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Job number

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1. Executive Summary

Sea level rise affects everyone in Marin County, from those living close to the shoreline to those living in the hills. Even those with property outside of the inundation zone will be affected by service disruptions due to the flooding of wastewater treatment plants and hospitals, and most relevant to TAM's interests, delays when flooding impacts key transportation routes, such as Highways 101 and 37. The impacts are likely to be felt most acutely by those with fewer resources, such as underserved and marginalized communities.

Marin County has been a leader in California and across the nation on understanding and preparing for its vulnerability to sea level rise (see Existing Plan Review Memo). To date, there have been several important efforts to identify exposure and hazards, as well as begin to map solutions, including countywide projects such as BayWAVE and C-SMART, in combination with existing and burgeoning city efforts in Sausalito, Corte Madera, San Rafael, and many others.

With the passage of Measure AA, the Transportation Authority of Marin (TAM) now has dedicated, on-going funds for sea level rise protection, estimated at approximately \$250,000 annually based on the current revenue projection. These funds have a wide array of eligibility and potential uses and can be used to respond to the various needs identified in vulnerability assessments prepared by BayWAVE, C-SMART, and Caltrans. TAM has contracted Arup, Pathways Climate Institute, and WRT to support its inaugural efforts to identify vulnerable areas in the County, develop area-specific sea level rise adaptation strategies, and create an implementation plan for TAM.

Following a review of existing work in and around Marin County, this next phase of the project (Task 3) updates the understanding of coastal flood vulnerability in Marin County, with a focus on the transportation system. Since the last countywide assessments were conducted, information was released on how sea level rise will also impact shallow groundwater tables, commonly referred to as groundwater rise. Groundwater rise projections are assessed in combination with permanent overland inundation from rising sea levels, as well as an analysis of current and future temporary 100-year flood exposure from both coastal storm surge and waves, as well as coastal/fluvial/pluvial impacts identified by FEMA floodplain mapping.

One important goal of this flood hazard analysis is to use the latest science to both reaffirm known locations of current and future coastal flood vulnerability and identify any new potential flood hazard locations. The focus areas can then be used to spur discussion within TAM and across Marin County to identify ongoing or planned transportation improvements and adaptation plans and increase coordination among stakeholders to implement measures that reduce the County's transportation flood vulnerability. Through this analysis, the consultant team identified 15 focus areas and provided information on the flood related hazards for each, the timing of impact on roads, impacts to multimodal transit and bike routes, and identification of key community and lifeline assets within each focus area to connect the transportation system to the communities they serve.

1.1 Purpose

This memorandum summarizes methods developed to identify Marin County coastal flood focus areas and to identify and present focus area locations, along with exposure statistics, focusing on transportation and transit assets. This memo will:

1. Define the multi-hazard, multi-stakeholder driven methodology to identify focus area locations
2. Discuss identified focus area locations
3. Discuss online data viewer that will be used for TAM and Technical Advisory Committee (TAC) and Focus Group discussions
4. Describe how focus area analysis can inform subsequent tasks and future TAM projects

For this project, *focus areas* are defined as locations that are vulnerable to sea level rise coastal hazards and fluvial/pluvial flood exposure, with implications to both Marin's transportation assets, as well as to important community and lifeline assets.

1.2 Approach & Outcomes

In recognition of the wealth of work that Marin County has already undertaken to map and understand its vulnerability to coastal flood hazards, the goal of Task 3 is to update known vulnerabilities, refine with the latest scientific information, and propose a suite of focus areas that will support future discussions for adaptation planning across Marin County, with a focus on the County's transportation assets. The exposure analysis, including the delineated focus areas, is provided in GIS geodatabases and through an online [Web Map](#) to increase uptake across the entire county. The focus areas are intended to spur future discussions on shared coastal flood hazard exposure, guide conversations about ongoing and planned transportation and adaptation projects, and encourage multi-stakeholder coordination as the County works to prepare and implement flood hazard adaptation measures. The boundaries for the focus areas should be interpreted as general boundaries and not strict boundaries.

2. Focus Area Location Identification Methodology

2.1 Data Collection and Management

The consultant team worked with TAM and the TAC to collect and collate a suite of countywide assets for the flood exposure and vulnerability assessment. In turn, building on past efforts, the consultant team updated a countywide exposure analysis and included an additional sea level rise flood projection as well as new scientific flood on exposure to sea-level rise driven groundwater rise. The following section describes the methods to collect and vet the different data sources.

2.1.1 Marin County Asset Data

TAM, in collaboration with the TAC and county representatives, solicited, collected, and shared the best available information on Countywide assets, such as roadways, facilities, and community infrastructure. Prior to the passage of Measure AA, which explicitly funds and empowers TAM to assess transportation vulnerability to sea level rise, Marin County's Department of Public Works led a project that assessed sea level rise impacts to Marin County transportation assets, with the goal of providing project-level information on coastal flood vulnerability and to support adaptation planning. The first iteration of the County's exposure analysis was completed as TAM's study was beginning. The consultant team leveraged DPW's work collecting and cataloging key County assets, which allowed the consultant to use the most recently vetted and reviewed asset information in this analysis.

Created as part of the Existing Plan Review, an ArcGIS online group repository was developed for coordination and sharing of data among the consultants (Figure 1). Accompanying excel files categorized each layer type as a point, line, or polygon and described relevant attribute characteristics, such as the number of assets within a specific category (e.g., 6 assets within the SMART layer or 549 assets within the Marin Transit Stops layer).

Once all the GIS data layers were compiled, the consultant team identified which assets would be appropriate for exposure analysis. The consultant team developed asset-based GIS geodatabases that could then be used for the exposure analysis (see section 3.1.1). Table 1 lists the full suite of assets included in the analysis.

Table 1 List of Assets

| Layer Category | Layer Name | shape | data source |
|---------------------------------|----------------------------------|-----------|---------------------------------|
| Active Transportation - Bike | Bikeways | polyline | TAM / TAC |
| Active Transportation - Trails | Trails | polyline | County SLR Transportation Tool |
| Airport | Airports | point | TAM / TAC |
| Community Assets | School Locations | point | County SLR Transportation Tool |
| County Assets | City and County Facilities | point | County SLR Transportation Tool |
| | County Facilities | point | TAM / TAC |
| | Publicly Owned Parcels | polygon | County SLR Transportation Tool |
| Emergency Response | Sand/Sandbag Provision Locations | point | County SLR Transportation Tool |
| | Tsunami Evacuation Zones | polygon | County SLR Transportation Tool |
| Equity | Equity Priority Communities | polygon | MTC Equity Priority Communities |
| Lifelines | Fire Stations | point | County SLR Transportation Tool |
| | Hospitals | point | County SLR Transportation Tool |
| | Law Enforcement | point | TAM / TAC |
| | Medical Facilities | point | TAM / TAC |
| Roads | HOV Lanes | polyline | TAM / TAC |
| | Marin County Roads | polyline | TAM / TAC |
| | Road Tunnels | polyline | TAM / TAC |
| Transit | Bus Routes OSM | polyline | TAM / TAC |
| | Bus Stops OSM | point | TAM / TAC |
| | GGT Ferry Stops | point | TAM / TAC |
| | GGT Routes | polyline | TAM / TAC |
| | GGT Stops | point | TAM / TAC |
| | Hubs and Park and Rides | point | TAM / TAC |
| | Marin Transit Routes | polyline | TAM / TAC |
| | Marin Transit Stops | point | TAM / TAC |
| | SMART Route | polyline | TAM / TAC |
| | SMART Stops | point | TAM / TAC |
| | Transit Hubs | point | TAM / TAC |
| Utilities | Channels | polyline | TAM / TAC |
| | Channels | line | TAM / TAC |
| | Manholes | point | County SLR Transportation Tool |
| | PGE Substations | point | TAM / TAC |
| | Pipes | polyline | TAM / TAC |
| | Pipes | line | TAM / TAC |
| | Pump Stations | point | County SLR Transportation Tool |
| | Pump Stations | point | TAM / TAC |
| | Stormwater Catchment Basins | point | County SLR Transportation Tool |
| | Stormwater Drainage Structures | point | County SLR Transportation Tool |
| | Wastewater Facilities | point | County SLR Transportation Tool |
| Wastewater Treatment Facilities | point | TAM / TAC | |

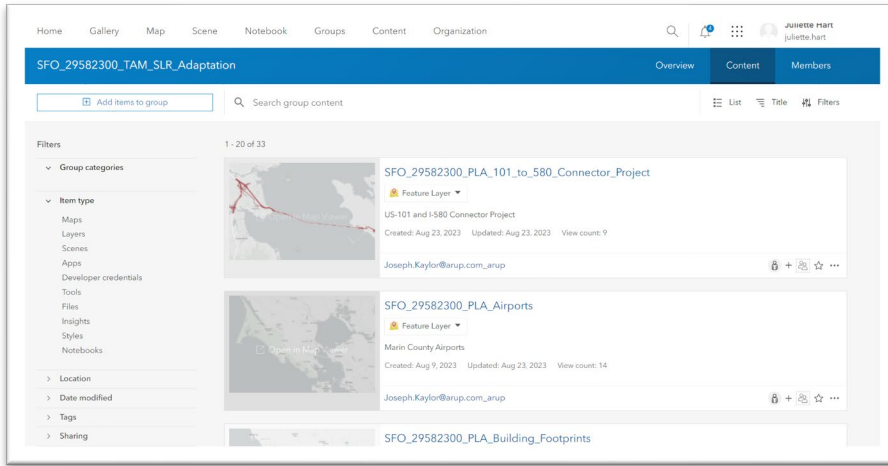


Figure 1 Screenshot of ArcGIS group repository that includes all vetted Marin County transportation and asset information.

