

# **THE CAREER PATHWAY FOR MACHINIST/MECHANICS IN THE WATER AND WASTEWATER INDUSTRY**

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A BAYWORK White Paper

8/18/2016

This research paper identifies the pathway from high school to Journey-Level status as a Machinist/Mechanic and details information on the skills required to start this pathway, training programs, and financial aid services available to students.

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# A WHITE PAPER ON THE CAREER PATHWAY FOR MACHINIST/MECHANICS IN THE WATER AND WASTEWATER INDUSTRY

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## Introduction

Within the San Francisco Bay Area, 7.5 million residents rely on over 50 water/wastewater utilities to provide safe drinking water and protect the environment. These utilities collect, treat, and distribute drinking water, and collect, treat, and properly discharge or reuse treated wastewater. BAYWORK, a consortium of 29 water/wastewater utilities and stakeholders, recognizes that operational reliability depends on access to qualified candidates for mission-critical job categories: water and wastewater treatment operators, water distribution operators, electricians, electronic maintenance technicians/instrument technicians, mechanic/machinists, and wastewater collections operators.

This White Paper on the career pathway for Machinist/Mechanics has two purposes:

- To provide information to students, parents, teachers, and counselors interested in helping young adults find challenging and well-paying careers in the field of Mechanics in the Bay Area
- To provide recommendations for future action to make this pathway more accessible and complete

## Machinist/Mechanics in the Water and Wastewater Industry

Industries such as water, power, and manufacturing rely on talented individuals who have the training to create, maintain, and repair mechanical equipment. This precision work requires mathematical and problem-solving skills, as well as the ability to use both complex and heavy equipment. Machinist/Mechanics use their knowledge of the working properties of metals and their skill with machine tools to plan and carry out the operations needed to make machined products that meet precise specifications. In the Bay Area, Journey-Level Machinist/Mechanics in water and wastewater utilities earn approximately \$69,600 to \$85,200 annually.<sup>1</sup>

### The Machinist/Mechanic Career Pathway

In the Bay Area, interested students can start on the career pathway to become a Journey-Level Machinist in high school. By taking courses in math and science, as well as hands-on courses such as woodworking, shop, and metal-working, students can prepare for vocational training.<sup>2</sup> After graduating from high school, vocational training is available at community colleges, or through union and utility apprenticeship programs. Vocational training in a mechanics program is a pre-requisite to becoming a Journey-Level Mechanic/Machinist in the Water and Wastewater Industry. The graphic below shows the requirements to become a Journey-Level Machinist.<sup>3</sup>

#### Useful Terms

##### **Career Technical Education:**

A term applied to schools, institutions, and educational programs that specialize in the skilled trades, applied sciences, modern technologies, and career preparation. Career Technical Education can be abbreviated to CTE, and is sometimes called Vocational Training.

##### **Apprenticeship:**

A combination of on-the-job training and related classroom instruction under the supervision of a journey-level craft person or trade professional in which workers learn the practical and theoretical aspects of a highly skilled occupation.

##### **Journey-Level Person:**

A person who has completed an apprenticeship program or is an experienced worker, not a trainee, and is fully qualified and able to perform a specific trade without supervision.

<sup>1</sup>BAYWORK 2014 Salary Survey

<sup>2</sup>For a full listing of courses and experiences suggested by industry experts, see Appendix A.

<sup>3</sup>These pre-requisites are based on the San Francisco Public Utilities Commission requirements for the Maintenance Machinist (#7332) job classification. We are conducting additional research on the job requirements of other utilities to supplement this information in FY 16-17

Sources for Terms: [www.cslb.ca.gov/Contractors/Journeymen/Journeymen\\_FAQS.aspx](http://www.cslb.ca.gov/Contractors/Journeymen/Journeymen_FAQS.aspx), [edglossary.org/career-and-technical-education/](http://edglossary.org/career-and-technical-education/), <http://lni.wa.gov/TradesLicensing/Apprenticeship/About/Whats/default.asp>

