Intersect concept. A 3-mile buffer is created around the centroid of the joining system. Receiving systems are then intersected with that 3-mile buffer to see which ones are within the 3-mile distance (Receiving System A) and which are outside of the buffer, (Receiving System B).

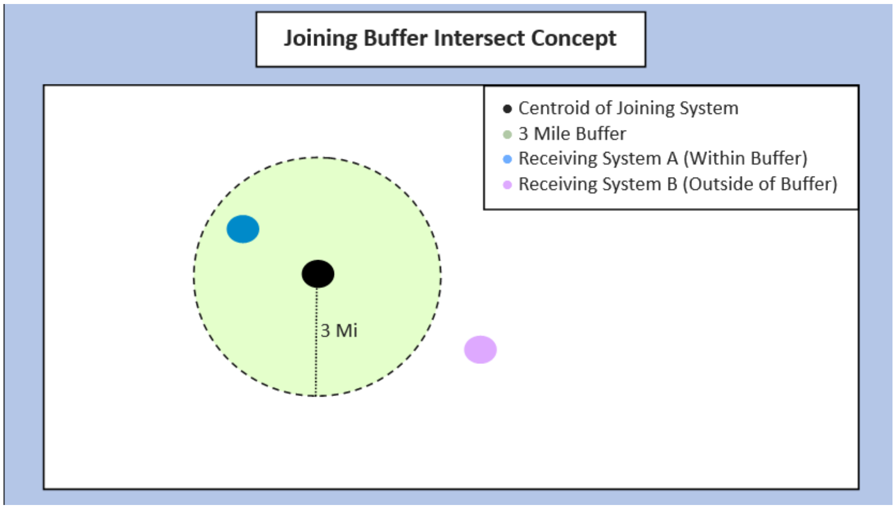
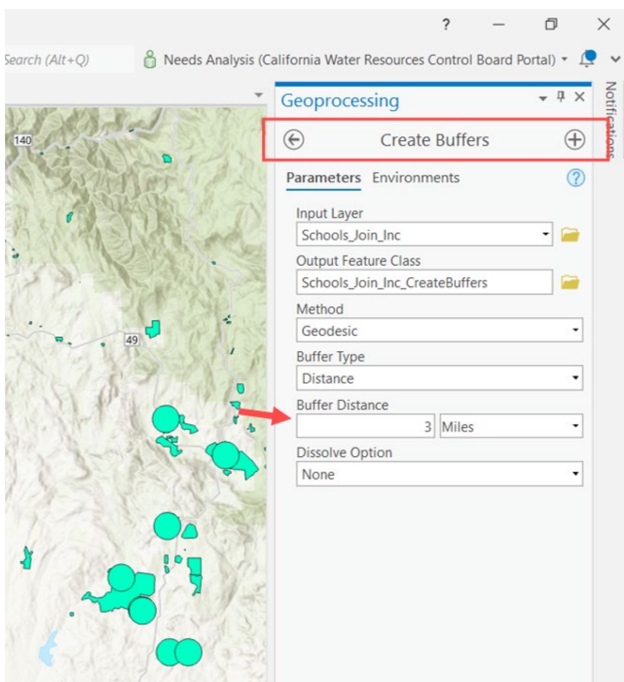


Figure 16: Create Buffers



2. Intersect “Receiving_POI” with 3-mile buffer, “Join_Buffer” layer.
3. Use “Table to Excel” to export the data created from the intersect.

Step 8: Identify Largest Receiving System

1. In excel, for all unique Joining PWSID’s manually select for one Receiving system with the most service connections.
2. Create a list of those Receiving PWSID’s and save that list as CSV. and upload into ArcPro labeled, “RSC”.

Step 9: Creating Largest Receiving System Layer

1. Use “Add Join” tool on the “Receiving_POI” layer to connect it to the “RSC” CSV.
2. There should be a new field added to the “Receiving_POI” layer from the “RSC” for the PWSID’s involved in the “RSC” file.
3. Use “Select by Attributes” tool to select for “RSC” “PWSID = Not Null”, this should select for those Receiving systems specified to have the highest service connection count that are within 3 miles of a Joining system.
4. Use create Layer from selection tool and label, “RPOI_SC”.

Step 10: Conduct Network Analysis

1. Upload “RPOI_SC”. as the facilities within in the network analysis tool and the use the centroid of the Joining system after filtering out intersecting systems “Join_POI” as the incidents.
2. Use the same settings as before and hit run.

State Small Water System Consolidation Route Analysis

For state small water systems, the methodology is similar to the public water system analysis, except for the following modifications:

- The closest Receiving system is identified/selected rather than the largest within the maximum distance criteria.
- The routing distance use 0.25 miles rather than 3 miles.

Domestic Wells Consolidation Route Analysis

Domestic wells present a unique challenge in the physical consolidation GIS analysis due to the lack of exact locational data. The State Water Board utilizes an approximation of domestic well counts and their locations based on data pulled from the Online System for Well Completion Records (OSWCR)[27] database (managed by the Department of Water Resources) which consists of “domestic” type well records, excluding those drilled prior to 1970 and only including “New/Production or Monitoring/NA” completion record types. The dataset includes a count of the total number of unique domestic well completion reports within each 1x1 mile section

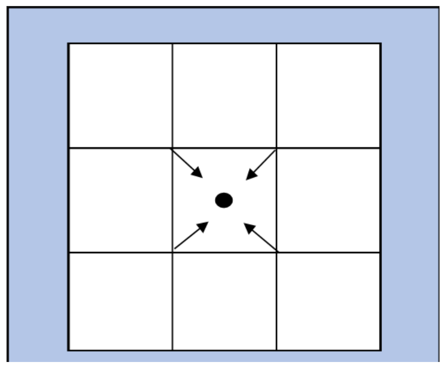
[27] Department of Water Resources OSWCR database

https://services.arcgis.com/aa38u6OgfNoCkTJ6/arcgis/rest/services/i07_WellCompletionReports_Exported_v2_gdb/FeatureServer statewide. The layer used in this analysis is from a modified version of the OSWCR used in the 2023 Risk Assessment.[28]

Step 1: Create Domestic Well Layer

1. The layer that is being used for the domestic wells was created by converting those 1x1 mile sections into centroid points using the “feature to point” tool in ArcPro.
2. There is a field within that layer’s attribute table that gives the count of wells per point. Label this new layer, “DW_Point”.