2.1.2 Climate Hazard Data

Climate hazards assessed for this study include: permanent sea-level rise inundation, temporary coastal flooding from 1-percent annual chance (100-year) coastal storm event today and with sea level rise, 100-year and 0.2-percent annual chance (500-year) FEMA special flood hazard area (which combines coastal, fluvial and pluvial flood exposure based on historical conditions), and sea level rise-driven shallow and emergent groundwater. Table 2 provides an overview of the data sources, projections, and justification for the selected projections.

Table 2: List of Data Sources

| Climate Hazard | Data Source | Projections | Justification & Constraints |
|---------------------------------------------------|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SLR – Permanent Inundation | USGS Coastal Storm Modeling System (CoSMoS) | 10 in (0.25 m) 20 in (0.5 m) 39 in (1 m) 59 in. (1.5 m) | For consistency with BayWAVE and C-SMART, this analysis repeated the use of the 10, 20 and 59 in projections of SLR. On current greenhouse gas (GHG) emissions trajectories (see Figure 2), recent federal sea level rise projections indicate we are likely to experience 39 in of SLR by 2070 – 2090. Thirty-nine inches of SLR also provides a mid-range projection between 20 in and 59 in and correlates with marked increases in flooding in most of the focus areas. |
| SLR – Temporary Flooding (100-year Coastal Storm) | USGS Coastal Storm Modeling System (CoSMoS) | 0 in + 100 yr storm 10 in + 100 yr storm 20 in + 100 yr storm 39 in + 100 yr storm 59 in + 100 yr storm | The 0 in + 100-year storm scenario provides a projection of flood exposure from a 100-year coastal event at today’s current spring astronomical tide. For consistency with the SLR flood exposure, analysis was also conducted for the 100-year coastal storm with 10, 20, 39, 59 in of SLR. |

| | | | |
|-----------------------------------------------|----------------------------------------------------|----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SLR-induced Shallow groundwater (GW) – SF Bay | Adapting to Rising Tides (ART) Shallow Groundwater | 12 in (1 ft) 24 in (2 ft) 36 in (3 ft) 66 in (5.5 ft) | For the SF Bay region, the ART shallow GW projections were used. To best align to the SLR amounts used for the CoSMoS tidal and storm surge flooding, the closest available ART scenarios were used. While not exact matches, the projections are close enough to the CoSMoS SLR projections, given the associated uncertainty in both projections (CoSMoS and ART). |
| SLR-induced Shallow groundwater (GW) – Ocean | CoSMoS – Groundwater (GW) | 10 in 20 in 39 in 59 in | For the open Pacific coast, CoSMoS-GW is available; the ART Shallow GW modeling is not. Here the team selected the SLR-induced GW projections that match the SLR projections used to project flood exposure from SLR and the 100-year storm events. |
| FEMA Special Flood Hazard Area | FEMA | 100-year floodplain 500-year floodplain | To understand current flood exposure from the combination of coastal, fluvial and pluvial impacts, the 100-year and 500-year floodplain extents were analyzed. The FEMA floodplain is based on historical conditions and does not consider climate change. While no future changes in the fluvial and pluvial floodplain due to climate change are available, the 500-year floodplain can represent potential increases in the 100-year floodplain. |

The modeling information used in this analysis all derive from authoritative and trusted data sources that are industry standard for assessing exposure to coastal flood hazards.

- Two data sources - the FEMA floodplain extents and the USGS Coastal Storm Modeling System – are developed by federal institutions and follow vetted, tested, and peer-reviewed methodologies. CoSMoS was funded in part by the CA Ocean Protection Council, along with internal funding from the USGS. It is recommended as one of the trusted resources for coastal hazard analysis for the entire coast of California – both oceanside and bayside.
- The Adapting to Rising Tides (ART) Shallow Groundwater Modeling was developed by Pathways Climate Institute and the San Francisco Estuary Institute (SFEI), two recognized and trusted science-based entities that serve the San Francisco Bay Area. The SF Bay Conservation and Development Commission (BCDC) promotes and recommends the use of the ART Shallow Groundwater modeling for assessing the impacts to shallow groundwater tables wherever it is available in the SF Bay area. Moreover, Marin County played an integral role in both providing information and reviewing the model results during the development of the model. ART does not provide shallow groundwater projections for the open Pacific coast of Marin County. For this, the consultant team turned to the USGS CoSMoS-Groundwater (GW) modeling. CoSMoS-GW was developed for the entire coast of California and was

developed using a model-based approach. While different than the data-driven approach used in the ART modeling, CoSMoS-GW (also funded by USGS and the CA OPC) provides reliable, authoritative, and trusted projections for shallow groundwater rise, important for assessing impacts to the Stinson Beach and Inverness focus areas.

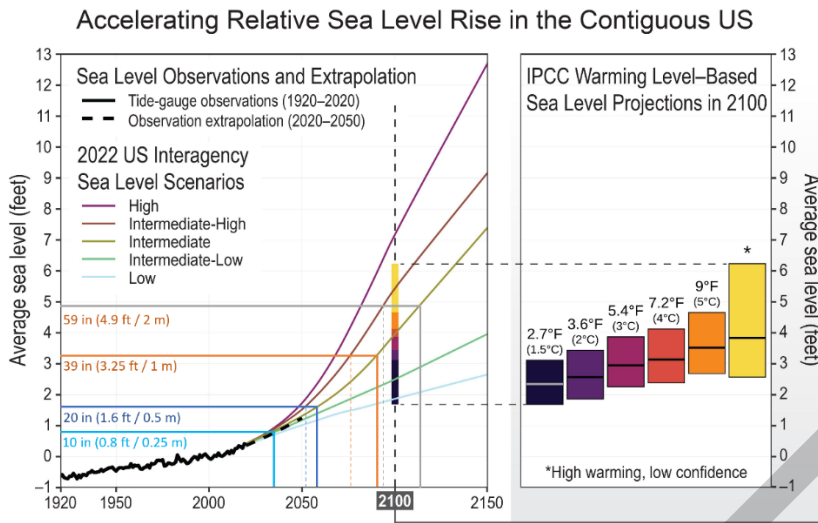


Figure 2: Federal sea level rise projections for the U.S. The colored lines in the left panel provide sea level rise projections from 1920 to 2150 under a range of greenhouse gas emissions scenarios. The black line indicates observations and a linear extrapolation of current observations from 2023 to 2050. We are currently tracking on the “Intermediate” projection curves. Assuming the world continues tracking on this Intermediate curve, the consultant team highlighted when the different SLR scenarios used in this project are expected to be reached: ~2040 for 10 inches; ~2060 for 20 inches; ~2090 for 39 inches; and ~2110 for 59 inches. This figure also allows the reader to extrapolate different timeframes of sea level rise based on different emissions trajectories. If globally, our emissions accelerate and we begin tracking on the intermediate-high curve, we are likely to experience higher rates of sea level rise sooner. The State of California, through the CA Ocean Protection Council is currently updating its recommended sea level rise projections. They are expected to follow the federal sea level rise projections.

2.1.3 Technical Advisory Committee Engagement

TAM invited representatives from Marin County, cities in the County, Caltrans, MTC, and BCDC to serve on the Technical Advisory Committee (TAC). The role of the TAC is to provide thought leadership and feedback throughout the course of the project. TAM worked with the TAC to identify relevant asset data sets to include in the exposure analysis. The consultant team presented the proposed analysis methodology to the TAC at the first TAC meeting (Oct. 12, 2023). Feedback from the TAC was incorporated and included into the updated methodology development. The TAC reviewed early versions of this memo and provided feedback on the identified focus areas. Feedback from the TAC was incorporated to develop the final suite of focus areas.

2.1.4 Data Limitations and Assumptions

The coastal flood hazard exposure analysis builds off prior Marin County analysis and existing spatial data sets, adding new information on shallow groundwater rise and additional sea level rise scenarios to refine the understanding of both extent and timing of impacts. By building off prior analyses and data sets, several assumptions and limitations apply.