## Career Requirements for a Machinist/Mechanic

<b>Education and Training</b>	}	<ul style="list-style-type: none"> <li>• High School Degree or GED</li> <li>• Completion of a recognized four (4) year Machinist's apprenticeship program</li> </ul>
<b>Certifications</b>	}	<ul style="list-style-type: none"> <li>• California State Driver's license</li> </ul>
<b>Exams</b>	}	<ul style="list-style-type: none"> <li>• N/A</li> </ul>
<b>Work Experience</b>	}	<ul style="list-style-type: none"> <li>• Two years of fulltime verifiable experience as a Journey-Level Maintenance Machinist, OR</li> <li>• Six year of trade-related training (certificate program or military training program) and fulltime verifiable experience as a Journey-Level Maintenance Machinist</li> </ul>
<b>2014 Bay Area Salary</b>	}	<ul style="list-style-type: none"> <li>• \$69,600 to \$85,200 annually</li> </ul>

Vocational training programs generally require both a high school degree and an exam.<sup>4</sup> Apprenticeships and training programs within utilities usually offer on-the-job experience and training at the same time to satisfy the work experience and education requirements to becoming a Journey Level Machinist. Community Colleges provide vocational training and are sometimes able to provide students assistance in gaining on the job experience.<sup>5</sup> Graduates from community college vocational training programs need to find on-the-job experience outside of their training to qualify for Journey-Level positions a Machinist.

Students who attend Community College training programs can take advantage of financial aid and scholarships directed specifically to Community College and students in Vocational Training.<sup>6</sup> After completing the required training and work experience, students can apply to positions around the Bay Area.

## Research Findings

### Methods

To develop the Machinist career pathway, BAYWORK staff collected data in eight distinct areas and answered the following questions:

<sup>4</sup> Sample questions reflecting the types of questions students need to answer to enter vocation training are listed in Appendix B. Tutoring for students interested in entering vocational training or apprenticeship programs is detailed in Appendix C.

<sup>5</sup> See Appendix F for a map of training locations throughout the Bay Area for Machinist/Mechanics

<sup>6</sup> For a complete list of financial services available to students seeking training in Machinist/Mechanics, see Appendix

- What do Machinists like about their jobs?
- What training, experience, and credentials are required to reach Journey-Level status as a Machinist?
- What earnings are associated with Machinist positions?
- What are suggested courses and experiences for students to be prepared for vocational training in Mechanics?
- What are examples of problems (e.g. math) students need to be prepared to solve to be successful in vocational training?
- Where is vocational training provided?
- Where can tutor assistance be obtained?
- Where can financial support and other support services be obtained?

### *Recommendations for future action*

To improve this pathway, BAYWORK recommends the following:

1. Increase in-house training for Machinist/Mechanics within agencies
  - a. Add entry-level and apprentice classifications to utilities in mechanics and machine tooling
  - b. Provide on-the-job training for entry-level and apprentice workers to advance those interested into journey-level positions
  - c. Coordinate with community college programs to develop the necessary curriculum to prepare graduates for entry-level and apprenticeship work
2. Partner with unions to develop new apprenticeship programs in BAYWORK utilities
  - a. Unions can provide classroom training, as well as crucial administrative support, to move interested candidates into apprenticeship positions in utilities
3. Expand existing training programs at the community college level
  - a. Identify programs that provide training and contributes directly to a pipeline for entry-level or apprenticeship work at utilities.
  - b. Secure commitments from training providers and from BAYWORK utilities to expand these programs as needed to support hard-to-fill positions in machine maintenance and mechanical work.

To address some of the challenges in the EMT/Instrument Tech pathway, BAYWORK has completed work on a number of projects. These are outlined in Appendix G. These projects center on increasing awareness of the industry, the salary, benefits, and advantages of the Machinist/Mechanic career path, and skills required to become a Machinist/Mechanic. Appendix G also shows the areas where BAYWORK has not completed projects. BAYWORK's initiative in fiscal year 2016-2017 is to address these barriers where BAYWORK has not previously led projects, specifically through supporting successful training programs and apprenticeship positions.