Figure 17: Domestic Well Centroid



Step 2: Identify Intersecting Domestic Wells

1. Intersect the “DW_Point” with the Receiving SABL layer.
2. Use “Table to Excel” tool on the new intersecting layer.

Step 3: Remove Intersecting Domestic Wells

1. In excel extract the list of unique Joining Domestic Well points then create a new CSV. and label, “DW_Points_Int”
2. In ArcPro upload the CSV and add a join to the “DW_Point” layer from the “DW_Points_Int” CSV. there should be a new field with the Domestic well ID numbers (DW_ID) of the ones from the intersecting list added.
3. Use “Select by Attributes” tool on “DW_Point” and select for where “DW_ID = Not Null”
4. Create a new layer from the select records and label, “DW_No_Int.”

Step 4: Create Buffer

1. Since each domestic well is an approximated location within a one-mile section, a buffer intersect is used for the consolidation distance estimate rather than a route analysis.

[28] 2023 Risk Assessment for State Small Water Systems and Domestic Wells https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2023sswsanddwriskassessment.pdf

2. Use “Create Buffer” tool on the “DW_No_Int” and add a 0.25-mile buffer and label “DW_Buffer”.

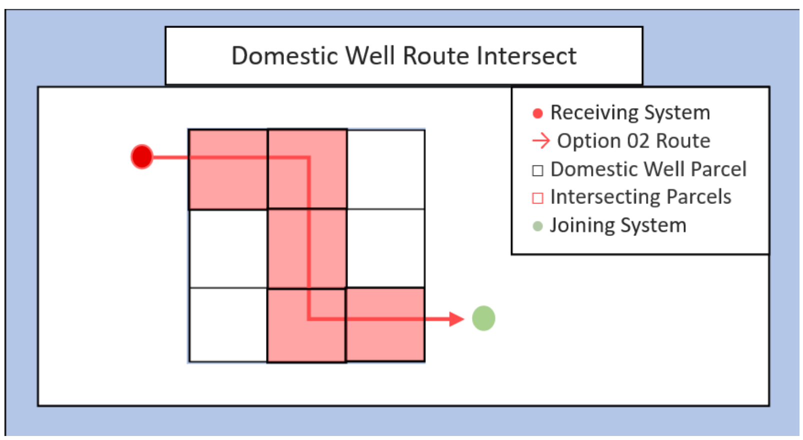
Step 5: Buffer Intersect

1. Intersect the new “DW_Buffer” with the Receiving SABL layer.
2. Use “Table to Excel” tool to export the intersect layer into excel.

Step 6: Intersecting Domestic Wells with the Public Water System Physical Consolidation Route Layer

1. Open the shapefile of the route created when the network analysis for the physical consolidation analysis for public water systems where the largest Receiving system was performed.
2. Intersect the public water system route shapefile with the original 1x1 mile section layer that represents each domestic well location.
3. Use “Table to Excel” function on the new intersect layer.

Figure 18: Route Intersect



Step 7: Excel Compilation

1. In excel compile the list of all unique domestic wells from both the direct intersect, buffer intersect, and the route intersect with their respective Receiving system.

Appendix B: Cost Assessment Model Methods and Assumptions for Physical Consolidation

Cost Estimate Methodology for Each Physical Consolidation Component

The Cost Assessment Model utilizes a set of assumptions to develop cost estimates for physical consolidation. The 2021 Cost Assessment model included many physical consolidation component cost assumptions which are detailed in the 2021 Drinking Water Needs Assessment.[29] The State Water Board has reviewed the 2021 Model's cost assumptions, conducted internal and external research, and has proposed additions and updates to ensure the Model incorporates current market values. Internal research and outreach included a thorough review of projects funded by the State Water Board and consultations with knowledgeable staff. External research and outreach consisted of a literature review, as well as consultations with water systems, venders, manufacturers, service providers, and consultants. Every effort was made to ensure cost assumptions were tailored to the state of California as much as possible.

The sections below detail the cost assumptions used in the 2021 Cost Model and gathered updated cost estimates from both internal and external sources. Each section includes the State Water Board's proposed cost component recommendation and corresponding justification. **The State Water Board is seeking stakeholder feedback and recommendations on the updated physical consolidation modeled cost components. The table below summarizes the recommendations.**

Table 9: Key Differences in Physical Consolidation Cost Estimate Components Between 2021 Cost Model and Recommended Updates

Model Cost Components	2021 Physical Consolidation	2021 Cost Estimate ($)	Recommended Update	Recommended Cost Estimate ($)
Pipeline ($/Lf)	Included	$155	Included	$220
Connection Fees ($/Joining system service connection)	Averaging connection fees for systems with service connection ≥ 3,000	$6,200	Averaging connection fees for receiving systems for each scenario	• Public Water Systems = $5,250 • SSWS =$5,438 • DW= $4,230
Service Line Cost ($/Project)	• Included for intersect	$5,000	Included for both intersect and route Joining systems	$6,200

[29] 2021 Drinking Water Need Assessment: https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2021_needs_assessment.pdf

Model Cost Components	**2021 Physical Consolidation**	**2021 Cost Estimate ($)**	**Recommended Update**	**Recommended Cost Estimate ($)**
	Joining systems. • Excluded for route Joining systems			
Backflow Prevention	Excluded[30]	N/A	Excluded	N/A
Administrative Cost ($/Project)	Excluded for state small water systems, domestic wells, and systems with service connection < 15	$100,000	Included for all Failing and At-Risk systems, except At-Risk Domestic wells	15% of total construction cost.
CEQA Cost ($/Project)	Excluded for state small water systems, domestic wells, and systems with service connection < 15	$85,000	Included for all Failing and At-Risk systems, except At-Risk Domestic wells	• Intersect systems = $25,000 • Route systems = $100,000
Treatment Cost	Excluded	N/A	Included for Failing Receiving systems due to water quality issues	Apply BAT Capital and O&M per failing analyte. (*excluded from physical consolidation funding viability determination*)
Additional Source	Excluded	N/A	Included for Receiving systems with	Additional cost for well or intertie if system relies on one

[30] Backflow was proposed in the November 2021 White Paper as a part of Other Essential Infrastructure but removed due to public feedback.