The topographic Digital Elevation Model (DEM) supporting the coastal flood hazard maps represent 2009-2011 conditions, therefore any new urban development or shoreline improvements may not be captured in the current maps. The DEM and all derived data layers have a horizontal resolution of 2 meters. The elevation data has a vertical accuracy of approximately 18 cm. The horizontal accuracy of the 2010 lidar (the bulk of the topography) has a root mean square error (RMSE) of 1m. Additional localized modifications to the DEM were implemented for the ART mapping products in 2018. Newer shoreline LiDAR information could be incorporated in subsequent discussions regarding future adaptation (Task 4), but was not incorporated during the exposure

analysis due to the heavy computational resources required for a county-wide implementation. Future efforts may elect to analyze this information, but was not included in the current project scope.

Travel demand and capacity (e.g., detour length and annual average daily traffic) was not considered in the exposure analysis to identify individual road segment criticality or delineation of the focus areas. Efforts to integrate TAM's model into County SLR planning efforts and tools are encouraged.

Asset locations were primarily represented as GIS point data, meaning the full footprint of several assets including hospitals, schools, community centers and other county facilities and were not captured in the overlay of the coastal hazards. The exposure analysis assigned a Yes or No attribute to these assets, rather than an area or percentage of the asset exposed to each of the flood hazards.

For the exposure analysis, the linear road network was segmented into 1/10th mile sections to assign an average depth of permanent inundation from sea level rise or temporary flooding from coastal storm surge and sea level rise. Due to the road segmentation, if any portion of each 1/10th mile segment overlaps with the flood hazard extents, the segment is identified as exposed.

The connections between assets within and across communities (e.g., local and regional road network dependencies on hospitals) were considered qualitatively in the development of the focus areas. Additional information on regional reliance on assets, or interdependencies and cascading impacts of assets (e.g., PGE stations) could refine the delineation of the focus areas and further inform the adaptation planning.

Elevated portions of roadways (bridges and overpasses) were manually identified to the best extent possible and removed from the exposure analysis, however some elevated segments may still remain in the resultant GIS outputs with the hazard exposure information.

2.2 Coastal Flood Hazard Exposure Analysis Methodology

2.2.1 Exposure Analysis

The exposure assessment was completed in GIS by overlaying the individual asset layers in the sector-based geodatabases with the hazard layers described in Table 2. The exposure assessment was based on how each asset is represented:

- For **point assets** (e.g., bus stops, pump stations), the assessment evaluated whether each asset was within the inundation zone for each of the hazard scenarios.
- For **linear assets** (e.g., roadways, SMART routes, channels), the length and percentage of the asset within the hazard zones were calculated. Roadways were divided into 528-foot (1/10th mile) segments and tagged with inundation statistics for each of the hazard scenarios, such as the first instance of exposure for SLR inundation and groundwater emergence.
- For **polygon assets** (e.g., parks, large facilities, EPC zones), the area and the percentage of the asset within the SLR inundation zones were calculated.

2.2.2 ArcGIS Geodatabase and Online Data Viewer

The exposure information was added to the GIS geodatabases to allow asset managers to identify when (and by how much) each asset would be exposed to flood hazards for each scenario. These geodatabases were provided to TAM for their use and dissemination, as appropriate.

Because not all agencies have access to desktop ArcGIS applications, all the coastal hazard projections and asset data, as well as the identified focus areas, are available through an [ArcGIS Web Map](#) (Figure 3).

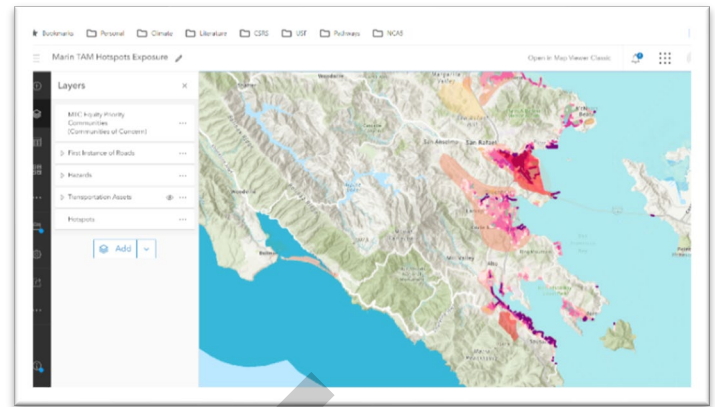
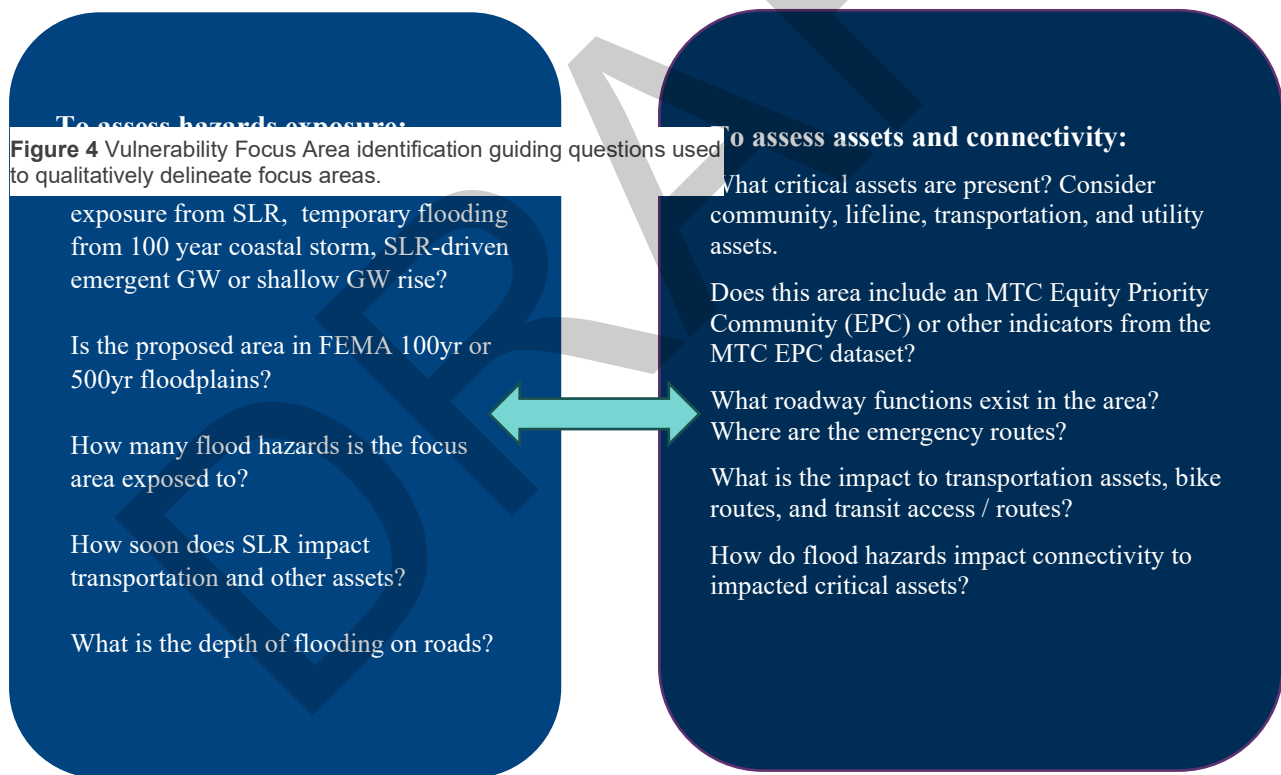


Figure 3 Screenshot of [ArcGIS Web Map](#)

2.3 Methodology to Delineate Vulnerability Focus Areas

Upon completion of the exposure analysis, the consultant team reviewed the exposure maps and statistics to propose an initial suite of focus areas. Initial outlining of the focus areas was based on extent of exposure for each of the different types of hazards. The team then used a series of questions to guide an iterative process to refine the proposed focus areas (Figure 4).



The initial focus areas were reviewed by TAM and presented to the TAC at the second TAC meeting (December 12, 2023). Feedback from these discussions helped refine the proposed suite of 15 focus areas.

3. Identified Focus Areas

3.1 Overview of Proposed Focus Areas

Following the methodology described above, 15 focus areas were identified (Figure 5). They ranged in their size, the number of hazards they experience (though most of them experience all three), the impact to transportation and transit assets, and the approximate number of lifelines and community assets included. The associated Appendix A: Hazard Matrix excel file (Figure 6) provides an overview of each of the focus areas and a subset of their exposure statistics.