## Appendix A: Suggested High School Coursework and Experiences for Interested Job-Seekers

Course/Experience	Suggested High School Coursework and Experiences
ALGEBRA	X
GEOMETRY	X
TRIGONOMETRY	X
PRE-CALCULUS	
ENGLISH (READING/WRITING)	X
PHYSICS	
CHEMISTRY	
COMPUTER APPLICATIONS	X
TECHNICAL DRAFTING	
ELECTRICITY/ELECTRONICS	X
INTRO TO ENGINEERING	X
AUTO SHOP	X
WELDING	X
METAL SHOP	X
WOODSHOP	X
MAINTENANCE AND REPAIR OF BICYCLES OR MOTOR VEHICLES	X
BUILDING CONSTRUCTION AND REPAIR	
WOOD/METAL CRAFTING	
MACHINERY REPAIR	X
BUILDING OR MAINTAINING COMPUTERS	
BIOLOGY	

Source: BAYWORK.org Skilled Trades Worker profiles, interviews with Water and Wastewater Utility Supervisors.

## Appendix B: Sample Questions Reflecting Skills Needed for Career Technical Education

- 1) What is the decimal equivalent for the fractions below:  
(Example,  $\frac{1}{4} = 0.25$ ):
  - a)  $\frac{1}{2} =$
  - b)  $\frac{2}{3} =$
  - c)  $\frac{3}{4} =$
- 2)  $\frac{3}{8} + \frac{3}{8} =$
- 3)  $\frac{1}{6} + \frac{3}{4} =$
- 4) What is 30% of 250?
- 5) Machining bolts cost \$2.80 per pound. What is the price of a box of bolts that weigh 4  $\frac{1}{2}$  lbs.? (Please round your answer to nearest cent.)
- 6) Find the area of a square that has a side that measures 6 inches.
- 7) A room needs to be tiled. The room is 18 ft. long and 12 ft. wide. Tile costs \$1.85 per square foot. What is the cost to tile the room?
- 8) Convert these decimals to fractions:  
(Example,  $0.50 = 50/100 = 5/10 = \frac{1}{2}$ )
  - a) .75 =
  - b) .125 =
  - c) .375 =
  - d) .5625 =
  - e) .9375 =
- 9) Joe used 13 gallons of gas to travel 403 miles in his new Nissan... How many miles per gallon does he get with this car?
- 10) A drill bit that measures  $\frac{5}{8}$  inch is too small for a job. The drill bit that measures  $\frac{3}{4}$  inch is too large. What size bit should you try next?

Source: East Bay Municipal Utility District in collaboration with BAYWORK and the Contextualized Learning Project

## Appendix C: Tutoring Services Available for Machinist/Mechanic Vocational Training

Table C-1: Tutoring Companies and the Subjects Offered

	Khan Academy	Chegg	Vocational Information	Tutor.com	Slader.com	WyzAnt	East Bay Tutoring	Microsoft Office Help	Sacramento State University
ALGEBRA	X	X		X	X	X	X		
GEOMETRY	X	X		X	X	X	X		
TRIGONOMETRY	X	X	X	X	X	X	X		
PRE-CALCULUS	X	X		X	X	X	X		
TYPING									
ENGLISH (READING/ WRITING)	X	X		X	X	X	X		
PHYSICS	X	X		X	X	X	X		
CHEMISTRY	X	X		X	X	X	X		
COMPUTER APPLICATIONS				X				X	
TECHNICAL DRAFTING			X						
ELECTRICITY/ ELECTRONICS									
INTRO TO ENGINEERING									
AUTO SHOP									
WELDING									
METAL SHOP			X						
WOODSHOP									
MAINTENANCE AND REPAIR OF BICYCLES OR MOTOR VEHICLES									
BUILDING CONSTRUCTION AND REPAIR									
WOOD/METAL CRAFTING			X						
MACHINERY REPAIR			X						
BUILDING OR MAINTAINING COMPUTERS									
BIOLOGY	X	X		X	X	X	X		
WATER/ WASTEWATER TREATMENT									X
WATER/ WASTEWATER DISTRIBUTION									X