Model Cost Components	2021 Physical Consolidation	2021 Cost Estimate ($)	Recommended Update	Recommended Cost Estimate ($)
			single source of water supply.	source. (*excluded from physical consolidation funding viability determination*)
Contingency	Included	20% Total Estimated Cost	Included for all Failing and At-Risk systems, except At-Risk Domestic wells	20% Total cost
Inflation	Not Included[31]	N/A	Included for all systems	3% Total cost
Planning & Construction	Not Included[32]	N/A	Included for all systems	10% Total cost
Regional Multiplier	Not Included [33]	N/A	Included for all systems	• Rural Counties (0%) • Urban Counties (+32%) • Suburban Counties (+30%)

The total modeled consolidation capital cost for Failing and At-Risk public water systems and state small water systems = Regionally adjusted pipeline cost + Regionally adjusted service line cost + Connection fees + Administration cost + CEQA cost + 20% contingency + 10% Planning and Construction + 3% Inflation

The total modeled consolidation capital cost for At-Risk domestic wells: Regionally adjusted pipeline cost + Regionally adjusted service line cost + Connection fees + 10% Planning and Construction + 3% Inflation

Pipeline Costs

Pipelines are designed to convey treated water from receiving systems to Joining systems' customers by connecting to the Receiving system's existing distribution

[31] Inflation was applied to the Drought Infrastructure Cost Assessment in the 2022 Risk Assessment, not for the consolidation analysis in the 2021 Risk Assessment.

[32] Inflation was applied to the Drought Infrastructure Cost Assessment in the 2022 Risk Assessment, not for the consolidation analysis in the 2021 Risk Assessment.

[33] The 2021 Cost Assessment model did not adjust the physical consolidation cost for regional variance; however, other long-term solutions were adjusted, such as treatment and other essential infrastructure.

system. Pipelines were assumed to be 12-inch diameter to ensure delivery of water at adequate pressure throughout the system.

Pipeline Cost Estimate Assumptions
Pipeline cost for 12-inch polyvinyl chloride (PVC) was gathered, analyzed, and compared against the 2021 Cost Assessment Model. Table 10 below summarizes the cost collected from each data source.

Table 10: Summary Comparison of Pipeline Cost (Materials and Installation) Per Linear Foot (Lf)

2021 Pipeline Cost	DFA Project/s	External Quote/s	State Water Board's Recommendation
$155[34] (2021)	$160[35] (2020)	$220[36] (2023)	**$220 (2023)**
	$250[37] (2022)	$198[38] (2022)	

Internal and external research conducted by State Water Board staff suggests that pipeline costs have increased since the 2021 Cost Assessment Model was developed. The State Water Board recommends updating the pipeline cost assumptions in the model from $155 per linear foot to $220 per linear foot. This cost estimate aligns with recent internal and external pipeline quotes. Underlying pipeline costs assumptions are detailed below:

- Modeled Pipeline Cost by Linear Foot
    a. Material cost for 12" PVC C900[39] = $55
    b. Installation cost vary with location accessibility, material, and other installation options and can range from $75 to $255[40]
    c. For the purpose of the cost model estimate, assume average installation cost = $165

[34] QK estimate collected by Corona Environmental in 2020 for the 2021 Cost Assessment.

[35] Coachella City consolidation project cost estimate.

[36] Ferguson Water Works, assuming average installation cost. Cost breakdown is summarized in the section below.

[37] Tulare City consolidation project.

[38] Construction project manager in the City of Independence.

[39] C900 PVC: C900 is the American Water Works Association (AWWA) standard for cast-iron-pipe-equivalent outside diameter PVC pressure pipe and fabricated fittings covering nominal pipe sizes from 4 inches through 12 inches. C900 pipes and fittings must comply with the Safe Drinking Water Act requirements, meaning for potable water transmission and distribution. The C900 standard does not include injection-molded PVC fittings.

[40] Ferguson Water Works pipeline installation range.

Equation 1: Installed Pipeline Cost Assumption

Cost/Lf = Material ($55) + Installation ($165) = $220

Pipeline Distance Assumptions

The Cost Model's GIS analysis will estimate the pipeline length needed along street layers, up to 3-miles for public water systems and 0.25-miles for state small water systems and domestic wells (learn more in Appendix A). For Intersect systems, a 1,000-foot distance is assumed for Public Water Systems & state small water systems, a lower intersect pipeline of 200 ft is recommended for At-Risk domestic wells.

For Route analysis Public Water Systems & state small water systems, an estimated pipeline cost accounted for an extra 1,000-foot buffer, in addition to the total distance.[41] For domestic wells, the pipeline cost estimate only includes the cost of installing a 0.25 mile (1,320 ft) pipeline that extends from the domestic well to the nearest Receiving system service area boundary.

Pipeline Cost Estimate Formulas

Total pipeline cost is a function of pipeline cost per Lf and the total estimated distance from the Joining system to the Receiving system.

Equation 2: Intersect Systems Pipeline Cost Estimate Formula

Total pipeline cost (Public Water Systems & state small water systems) = 1,000 ft x $220/Lf

Total pipeline cost (Domestic Wells) = 200 ft[42] x $220/Lf

Equation 3: Route Systems Pipeline Cost Estimate Formula

Total estimated pipeline cost (public water systems & state small water systems) = [1,000 ft Buffer + Total distance (ft) from GIS analysis] x $220/Lf

Total estimated pipeline cost (domestic wells) = 1,320 ft[43] x$ 220/Lf

Service Line Cost

Service lines are water service laterals running from the branched main in the water system's distribution system into the customer's property where the meter is installed.

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[41] This assumption was utilized in the 2021 Needs Assessment and was re-evaluated internally for the proposed updated Cost Assessment Model.

https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2021_needs_assessment.pdf

[42] The State Water Board's internal workgroup recommends a 200 ft pipeline estimate for the construction of a water main to connect a domestic well within an existing service area boundary of a community water system.