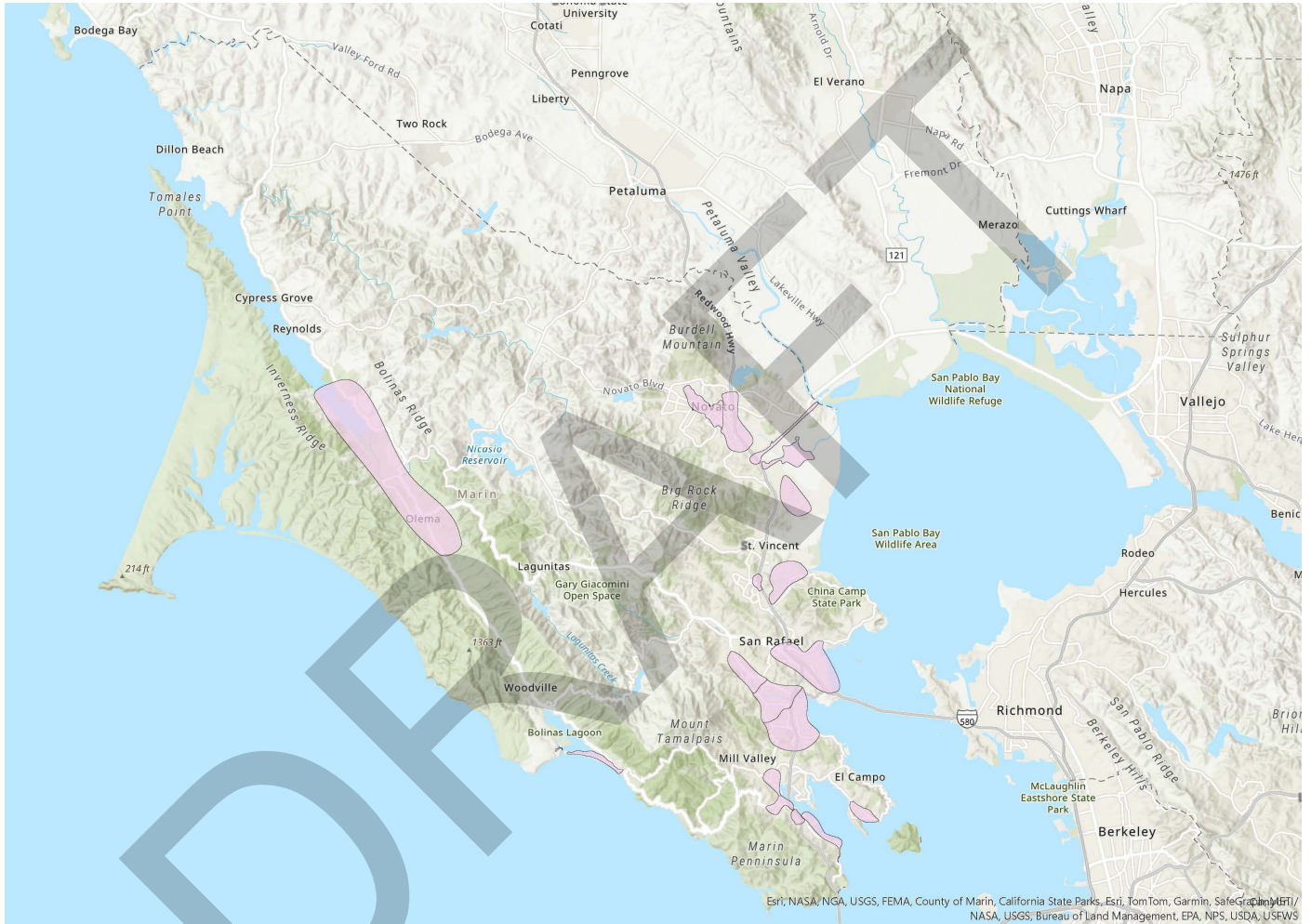


Figure 5 Map of 15 vulnerability focus areas.

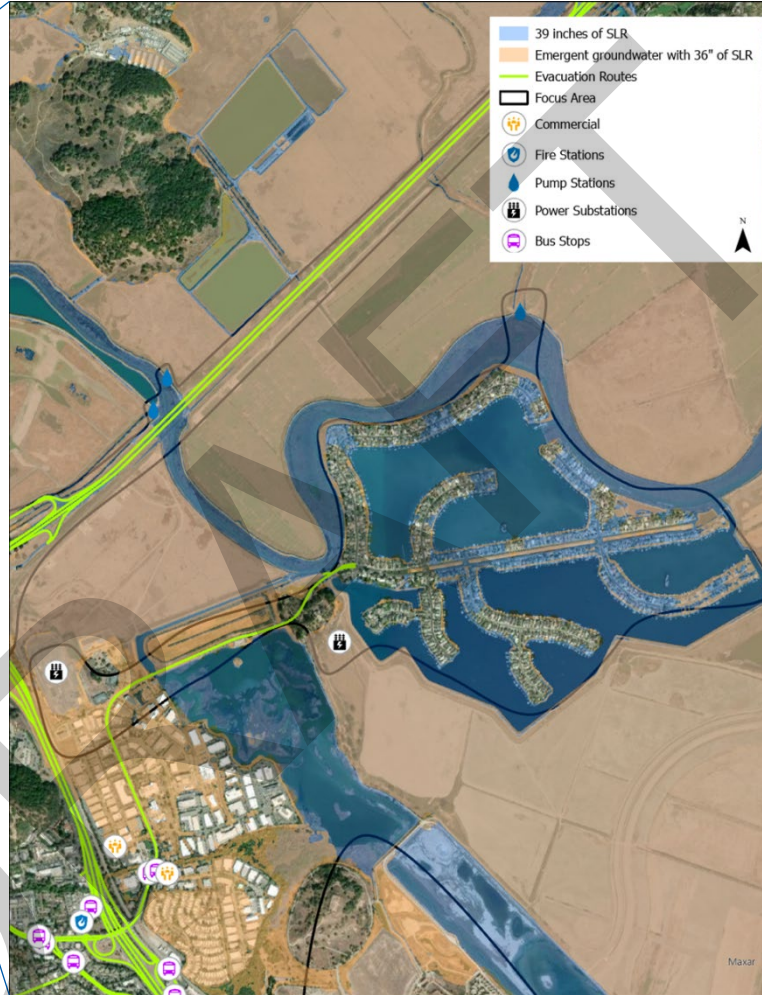
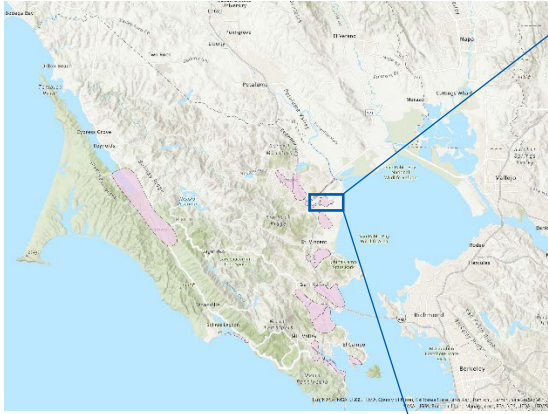
| Focus Area | Permanent Physical Exposure - SLR First Inundation | Physical Exposure - GW Shallow (surface - 3 ft below surface) | Physical Exposure - GW Emergent | Temporary Physical Risk - 100 yr floodplain | Temporary Physical Risk - CoSMoS 100 yr | Physical Risk - Number of Hazards | Physical Risk - Average | Equity Priority Community | Focus Area - Transportation & Transit Assets | Focus Area - Lifelines | Focus Area - Community Assets |
|-------------------|----------------------------------------------------|---------------------------------------------------------------|---------------------------------|---------------------------------------------|-----------------------------------------|-----------------------------------|-------------------------|------------------------------------------------------|------------------------------------------------------------------------|-------------------------------------------------------------|-------------------------------|
| Bel Marin Keys | 20 in | present day | present day | Y | present day | 3 | 3.3 | 21% - 36% Low Income | na | 2 power substations 1 pump station | na |
| Bolinas | 39 in. | present day | 49 in | Y | 20 in. | 3 | 2.6 | 37% - 66% Low Income | 1 bus stop | na | 1 library 1 school |
| Corte Madera | 30 in | present day | present day | Y | 10 in. | 3 | 3.0 | 21% - 36% Low Income >21% Zero Vehicle Households | Highway 101 1 park and ride hub 2 ferry stations 10 bus stops | 1 fire department 2 police stations 1 PG&E substation | 2 schools 1 library |
| Hamilton Wetlands | 49 in | present day | present day | N | 39 in. | 1 | 2.0 | 10% - 20% Zero Vehicle Households | 3 bus stops 1 SMART station and | na | 1 library 1 school |
| | | | | | | | | 21% - 37% Low Income | US-101 and CA-37 interchange SMART runs parallel to I-5-101 | | |

Figure 6: Screenshot of Focus Area Hazard Matrix. This matrix provides summary information about each focus area.

In the following section, we provide high level overviews of each of the focus areas and list a suite of exposure statistics that help provide contextual information about the selected sites. There are any number of queries that can be asked of the exposure data; therefore these descriptions are intended to provide one possible set of answers to one possible set of questions. It is expected that as TAM and County partners begin the work of developing adaptation and implementation plans, the exposure analysis can be queried to help with identification of the different flood impacts to asset, properties, and people, and help advance discussions relevant to each site.

