

Adapting to Rising Tides



Pipelines Vulnerability and Risk Profile

Natural gas, liquid petroleum, jet fuel, gasoline, and diesel fuels are transported via pipelines that cross the ART project area. Pipelines are usually buried at a depth of 3 to 4 feet in high-carbon steel pipelines. Many are located in railroad and state road or highway right-of-ways, and some pipelines cross natural areas such as marshes and flood control and stream channels. For example, a major natural gas pipeline parallels I-880 while another pipeline runs parallel to the shoreline from Emeryville to the Oakland Airport. This second pipeline is under a raised dike along the west edge of the airport that is 5 to 6 feet above the Bay, and then crosses under Bay to the San Francisco Airport via Brisbane.

Key Issues

Buried pipelines are directly and indirectly sensitive to higher groundwater table and salinity intrusion. Exposure to salt water can corrode pipelines that are not properly protected as specified in federal and state regulations. Rising groundwater levels could increase liquefaction potential leading to additional damage during a seismic event. In the event of flooding, pipelines that are not weighted or anchored may float and become exposed, particularly during prolonged flooding and in marshy or sandy soils. Erosion during storm events could also expose and damage pipelines. Damage to pipelines could result in service disruptions as well as threats to public safety and the environment in the event of an explosion or release of hazardous contents. Information on the location and depth of pipelines was not publicly available.

Vulnerabilities	Consequences
Timing <ul style="list-style-type: none">• Due to a lack of data on location and depth, in combination with uncertainty in the timing of groundwater rise, it is unclear when specific pipeline assets may be vulnerable. Physical and Functional Qualities <ul style="list-style-type: none">• Pipes that are not properly protected are sensitive to corrosion if exposed to saltwater either in areas that are flooded or if there is saltwater intrusion.• Flooded pipelines could float and become exposed if not weighted or anchored.• The material covering some pipelines may be sensitive to erosion, which could result in direct exposure and potential damage of the pipeline.• Rising groundwater increases the risk of liquefaction, which could damage buried pipelines in a seismic event. Information <ul style="list-style-type: none">• Georeferenced information on the location and depth of pipelines in the ART project area is not publicly available. Management Control <ul style="list-style-type: none">• Existing operations and maintenance plans may not have well-coordinated plans - shared with emergency responders and other relevant entities - for shutdown and other measures to minimize damages in the event that a pipeline is affected by a storm flooding event.	Scale <ul style="list-style-type: none">• Damaged pipelines could affect adjoining properties and neighborhoods.• Depending on the areas served by pipelines (e.g. some serve the airports) consequences of damage to pipelines could be subregional and regional. Ecosystem Services <ul style="list-style-type: none">• The contents of pipelines include jet fuel, diesel, and other petroleum products and hazardous materials, which, if released, would harm natural area habitats and sensitive species. People <ul style="list-style-type: none">• If damaged, pipelines could explode or leak, causing a hazard for any nearby populations. Economy <ul style="list-style-type: none">• If pipelines are disrupted, the movement of goods (fuel, gas, diesel) would either be suspended or transferred to an alternate means of transport.• Pipelines serve major users, such as Oakland Airport, which if forced to suspend operations would result in economic losses.