[43] The State Water Board's internal workgroup recommends 0.25 miles (1,320 ft) estimate for the construction of a water main to connect a domestic well to a Receiving system, where the domestic well is outside of the Receiving water system's service area.

Service lines vary in length but are usually longer in rural or suburban areas since most customers are set further back from the road.

Service Line Cost Estimate Assumptions

The 2021 Cost Assessment Model included a $5,000 service line cost for all new service connections. State Water Board staff reviewed service line costs from different State Water Board funded projects and solicited external quotes for lateral installations. Table 11 summarizes the service line cost collected from each data source.

Table 11: Summary Comparison of Service Line Quotes

2021 Service Line	DFA Project/s	External Quote/s	State Water Board's Recommendation
$5,000[44] (2021)	$5,500[45] (2020)	$6,200[46] (2023)	**$6,200 (2023)**
	$10,000[47] (2020)		
	$6,000[48] (2019)		
	$5,000[49] (2022)		

Internal and external research and outreach conducted by State Water Board staff suggests that service line cost varies, depending on length, location, material, and many other installation factors. After internal discussions and based on service provider's feedback, the State Water Board recommends updating the service line cost assumptions in the model from $5,000 to $6,200. Underlying service line costs assumptions are detailed below:

Equation 4: Service Line Cost Assumption

Cost/Lf = Material Cost ($3.30/Lf) + Installation ($100/Lf)

[44] This cost was developed by Corona Environmental and utilized in the 2021 Needs Assessment. This cost was assumed for intersect systems only. https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2021_needs_assessment.pdf

[45] Sanger City Water Connection Project.

[46] Based on local plumber pricing and recommendations in a Sacramento-suburban area. Cost breakdown is summarized in the cost methodology section.

[47] Yuba city waterline extension project.

[48] Dunsmuir city tank relocation and replacement project.

[49] Kings Canyon water supply upgrade and consolidation project.

Equation 5: Service Line Length Assumption

Lateral Length = 60 ft[50]

Equation 6: Service Line Total Estimated Cost

Cost/Lf = Material Cost x Lateral Length + Installation Cost x Lateral Length

(60 ft x $3.30) + ($100 x 60 ft) = $6,200 x Count of Joining system service connections

Connection Fees

Connection fees are one-time charges that Receiving systems typically issue for new customers being connected to their water system or existing customers wishing to increase usage. It is important to estimate a certain level of capacity required to serve both base and peak demand periods. The connection fee equates the reservation of system capacity to serve that new connection.[51] Connection fees can vary dramatically from system to system across the State. The State Water Board collects information about new connection fees in the electronic Annual Report (eAR) that water systems are required to complete.

Connection Fees Cost Estimate Assumptions

The 2021 Cost Assessment Model connection fee assumption of $6,600 per connection was developed based on averaging connection fee data collected in the 2018 eAR for systems with service connections greater than or equal to 3,000 connections. State Water Board staff recommend modifying this approach for the 2024 Cost Model to instead use the average connection fees for the list of identified Receiving systems selected by the Model's physical consolidation analysis.

For comparison purposes, connection fees from three consolidation projects funded by the State Water Board were evaluated, a literature review for connection fees was conducted, and water system fee sheets were examined to test the cost assumption. Table 12 summarizes the results of this comparison.

[50] Based on local plumber recommendations in a Sacramento-suburban area.

[51] Monte Vista Water District 2022 WATER CONNECTION FEE STUDY
https://www.mvwd.org/DocumentCenter/View/1084/2022-Connection-Fee-Study-Report-PDF

Table 12: Summary Comparison of Connection Fees Quotes

2021 Connection Fees	DFA Project/s	External Quote/s	State Water Board's Recommendations[52]
$6,600[53] (2021)	$3,200[54] (2020)	$7,055 [55] (2021)	• Public Water Systems = $5,250 • State Small Water Systems = $5,438 • Domestic Wells = $4,320
	$1,000[56] (2020)	$8,782[57] (2021)	
	$3,500[58] (2022)	$3,721[59] (2021)	

The steps below summarize the methodology that State Water Board utilized to update the connection fee cost assumption in the Model:

Equation 7: Develop Average Connection Fees

- Consolidated public water system connection fees = Average connection fees for their potential Receiving public water systems.
- Consolidated small water system connection fees = Average connection fees for their potential Receiving public water systems
- Consolidated domestic well connection fees = Average connection fees for their potential Receiving public water systems.

Equation 8: Determine Connection Fees for Each Joining System

Connection fees cost ($) = Average Receiving system's connection fees x count of Joining system's service connections

Administration

Administration costs are fees charged by a consultant related to providing eligible supportive services to the project. The eligible expenses are usually defined for each

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[52] Using 2021 Electronic Annual Report (eAR) data. The average connection fees for the Receiving systems were calculated for each Joining system type.

[53] This cost was developed by Corona Environmental and utilized in the 2021 Needs Assessment. https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2021_needs_assessment.pdf

[54] Coachella city consolidation project cost estimate.

[55] Based on data reported from East Orange County water systems and collected in the 2021 eAR.

[56] Construction project in Shasta CSD Services, 2020.

[57] Based on data reported by City of Angels in the 2021 eAR.

[58] Tulare city consolidation project, 2022 cost.

[59] Based on data reported by City of Sacramento Main in the 2021 eAR.

budget line item but is mainly comprised of legal fees, project management, and inspections. Administrative fees, such as Local Agency Formation Commission (LAFCo) or California Public Utilities Commission (CPUC) fees, have not been included. Additional data would need to be collected to determine how these costs can be incorporated into future iterations of the Cost Model.

Administrative Fees Cost Estimate Assumptions

In the 2021 Cost Assessment Model, a flat administration cost of $200,000 was developed based on information collected from an Investor-Owned Utility for recent acquisitions in California, but no other data or case studies were considered. In an effort to re-evaluate this cost assumption, State Water Board staff collected and reviewed administrative fees from State Water Board funded consolidations and external construction and improvement projects. Table 13 below summarizes the administration fees collected from each data source.