**Table C-2: Tutoring Company Information**

<b>Tutoring Resource</b>	<b>Cost</b>	<b>Location</b>	<b>Website</b>
<b>Khan Academy</b>	Free	Online	<a href="https://www.khanacademy.org/">https://www.khanacademy.org/</a>
<b>Chegg</b>	Free	Online	<a href="http://www.chegg.com/tutors">http://www.chegg.com/tutors</a>
<b>Vocational Information Center</b>	Free	Online	<a href="http://www.khake.com/page88.html">http://www.khake.com/page88.html</a>
<b>Tutor.com</b>	Varies	Online	<a href="http://www.tutor.com/subjects">http://www.tutor.com/subjects</a>
<b>Slader.com</b>	Free	Online	<a href="http://www.slader.com/tutoring/peer/">http://www.slader.com/tutoring/peer/</a>
<b>WyzAnt</b>	Varies	Online, In-Person	<a href="https://www.wyzant.com/resources">https://www.wyzant.com/resources</a>
<b>East Bay Tutoring</b>	Varies	In-Person	<a href="http://eastbaytutoring.com/">http://eastbaytutoring.com/</a>
<b>Microsoft Office Help</b>	Free	Online	<a href="https://support.office.com/en-us/?legRedirect=true&amp;CorrelationId=e3e5eb71-bb73-47b7-842b-0c57ad2406e1">https://support.office.com/en-us/?legRedirect=true&amp;CorrelationId=e3e5eb71-bb73-47b7-842b-0c57ad2406e1</a>
<b>Sacramento State University</b>	Varies	Online	<a href="http://www.owp.csus.edu/courses/catalog.php">http://www.owp.csus.edu/courses/catalog.php</a>

## Appendix D: Training Programs in the Bay Area for Careers in Mechanics

Training Institution	Type Of Training Institution	Training Program	Link to Training Program
<b>Gavilan College</b>	Community College	Water And Wastewater Technology	<a href="http://www.gavilan.edu/water/">http://www.gavilan.edu/water/</a>
<b>Napa Valley College</b>	Community College	Machine Tool Technology	<a href="http://www.napavalley.edu/academics/technicaldivision/mach/pages/default.aspx">http://www.napavalley.edu/academics/technicaldivision/mach/pages/default.aspx</a>
<b>Santa Rosa Junior College</b>	Community College	Machine Tool Technology	<a href="http://itt.santarosa.edu/machine-tool">http://itt.santarosa.edu/machine-tool</a>
<b>Laney College</b>	Community College	Industrial Maintenance	<a href="http://www.laney.edu/wp/industrialmaintenance/">http://www.laney.edu/wp/industrialmaintenance/</a>
<b>Laney College</b>	Community College	Machine Technology	<a href="http://www.laney.edu/wp/machine_technology/">http://www.laney.edu/wp/machine_technology/</a>
<b>Chabot College</b>	Community College	Machine Tool Technology	<a href="http://www.chabotcollege.edu/mtt/">http://www.chabotcollege.edu/mtt/</a>
<b>Diablo Valley College</b>	Community College	Mechanical Technology	<a href="http://www.dvc.edu/academics/psed/archi-engin/engineeringtech/index.html">http://www.dvc.edu/academics/psed/archi-engin/engineeringtech/index.html</a>
<b>College Of Marin</b>	Community College	Machine And Metals Technology	<a href="http://www.marin.edu/apps/directory/programprofile.aspx?acadprogramid=64">http://www.marin.edu/apps/directory/programprofile.aspx?acadprogramid=64</a>
<b>San Jose City College</b>	Community College	Machine Technology	<a href="http://www.sjcc.edu/academics/departments-divisions/machine-technology">http://www.sjcc.edu/academics/departments-divisions/machine-technology</a>
<b>De Anza College</b>	Community College	CNC Technology/CNC Machinists	<a href="https://www.deanza.edu/manufacturing/">https://www.deanza.edu/manufacturing/</a>
<b>Hartnell College</b>	Community College	Drafting And Design Engineering Technology - Mechanical	<a href="http://www.hartnell.edu/drafting-design-engineering-technology-mechanical">http://www.hartnell.edu/drafting-design-engineering-technology-mechanical</a>
<b>Silicon Valley CTE</b>	ROP	Precision Machining	<a href="http://www.metroed.net/svcte/svcte-classes/">http://www.metroed.net/svcte/svcte-classes/</a>
<b>California Tooling &amp; Machining Apprenticeship Association</b>	Other	CTMAA Apprenticeships/ Program Finder	<a href="https://www.calmachinist.com/index.php?p=pages&amp;id=13">https://www.calmachinist.com/index.php?p=pages&amp;id=13</a> <a href="https://www.calmachinist.com/index.php?p=apprentice&amp;id=3">https://www.calmachinist.com/index.php?p=apprentice&amp;id=3</a>