DRAFT

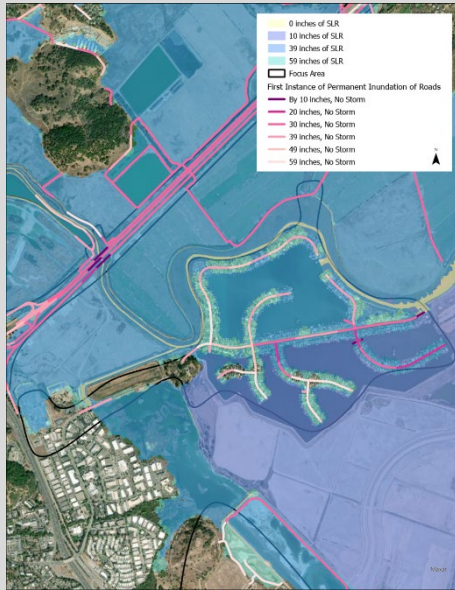
3.1.1 Bel Marin Keys Focus Area



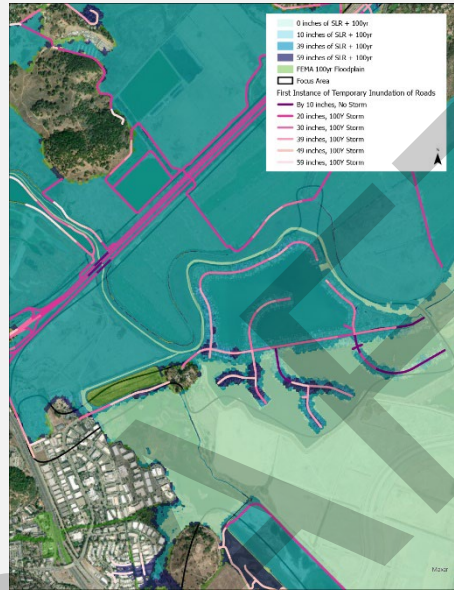
The site includes:

- 2 power substations
- 1 pump station
- 1 ingress/egress route

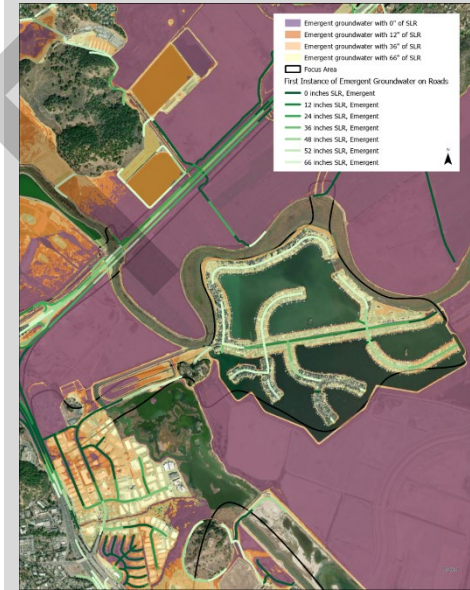
Permanent Inundation Exposure



Temporary Flood Exposure

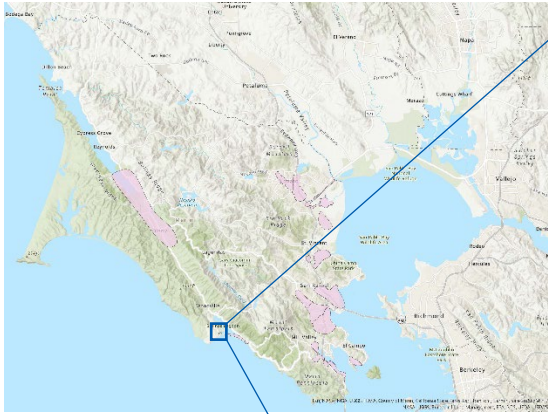


Groundwater Rise Exposure



| Focus Area | Permanent Physical Exposure - SLR First Inundation | Physical Exposure - GW Shallow (surface - 3 ft below surface) | Physical Exposure - GW Emergent | Temporary Physical Risk - 100 yr floodplain | Temporary Physical Risk - CoSMoS 100 yr | Physical Risk - Number of Hazards | Physical Risk - Average | Equity Priority Community |
|----------------|----------------------------------------------------|---------------------------------------------------------------|---------------------------------|---------------------------------------------|-----------------------------------------|-----------------------------------|-------------------------|---------------------------|
| Bel Marin Keys | 20 in | present day | present day | In FEMA 100 yr Floodplain | present day | 3 | 3.3 | 21% - 36% Low Income |

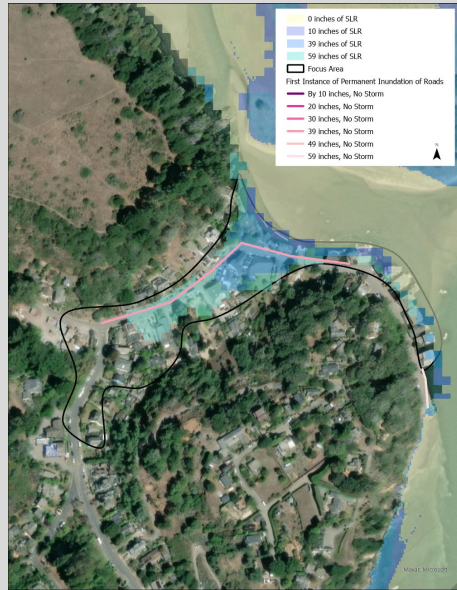
3.1.2 Bolinas Focus Area



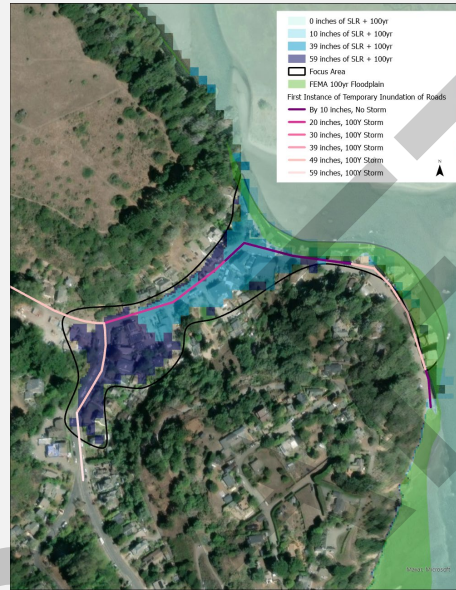
This site includes:

- 1 bus stop
- 1 library
- 1 school
- 1 ingress/egress route

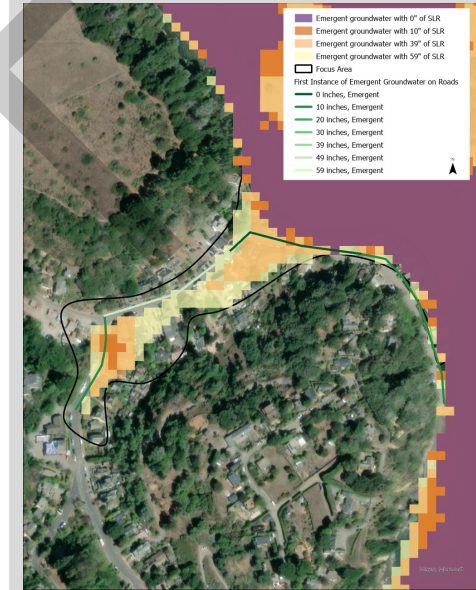
Permanent Inundation Exposure



Temporary Flood Exposure

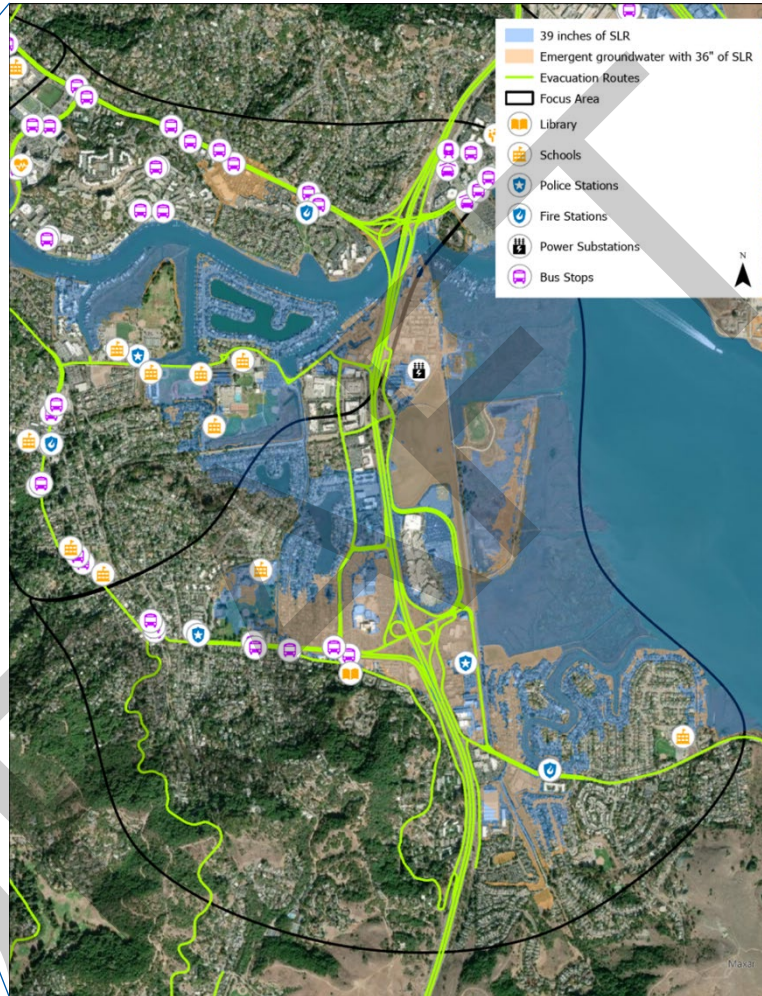
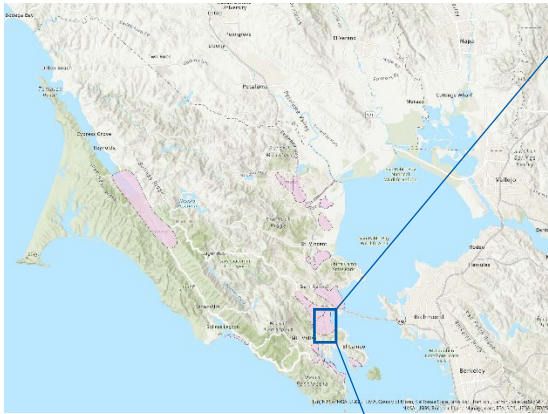


Groundwater Rise Exposure



| Focus Area | Permanent Physical Exposure - SLR First Inundation | Physical Exposure - GW Shallow (surface - 3 ft below surface) | Physical Exposure - GW Emergent | Temporary Physical Risk - 100 yr floodplain | Temporary Physical Risk - CoSMoS 100 yr | Physical Risk - Number of Hazards | Physical Risk - Average |
|------------|----------------------------------------------------|---------------------------------------------------------------|---------------------------------|---------------------------------------------|-----------------------------------------|-----------------------------------|-------------------------|
| Bolinas | 39 in. | present day | 49 in | In FEMA 100 yr Floodplain | 20 in. | 3 | 2.6 |

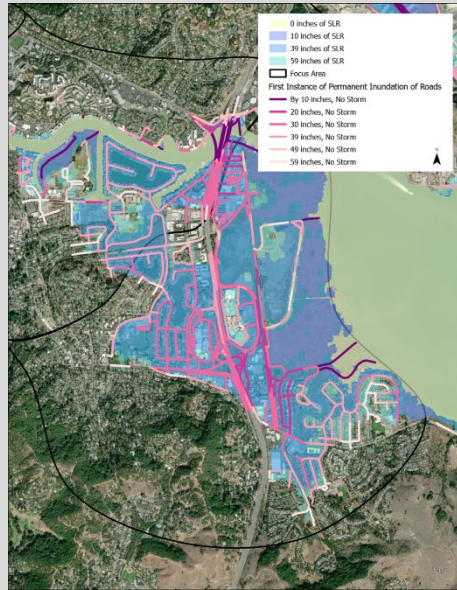
3.1.3 Corte Madera Focus Area



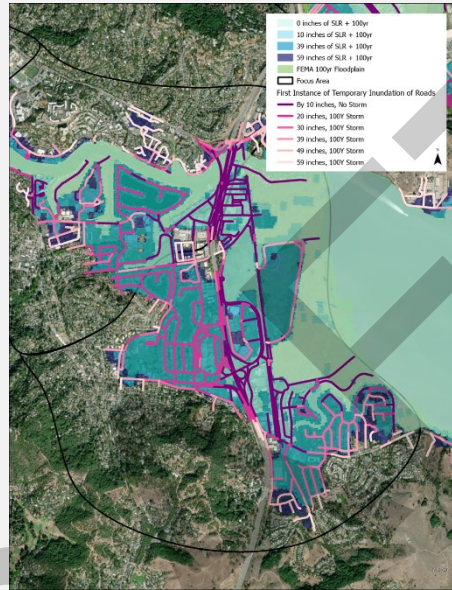
The site includes:

- 1 fire station
- 2 schools
- 1 library
- 2 police stations
- 1 hub, park, and ride area
- 2 ferry stops
- 1 power substation
- 10 bus stops, including local and Golden Gate Transit (GGT)
- Highway 101

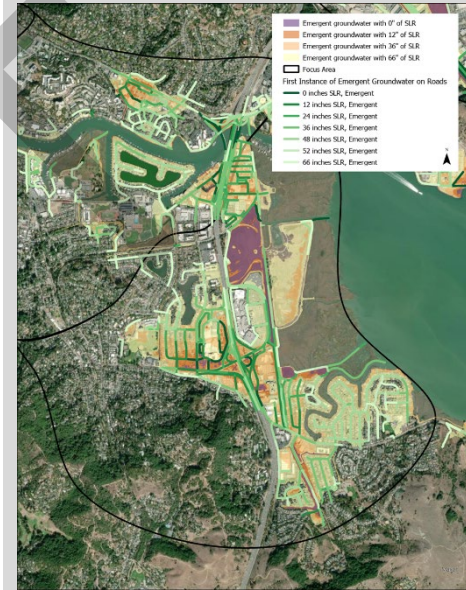
Permanent Inundation Exposure



Temporary Flood Exposure

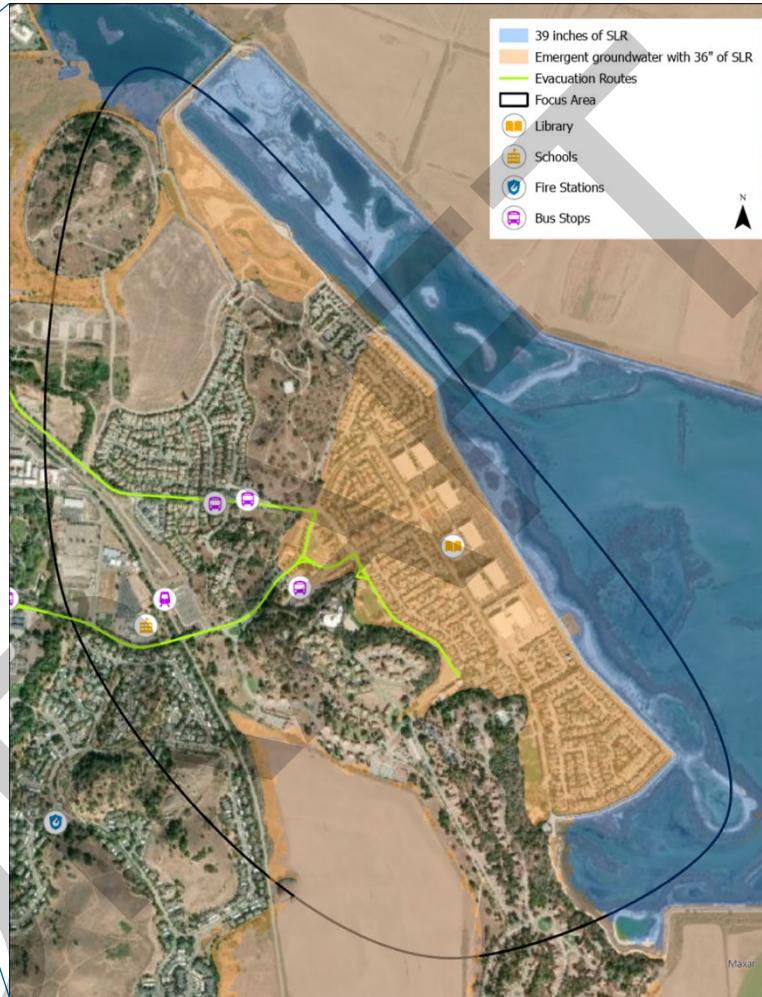
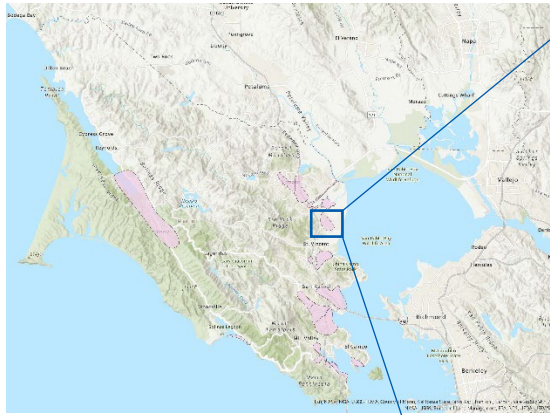