Table 13: Summary Comparison of Administration Fees Quotes

2021 Administration Fees	DFA Project/s	External Quote/s	State Water Board's Recommendation
$200,000[60]	$151,480[61] (2022)	$100,000[62] (2022)	**15% Construction Cost**[63] (2023)
	$142,819[64] (2019)		
	$106,000[65] (2018)		
	15% Construction Cost[66] (2020)	15% Construction Cost[67] (2023)	

Since administration costs are typically driven by the size of project and time spent on each eligible item, the State Water Board recommends updating the Cost Assessment Model to include an administration cost that varies depending on the total construction

60 This cost was developed by Corona Environmental and utilized in the 2021 Needs Assessment for all systems except State Small Water Systems, Domestic Wells and systems with public water systems with service connection <15. https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2021_needs_assessment.pdf.

61 Gurnsey Avenue Mutual Water Company consolidation project

62 Based on external quote, lump sum regardless of project size.

63 Based on external quote, total construction cost is factored in.

64 Dutch Flat Mutual Consolidation Project.

65 Rosamond CSD estimated cost to connect Water Systems.

66 Yuba City waterline extension project.

67 Based on external quote, total construction cost is factored in.

cost, rather than adapting a lump sum value which can be very high and unrealistic for some small-scale projects. After internal discussions with expert staff, the State Water Board recommends updating the administration cost assumptions in the Model from $200,000 per project to 15% of total physical consolidation construction cost. Underlying costs assumptions are detailed below:

Equation 9: Calculate Construction Cost

Construction Cost = Regionally Adjusted Pipelines Cost + Regionally Adjusted Service Lines Cost

Equation 10: Calculate Project Administration Fees

Administration Fees = 0.15 x (Construction Cost)

California Environmental Quality Act (CEQA) Fees

CEQA fees include an initial study to determine whether the project may have a significant adverse effect on the surrounding environment. Also, an additional cost is typically included to cover the preparation of an Environmental Impact Report (EIR), if adverse effects are identified. However, most consolidation projects apply revisions in the project plans or proposals to avoid or mitigate the effects to a safer extent where all adverse impacts are eliminated, then, a Mitigated Negative Declaration (MND) can be adopted and filed.

CEQA Fees Cost Estimate Assumptions

In the 2021 Cost Assessment Model, a flat cost of $85,000 for CEQA Plus,[68] Mitigated Negative Declaration was applied per consolidation project. CEQA process[69] and fees were collected and analyzed using different internal and external sources. Also, recent CEQA filling fees were gathered from CEQA environmental webpage.[70] Table 14 below summarizes the CEQA fees gathered from different sources.

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[68] CEQA Plus: The State Water Board elected to develop its own State Environmental Review Process which utilizes the environmental documents developed under the CEQA as well as documents prepared for compliance with specified federal environmental laws and regulations (also referred to as federal crosscutters) for its “NEPA-like” process (which is referred to as “CEQA Plus”). The CEQA Plus process complies with the required elements outlined in 40 C.F.R. section 35.3140(b) and refers to the documents prepared for the CEQA as well as the supplemental information provided for compliance with the applicable federal cross cutters authorities: https://www.waterboards.ca.gov/water_issues/programs/grants_loans/srf/docs/policy0513/appendix_i_envguide.pdf.

[69] Governor’s Office of Planning and Research, CEQA Technical Advice Series:

https://opr.ca.gov/docs/MND_Publication_2004.pdf

[70] CEQA Environmental Document Filing Fees: https://wildlife.ca.gov/Conservation/Environmental-Review/CEQA/Fees

Table 14: Summary Comparison of CEQA Fees Quotes

2021 CEQA Fees	DFA Project/s	External Quote/s	State Water Board's Recommendations
$85,000[71] (2021)	$8,836[72] (2020)	$65,000[73] (2023)	• Intersect Systems = **$25,000** • Route Systems = **$100,000**
	$49,000[74] (2020)		
	$21,500[75] (2017)		
	$36,000[76] (2020)	($25,000-$100,000)[77] (2023)	

CEQA costs can vary depending on whether the project may have a significant adverse effect on the environment and the requirements associated with alleviating any potential negative effects. Based on external and internal feedback, CEQA costs are usually proportional to the distance between Receiving and Joining systems. As such, when two systems are adjacent and their boundaries are intersecting, there is usually less anticipated disruption and subsequently less damage to the environment. However, when systems are relatively far apart and can only be physically consolidated through a route, it is expected to have a substantial change in the physical conditions within the area affected by the project, mainly land, and subsequently an increase in needed mitigation measures. Therefore, the State Water Board recommends developing a CEQA cost that differentiates between intersect and route modeled physical consolidations, unlike the previous assumption utilized in the 2021 Cost Assessment Model that applied the same CEQA costs to both intersect and route-based modeled consolidation projects. Underlying costs assumptions are detailed below:

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[71] This cost was developed by Corona Environmental and utilized in the 2021 Needs Assessment. Cost was applied for all systems except State Small Water Systems, Domestic Wells and public water systems with service connection <15. https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2021_needs_assessment.pdf.

[72] City of Chino Water Treatment Facility Expansion Project.

[73] Based on external quote, lump sum regardless of project size.

[74] Shasta CSD Water System Improvement Project.

[75] Diablo Water District Santiago Island Village Annexation and Water Service Anticipated Cost.

[76] Yuba city waterline extension project.

[77] Based on external quote, a cost range that varies with distance between the consolidating systems.

Equation 11: CEQA For Intersect Consolidation

CEQA Fees = $25,000[78]

Equation 12: CEQA For Route Consolidation

CEQA Fees = $100,000[79]

Physical Consolidation Cost Adjustments

Inflation

Due to increases in the price of construction materials, and on-going supply chain issues stemming from the COVID-19 pandemic, the State Water Board is proposing adjusting the modeled capital physical consolidation costs with a 3% inflation rate multiplier where appropriate. The State Water Board recommends adopting the California-specific inflation rate multiplier based on the California Department of Finance's[80] Urban Consumer Price Index (CPI-U).[81] The State Water Board may adjust this percentage accordingly as new data becomes available.