Source: BAYWORK.org, Training Locations

## Appendix E: Financial Aid Available for Machinist/Mechanic Training

### Overview of Financial Support for Education

There are many ways to receive financial assistance when paying for an education. The following are typical types of education financial aid:

- **Scholarships** – a form of financial aid that does not need to be repaid and is typically awarded on the basis of academic or other achievement.
- **Grants** – a form of financial aid that does not need to be repaid and is typically based on financial need.
- **Loans** – A borrowed sum of money to be used for education expenses that must be paid back, usually with interest. The most common loan program is the Federal Student Aid administered by the US Department of Education. The Free Application for Federal Student Aid (FAFSA) can be found here: <https://fafsa.ed.gov/>
- **Work Study** – a financial aid program where students are given a part-time job, allowing them to earn money to help pay education expenses.
- **Fee Waivers** – Educational fees may be waived at certain institutions as a form of financial aid.

At the beginning of the financial aid search, it may be challenging to understand the wide array of financial aid options available to students and decipher which options are best suited for an individual student. The resources in this section will provide students and their families with the following:

- An overview of the financial aid basics and tips for where to start the process.
- Checklist of activities to do in middle school and high school to help prepare for college and the associated fees
- Definitions of common financial aid terminology to help understand student aid descriptions, applications and contracts.
- An explanation of the difference between grants, scholarships, loans and additional options
- Evaluation methods to compare financial aid packages from different schools
- Tools to search for financial aid opportunities
- Recommendations for reducing the cost of going to school

#### Resources:

- <http://www.educationplanner.org/students/paying-for-school/index.shtml>
- <http://www.losmedanos.edu/studentervices/finaid/terms.asp>

## Community College and Vocational Training Financial Aid and Scholarships

The resources in this section will provide students and their families with the following:

- List of grants and scholarships available for community college students specifically
- Lists of scholarships specific to industry and career types
- Searches for scholarships, grants and loans
- Free workshop opportunities to help families navigate the process of preparing for and funding higher education

### Resources:

- <http://www.scholarshipsandgrants.us/community-college-scholarships/>
- <https://www.salliemae.com/>
- <http://www.thesalliemafund.org/>
- <http://www.khake.com/page57.html>

To find more information regarding financial aid at a specific Bay Area Community College, click on the link for the community college in Table E-1 to be directed to their financial services webpage.