Regional Adjustments

Pipeline and service line costs, especially installation, vary greatly depending on the setting, and prices can dramatically increase with a high cost of living and for lines that are difficult to access. An installation through farmland will be much less than an urban environment with pavement, traffic control, limited hours, and conflicting utilities.[82] In the 2021 Cost Assessment Model, regional adjustments were applied to other long-term solutions, excluding physical consolidation. However, after internal discussions with expert staff and external research and outreach, the State Water Board proposes to adjust pipeline and service line cost estimates for regional cost variance using RSMeans City Cost Index (CCI).[83] The CCI was used to compare and adjust costs between locations. The California CCI shown in Table 15 were applied based on each system's location.

[78] Cost includes Initial Study Cost and Fees + MND Study Cost and Fees.

[79] Cost Includes Initial Study Cost and Fees + EIR Cost and Fees

[80] Economic Forecasts, U.S. and California | Department of Finance - https://dof.ca.gov/forecasting/economics/economic-forecasts-u-s-and-california/

[81] The inflation rate can be calculated month-to-month using a publicly available resource.

US-CA-Inflation-Forecast-GB-2023-24.xlsx (live.com).

https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fdof.ca.gov%2Fwp-content%2Fuploads%2Fsites%2F352%2FForecasting%2FEconomics%2FDocuments%2FUS-CA-Inflation-Forecast-MR-2023-24.xlsx&wdOrigin=BROWSELINK

[82] American Water Works Association, Life Cycle Cost Analysis for Pipelines: https://american-usa.com/news/wp-content/uploads/AWWA-WIC-St.-Louis-.pdf

[83] RSMeans City Cost Index: https://www.rsmeans.com/rsmeans-city-cost-index

Table 15: RSMean City Cost index for Locational Cost Estimating

Location	RSMeans CCI	Percent Adjustment
Rural	+3.0	0%
Urban	+3.97	+32%
Suburban	+3.89	+30%

The categorization of counties by the generalized location for applying the CCI is shown in Table 16:

Table 16: California Counties Categorized by Generalized Location

Location	Counties
Rural	Alpine, Amador, Butte, Calaveras, Colusa, Del Norte, Fresno, Glenn, Humboldt, Imperial, Inyo, Kern, Kings, Lake, Lassen, Madera, Mariposa, Mendocino, Merced, Modoc, Mono, Nevada, Placer, Plumas, San Joaquin, Shasta, Sierra, Siskiyou, Stanislaus, Sutter, Tehama, Trinity, Tulare, Tuolumne, Yolo, Yuba
Suburban	Alameda, Contra Costa, El Dorado, Marin, Monterey, Napa, Orange, San Benito, San Bernardino, San Luis Obispo, Santa Barbara, Santa Cruz, Solano, Sonoma
Urban	Los Angeles, Riverside, Sacramento, San Diego, San Francisco, San Mateo, Santa Clara, Ventura

Contingency

The amount of construction budget that is usually allocated to account for additional and unexpected costs due to natural, staffing, or funding issues. In the 2021 Cost Assessment Model, the contingency was assumed to be 20% of the total project cost. After external discussion with engineering consultants and due to the high unpredictability of the estimated total cost, it is proposed to maintain contingency at 20% to account for fluctuated costs and to ensure appropriately allocated estimated cost.

Planning and Construction

The amount of budget that is spent on planning, management, and execution of construction projects. This process is essential in creating an organized timeline of events, allocating staffing for the project, and determining the necessary materials and equipment. Devoting this budget is necessary to create a well-crafted construction plan to keep the project on schedule and within budget. It can also help ensure the overall quality of the project meets the client's expectations. In the 2021 Cost Assessment Model, Planning and Construction was not accounted for in the physical consolidation, however, after conducting external research with consultants and also in consultation with expert internal staff, State Water Board recommends applying 10% planning and construction.

Appendix C: Modeled Physical Consolidation Options Analysis

The State Water Board explored a number of different options on how to enhance the modeled physical consolidation analysis in the Cost Assessment Model. Alternative options were explored for the following steps of the Model:

- **Step 1**: Identification of Systems to Include in the Analysis
- **Step 4**: Funding Viability Thresholds

The sections below will provide an overview of the different options that were explored.

Step 1: Identification of Systems to Include in the Physical Consolidation Analysis

The original 2021 Cost Assessment Model had narrow criteria for the public water systems included in the physical consolidation analysis. The State Water Board explored additional options for possible Joining and Receiving public water systems criteria. Table 17 summarizes the State Water Board's recommended updates to the criteria. The State Water Board did not explore alternative options for Joining and Receiving system criteria for state small water systems and domestic wells beyond what is recommended in the body of this white paper.

Table 17: Joining & Receiving System Criteria Options Considered

	2021 Cost Model	**2024 Updated Cost Model Joining/Receiving System Options Analyzed**			
		Option 1	**Option 2 (*recommended*)**	**Option 3**	**Option 4**
Joining System Criteria:					
Failing Public Water Systems	Population <= 3,300. (346 systems).	< 1,000 service connections. (345 systems).	< 1,000 service connections. (345 systems).	All	< 500 service connections. (336 systems)
At-Risk Public Water Systems	Population <= 3,300. (463 Systems).	< 500 service connections. (444 systems).	< 500 service connections. (444 systems).	< 500 service connections. (444 systems).	< 500 service connections. (444 systems).
Potentially and Not At-Risk Public Water Systems	Excluded	Excluded	Excluded	Excluded	Excluded

Receiving System Criteria:

Failing Public Water Systems	Excluded	***Shortest Distance*** ≥ 1,000 service connections. (36 systems).	***Largest System*** ≥ 1,000 service connections. (36 systems).	Excluded	≥ 500 service connections. (45 systems).
At-Risk Public Water Systems	Excluded	***Shortest Distance*** ≥ 500 service connections. (68 systems).	***Largest System*** ≥ 500 service connections. (68 systems).	≥ 500 service connections. (68 systems).	≥ 500 service connections. (68 systems).
Potentially and Not At-Risk Public Water Systems	Population > 3,300. (578 systems).	***Shortest Distance >*** 500 service connections. (697 systems).	***Largest System*** **>** 500 service connections. (697 systems).	> 500 service connections. (697 systems).	> 500 service connections. (697 systems).

Step 4: Determine if Physical Consolidation Cost Estimates Meet Model Funding Viability Thresholds

To account for inherent limitations in modeling physical consolidation costs, the State Water Board explored inflating the Model's funding viability thresholds by an additional 10% and 20% of the IUP funding thresholds. Table 18 below summarizes the analyzed funding thresholds by systems size:

Table 18: Funding Viability Threshold Options for Modeled Consolidation Projects for Public Water Systems

	2021 Funding Viability Thresholds	Updated 2023-24 IUP Funding Thresholds	Funding Viability Threshold Option 1: 10% IUP	Funding Viability Threshold Option 2: 20% IUP (*Recommended*)
Public Water System *> 75 service connections*	• Total Capital Cost < $500,000 • Cost Per Connection < $60,000	Cost Per Connection < $80,000	Cost Per Connection < $88,000	Cost Per Connection < $96,000
Public Water System *< 75 service connections*	• Total Capital Cost < $500,000	Total Capital Cost < $6 million	Total Capital Cost < $6.6 million	Total Capital Cost < $7.2 million

	• Cost Per Connection < $60,000			
State Small Water System	N/A	N/A	$2 M	$2 M

The State Water Board did not explore any additional funding viability thresholds for consolidation projects with state small water systems beyond what is detailed in the body of this white paper. However, three funding viability thresholds options were explored for consolidation with domestic wells. Maximum funding viability threshold options included: $100,000; $150,000, and $200,000 per domestic well.

The State Water Board conducted a thorough analysis to estimate the preliminary number of Failing and At-Risk public water systems, state small water systems and domestic wells that meet both of the physical consolidation distance criteria options for Joining and Receiving systems (Step 1), and the project *funding viability threshold* options in the table above (Step 4). The tables below summarize the results of this analysis.

Based on feedback from the State Water Board's internal workgroup, the 20% IUP funding viability threshold adjustment is recommended based on the marginal differences in the number of systems and total estimated costs between the different options. The internal workgroup recommended the $150,000 maximum funding viability threshold for domestic wells based on observed consolidation projects.

Table 19: Failing At-Risk Public Water Systems Preliminary Cost Estimates Utilizing Various Joining and Receving System Criteria & *10% IUP Adjustment* Funding Viability Threhsolds

	# of Possible Joining Systems Assessed for Distance Criteria (Step 1)	# of Joining Systems Meeting Distance Criteria (Step 2)	Total Estimated Cost for All Systems Meeting Distance Criteria (Step 3)	# of Systems where Consolidation Project Meets Project Funding Viability Thresholds (Step 4)	Total Estimated Cost for Systems Meeting Distance Criteria & Funding Viability Thresholds (Step 4)
Failing Public Water Systems					
Option 1	345	173	$545 M	**169**	**$514 M**
Option 2	345	173	$580 M	**169**	**$550 M**
Option 3	346	172	$2,100 M	**166**	**$2,064 M**
Option 4	336	172	$533 M	**166**	**$487 M**
At-Risk Public Water Systems					
Option 1	444	250	$894 M	**244**	**$850 M**
Option 2	444	250	$916 M	**248**	**$900 M**
Option 3	444	242	$860 M	**236**	**$815 M**
Option 4	444	248	$880 M	**242**	**$838 M**

Table 20: Failing At-Risk Public Water Systems Preliminary Cost Estimates Utilizing Various Joining and Receving System Criteria & *20% IUP* Adjustment Funding Viability Threhsolds

	# of Possible Joining Systems Assessed for Distance Criteria (Step 1)	# of Joining Systems Meeting Distance Criteria (Step 2)	Total Estimated Cost for All Systems Meeting Distance Criteria (Step 3)	# of Systems where Consolidation Project Meets Project Funding Viability Thresholds (Step 4)	Total Estimated Cost for Systems Meeting Distance Criteria & Funding Viability Thresholds (Step 4)
Failing Public Water Systems					
Option 1	345	173	$545 M	**169**	**$514 M**
Option 2	345	173	$580 M	**169**	**$547 M**
Option 3	346	172	$2,100 M	**167**	**$2,070 M**
Option 4	336	172	$533 M	**168**	**$501 M**
At-Risk Public Water Systems					
Option 1	444	250	$894 M	**248**	**$878 M**
Option 2	444	250	$916 M	**248**	**$901 M**
Option 3	444	242	$860 M	**240**	**$844 M**
Option 4	444	248	$880 M	**246**	**$866 M**

Table 21: At-Risk Domestic Wells Preliminary Cost Estimates Utilizing Various Funding Viability Threhsolds

At-Risk DWs Funding Viability Thresholds Options	# of Potential DWs Assessed for Distance Criteria (Step 1)	# of Joining DWs Meeting Distance Criteria (Step 2)	Total Estimated Cost for All DWs Meeting Distance Criteria (Step 3)	# of DWs where Consolidation Project Meets Project Funding Viability Thresholds (Step 4)	Total Estimated Cost for Systems Meeting Distance Criteria & Funding Viability Thresholds (Step 4)
< $100 k	81,596	25,634	$557 M	25,385	$509 M
< $150 k				25,480	$520 M
< $200 k				25,573	$536 M

Appendix D: Public Feedback on the Cost Assessment Model's Physical Consolidation Analysis

The State Water Board hosted a series of workshops and webinars over the last few years and received stakeholder feedback on the Cost Assessment Model's physical consolidation analysis. The section below summarizes this feedback and the State Water Board's response.