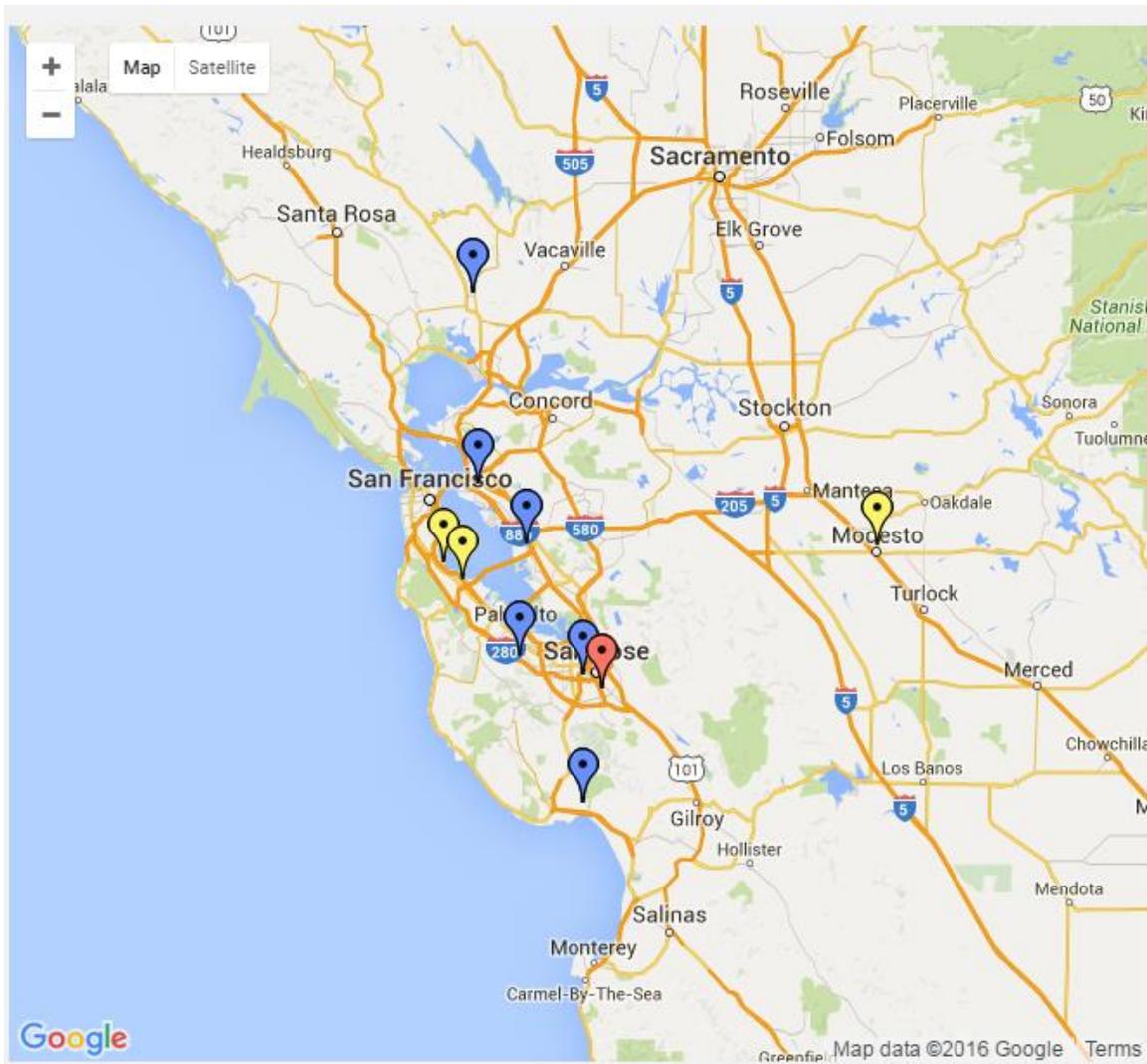
## Appendix F: Locations of Training Programs and Employers for Machinist/Mechanics in Bay Area

### Training Opportunity Map

Jobs in the water and wastewater industry provide the opportunity to earn a good living for yourself and your family while serving your community and protecting the environment. Our Training Opportunity Map provides information on Bay Area colleges, universities, unions, and vocational programs that can help you prepare for a rewarding career.

#### Map Legend

-  Colleges
-  Unions
-  Regional Operational Program (ROP)
-  High Schools
-  Other