From: Leadership Council; Community Water Center; and Clean Water Action
Received February 24, 2023

> *"The Board should revise the Cost Assessment Methodology to account for the limitations of Point of Use and Point of Entry treatment. We have expressed our opposition with the current Cost Assessment's approach which identifies point-of-use (POU) and point-of-entry (POE) treatment as a viable alternative for impacted communities where physical or administrative consolidation would exceed a $60,000 per-connection threshold. We are supportive of the Draft White Paper's identification of a more robust approach that would consider community-specific issues and challenges, especially since the Board's Draft POU/POE White Paper details significant Environmental Justice implications and implementation challenges for the deployment of POU and POE treatment solutions."*
>
> **State Water Board Response**: The State Water Board is recommending updating the Cost Assessment Model in two ways that will address this concern. The first is that the Cost Model will assess water systems for physical consolidation first, then treatment, and other long-term solutions before potentially selecting POU/POE as a long-term solution. The State Water Board agrees that POU/POE is not an ideal long-term solution. The second proposed update is to increase the funding viability thresholds per connection for modeled physical consolidation. The results of the analysis should be a greater selection of physical consolidation over POU/POE as the selected modeled long-term solution for impacted communities.
>
> *"The Board should incorporate an update of its progress in mandatory and voluntary drinking water consolidations across the State, which should include the total number of potential consolidations, progress in outreach efforts, and other relevant information. The update should also identify areas where faster progress is needed and highlight barriers that are impeding consolidation efforts. The Board should also translate the number of failing or at-risk water systems and Private Domestic Wells from connections to population."*
>
> **State Water Board Response**: The State Water Board does summarize progress in mandatory and voluntary consolidations in the annual Drinking Water Needs Assessment in the *Retrospection* section of the report. The summary

includes many, but not all, of the requested data points. The State Water Board will consider how to incorporate better analysis of barriers to advancing consolidation projects either in the annual Drinking Water Needs Assessment, Fund Expenditure Plan, or other publication(s).

From: Association of California Water Agencies and the California Municipal Utilities Association
Received September 8, 2022

"The Needs Assessment, including the Cost Assessment, and the Fiscal Year 2022-'23 Fund Expenditure Plan for the Safe and Affordable Drinking Water Fund should prioritize and focus on the primary purpose of remediating public water systems that are failing to provide an adequate supply of safe drinking water for the customers that they serve (i.e., systems on the Human Right to Water (HR2W) list) and those that have been deemed at-risk of failure. ACWA and CMUA note that the State Water Board continues to propose to expand the scope of the Cost Assessment. Annually changing the goals and metrics of the Cost Assessment shifts focus away from failing systems in disadvantaged communities.

As the State Water Board implements solutions, and systems that were once failing come off the HR2W list, the State Water Board should have the ability to consistently track the actual costs and better refine the Cost Assessment to use this information for ongoing budgeting and prioritization of expenditures. If the methodology and modeled solutions are frequently changing it will remain difficult to accurately assess success. Some refinement is necessary and should be expected, however gauging success of the program or identifying opportunities to make adjustments becomes untenable when the metrics for a failing system continue to change."

State Water Board Response: The recommended updates to the Cost Assessment Model are intended to refine and narrow the scope of the Assessment. For example, the recommendation to exclude Not At-Risk state small water systems and domestic wells from the modeled physical consolidation analysis aligns with the SAFER Program's funding priorities.

The State Water Board is utilizing new data from state-funded projects to update the Cost Model's component cost assumptions. Recommendations from SAFER staff and SAFER-funded technical assistance providers are also relied upon to further enhance the Model, which ultimately should result in better data and information to improve SAFER program budgeting.

"State Water Board staff proposes… [to] change to the Cost Assessment Model to not assess physical consolidation against other potential treatment-based model solutions if physical consolidation is found to be a viable model solution at

the beginning of the Assessment. ACWA and CMUA agree physical consolidation for failing and at-risk public water systems should not be overlooked as a viable model solution due to higher estimated costs. However, overlooking other possible cost-effective solution types, e.g., Point of Use/Point of Entry (POU/POE) devices, solely to ensure that physical consolidation is not overlooked is counterproductive to the Safe and Affordable Funding for Equity and Resilience (SAFER) program's priorities. To ensure that failing systems are removed from the HR2W and At-Risk lists, physical consolidation should continue to be assessed against other potential treatment-based model solutions."

State Water Board Response: For Failing water systems, physical consolidation is the preferred long-term solution as reflected in the California Health and Safety Code (see below) and subsequent State Water Board policy.

> ***HSC 116769***: (c) The fund expenditure plan shall prioritize funding for all of the following: (1) Assisting disadvantaged communities served by a public water system, and low-income households served by a state small water system or a domestic well. (2) The consolidation or extension of service, when feasible, and administrative and managerial contracts or grants entered into pursuant to Section 116686 where applicable. (3) Funding costs other than those related to capital construction costs, except for capital construction costs associated with consolidation and service extension to reduce the ongoing unit cost of service and to increase sustainability of drinking water infrastructure and service delivery.[84]

"State Water Board staff proposes… a physical consolidation cost assumption that a receiving system must have 1,000 service connections or more. ACWA and CMUA believe that 1,000 service connections minimum for a receiving water system is arbitrary figure and suggest removing the proposed assumption, unless further refinement and justification can be achieved. ACWA and CMUA acknowledge that it is important for a receiving system to have a proper level of sophistication to maneuver the consolidation process and have the capacity to serve additional customers. However, further assessment is needed to determine if 1,000 connections is the appropriate level of connections to achieve sustainability."

State Water Board Response: The State Water Board has refined its proposed service connections criteria for Receiving systems to greater than 1,000 service

[84] Intended Use Plan Page 31: https://www.waterboards.ca.gov/water_issues/programs/grants_loans/docs/2022/dwsrf-iup-sfy2022-23-final.pdf

connections if the Receiving system is currently Failing and greater than 500 service connections if the Receiving system is non-Failing. The State Water Board is recommending keeping the 1,000 service connection threshold for Failing systems based on a historical review of Failing water systems since 2017. The majority of systems that fail are small water systems serving less than 1,000 service connections. Therefore, Failing water systems with less than 1,000 service connections are not preferred Receiving water systems in a physical consolidation project. However, decisions on funding projects with Receiving Failing water systems with 1,000 service connections or less will be made on a case-by-case basis, taking into account additional local information not captured in the Cost Assessment or the broader Needs Assessment.

From: Staff calls with engineering consultants located throughout California

During the Cost Model re-build process, State Water Board staff connected with many firms, consultants, vendors, and contractors to validate and update capital, operation, and maintenance cost assumptions in the Model. State Water Board staff were recommended to increase the 2021 cost assumptions due to the considerable increase in the cost of construction and equipment material since the release of the 2021 Needs Assessment.

State Water Board Response: The State Water Board is recommending updating the Cost Assessment Model component cost assumptions by gathering recent internal and external quotes, applying an inflation multiplier, and adjusting for regional cost variance. The updated Model's output cost should better reflect and align with current market prices.