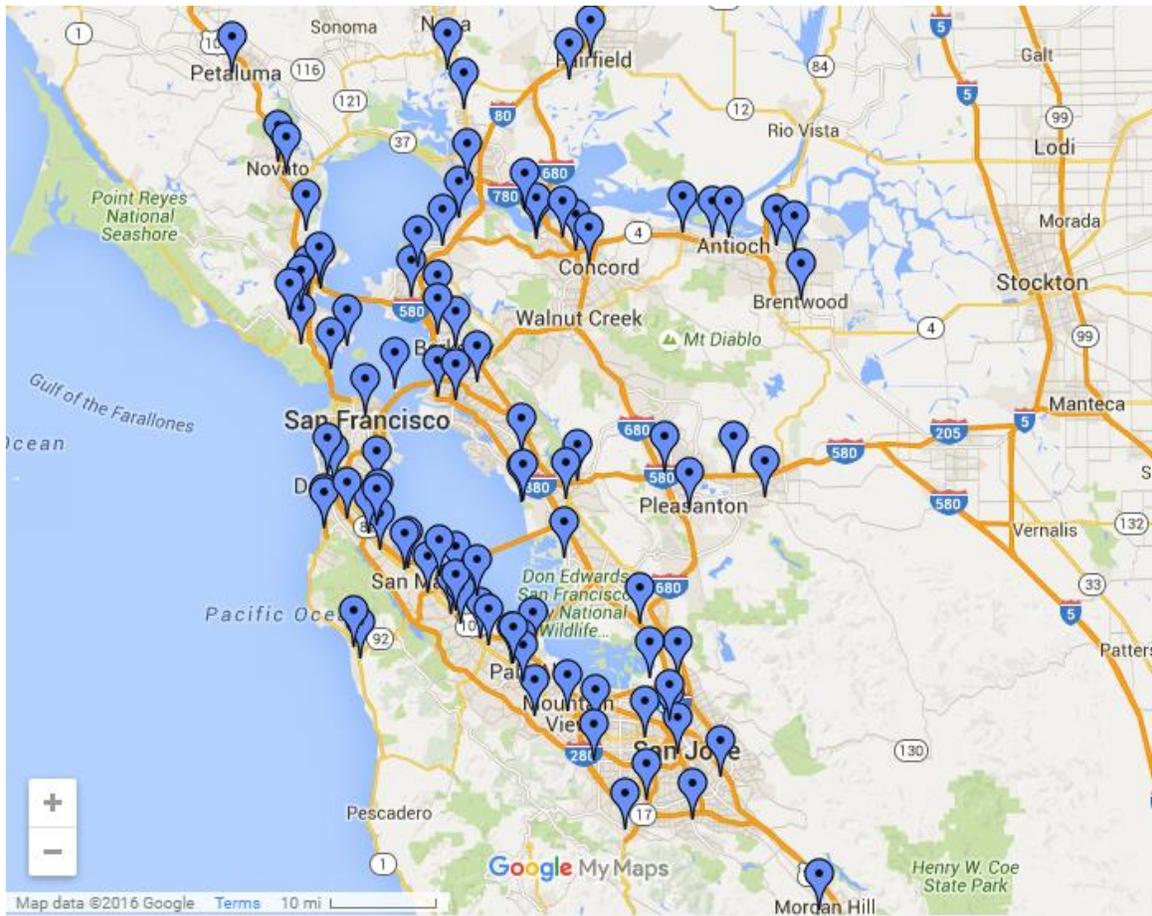
This map shows locations of unions, community colleges and other organizations offering vocational training in Mechanics. The interactive map is available on [Baywork.org](http://Baywork.org)

## Employer Location Map

There are over 70 water and wastewater utilities in the Bay Area, ranging from large municipal utilities to small private companies. Our Employer Location Map helps you locate these employers.

[Learn More](#)

CA Employment Development Department



This map shows locations of employers in the water and wastewater industry in the Bay Area. The interactive map is available on [Baywork.org](http://Baywork.org).

## Appendix G: Challenges in the Machinist/Mechanic pathway and related BAYWORK projects

	BAYWORK Projects												
	Brochures	Posters	Presentations	Facility Tours	Career Fairs	Contextualized Learning Curriculum	Water-related curriculum	White Paper Project	Website	Community College Advisory Committee	Community Colleges Curriculum Development	Internship Development	Equipment Donation to Community Colleges
Limited awareness of the water/wastewater industry	X	X	X	X	X	X	X	X	X	X	X	X	
Limited awareness of skilled trades and engineering jobs	X	X	X	X	X	X		X	X			X	
Limited awareness of skills needed to obtain skilled trade/engineering jobs	X		X			X	X	X	X	X	X		
Limited career technical education available in high school								X					
Uneven career technical education available in community colleges								X		X	X		
Inadequate equipment in community college programs								X					X
Difficulty finding qualified career technical education instructors								X					
Difficulty developing industry relevant curriculum								X		X	X		
Limited union apprenticeships								X					
Limited financial support for students								X					
Lack of tutoring resources to address skills needed for training								X					
Insufficient internships in skilled trades and engineering								X				X	
Limited entry-level positions in skilled trades and engineering								X					

The table above shows challenges in the Machinist/Mechanic pathway and the related BAYWORK projects that seek to address these challenges.

Source: BAYWORK.org, interviews with Candidate Development Subcommittee