Groundwater Rise Exposure



| Focus Area | Permanent Physical Exposure - SLR First Inundation | Physical Exposure - GW Shallow (surface - 3 ft below surface) | Physical Exposure - GW Emergent | Temporary Physical Risk - 100 yr floodplain | Temporary Physical Risk - CoSMoS 100 yr | Physical Risk - Number of Hazards | Physical Risk - Average | Equity Priority Community |
|--------------|----------------------------------------------------|---------------------------------------------------------------|---------------------------------|---------------------------------------------|-----------------------------------------|-----------------------------------|-------------------------|------------------------------------------------------|
| Corte Madera | 30 in | present day | present day | In FEMA 100 yr Floodplain | 10 in. | 3 | 3.0 | 21% - 36% Low Income >21% Zero Vehicle Households |

3.1.4 Hamilton Wetlands Focus Area



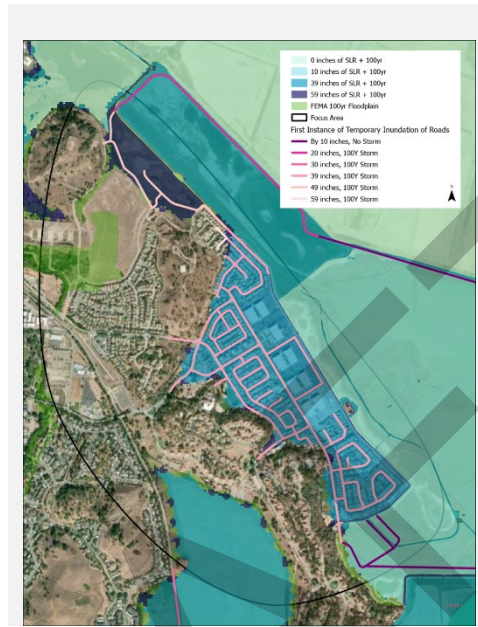
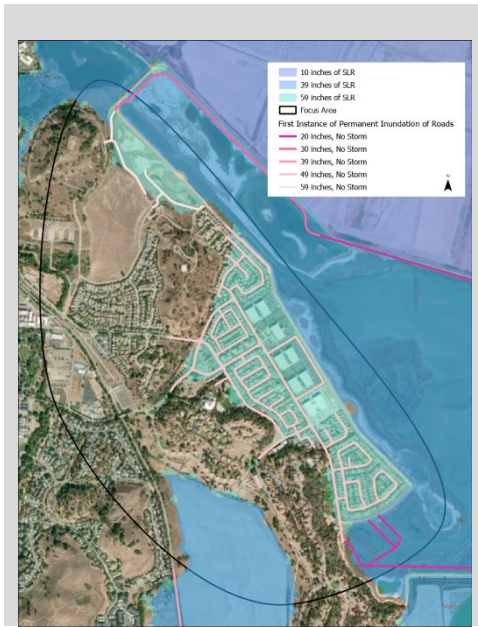
The site includes:

- Highway 101
- 1 library
- 3 bus stops
- 1 school
- 1 SMART station
- 1 ingress/egress route

Permanent Inundation Exposure

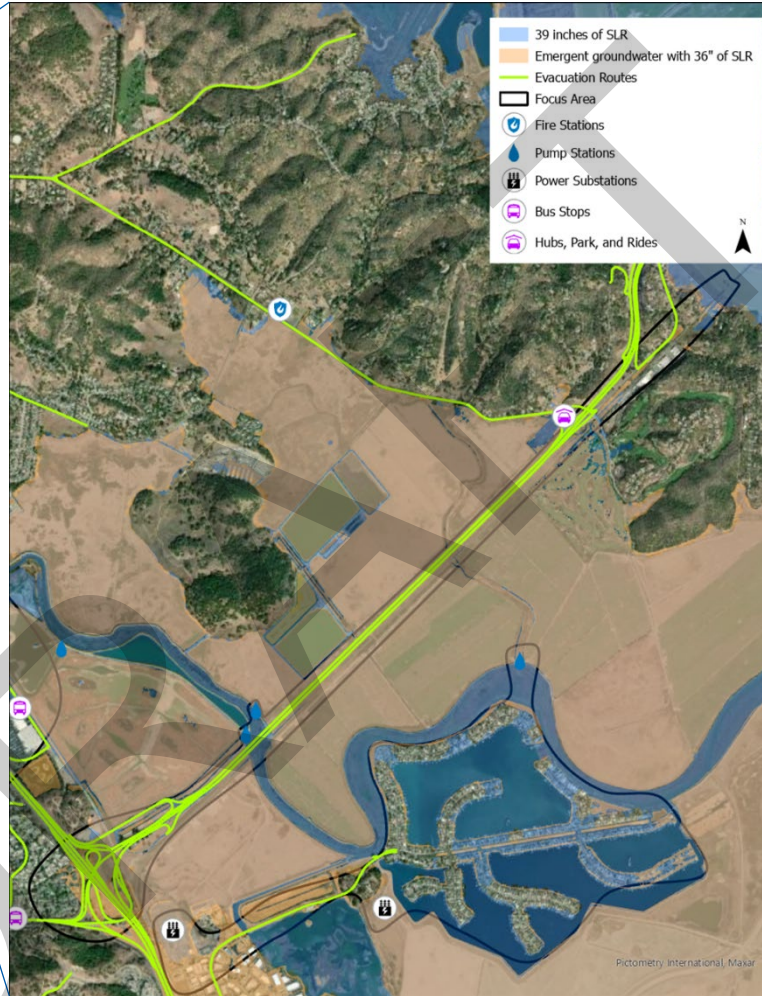
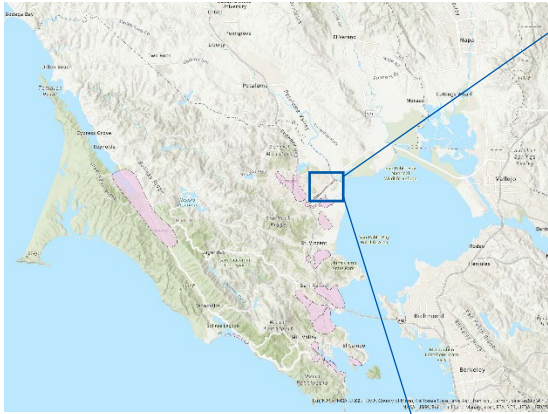
Temporary Flood Exposure

Groundwater Rise Exposure



| Focus Area | Permanent Physical Exposure - SLR First Inundation | Physical Exposure - GW Shallow (surface - 3 ft below surface) | Physical Exposure - GW Emergent | Temporary Physical Risk - 100 yr floodplain | Temporary Physical Risk - CoSMoS 100 yr | Physical Risk - Number of Hazards | Physical Risk - Average | Equity Priority Community |
|-------------------|----------------------------------------------------|---------------------------------------------------------------|---------------------------------|---------------------------------------------|-----------------------------------------|-----------------------------------|-------------------------|-----------------------------------|
| Hamilton Wetlands | 49 in | present day | present day | NOT in FEMA 100 yr Floodplain | 39 in. | 1 | 2.0 | 10% - 20% Zero Vehicle Households |

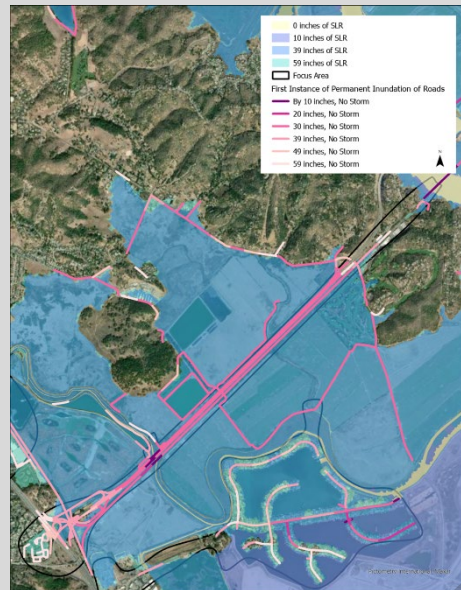
3.1.5 Highway 37 / 101 Focus Area



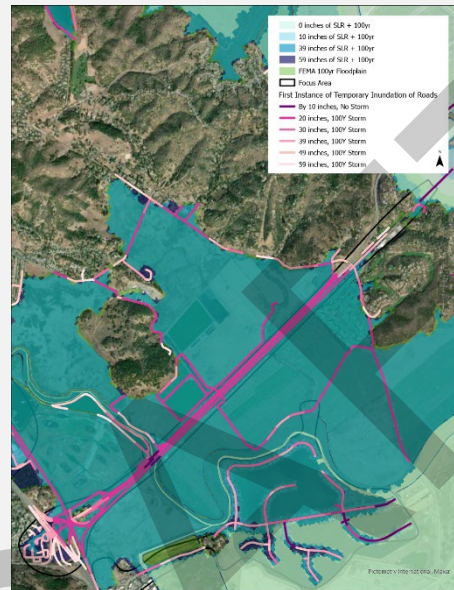
The site includes:

- Highway 37 and Highway 101
- 2 pump stations
- 1 park, hub, and ride area
- 1 ingress/egress route

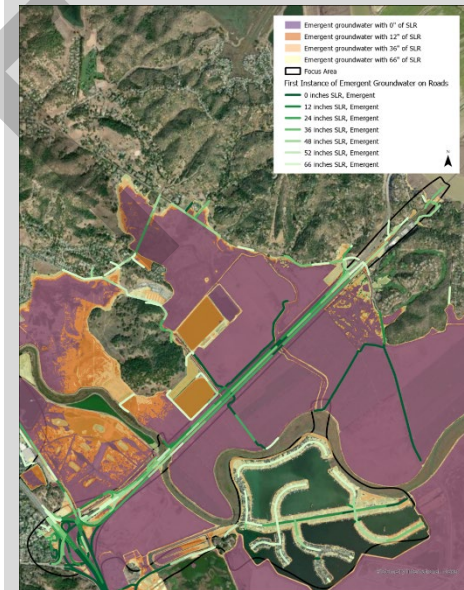
Permanent Inundation Exposure



Temporary Flood Exposure

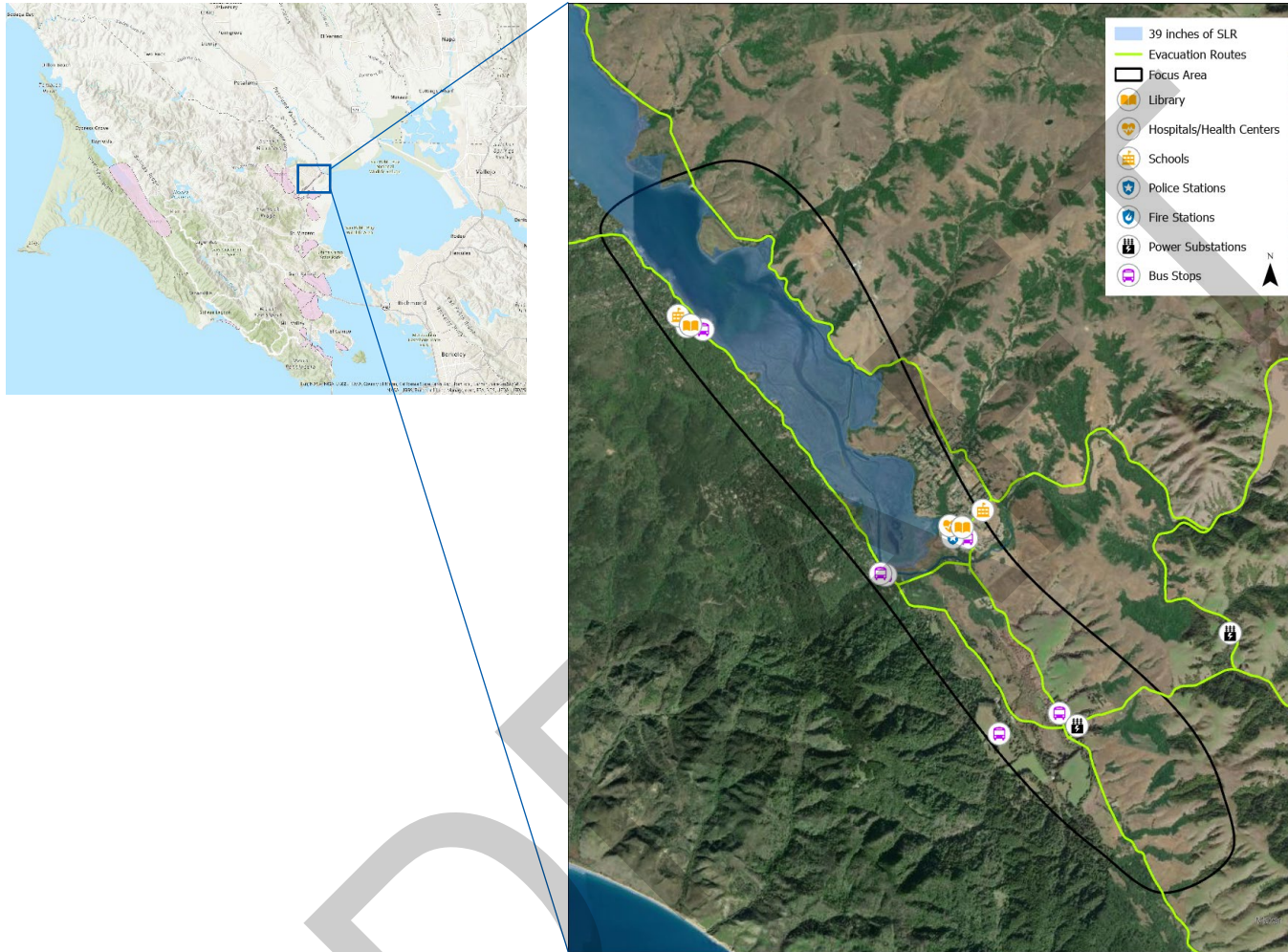


Groundwater Rise Exposure



| Focus Area | Permanent Physical Exposure - SLR First Inundation | Physical Exposure - GW Shallow (surface - 3 ft below surface) | Physical Exposure - GW Emergent | Temporary Physical Risk - 100 yr floodplain | Temporary Physical Risk - CoSMoS 100 yr | Physical Risk - Number of Hazards | Physical Risk - Average | Equity Priority Community |
|----------------|----------------------------------------------------|---------------------------------------------------------------|---------------------------------|---------------------------------------------|-----------------------------------------|-----------------------------------|-------------------------|-----------------------------------------------------------|
| Highway 37/101 | 30 in | present day | present day | In FEMA 100 yr Floodplain | 20 in. | 3 | 3.0 | 21% - 37% Low Income 10% - 20% Zero Vehicle Households |

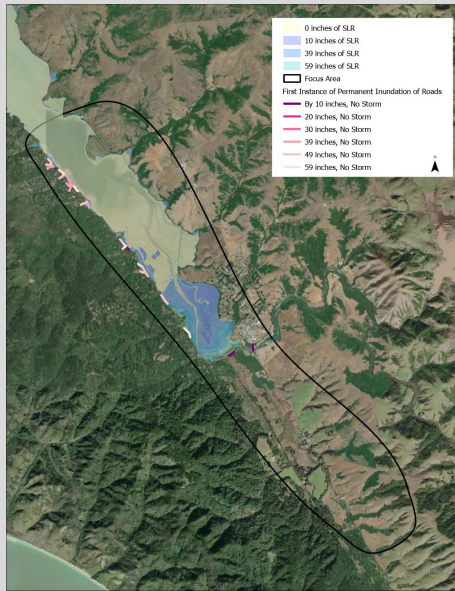
3.1.6 Inverness Focus Area



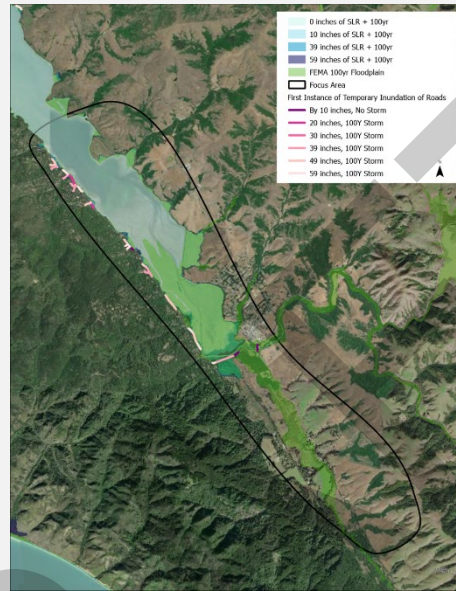
This site includes:

- 1 power substation
- 6 bus stops (no GGT bus stops)
- 1 school
- 1 police station
- 1 fire station
- 2 libraries
- 1 health center/hospital
- 1 ingress/egress route

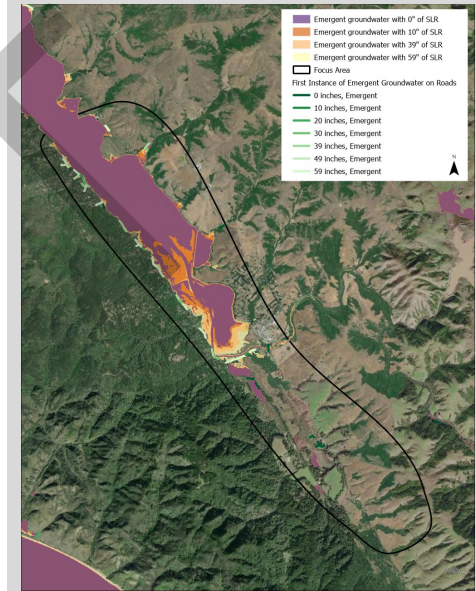
Permanent Inundation Exposure



Temporary Flood Exposure

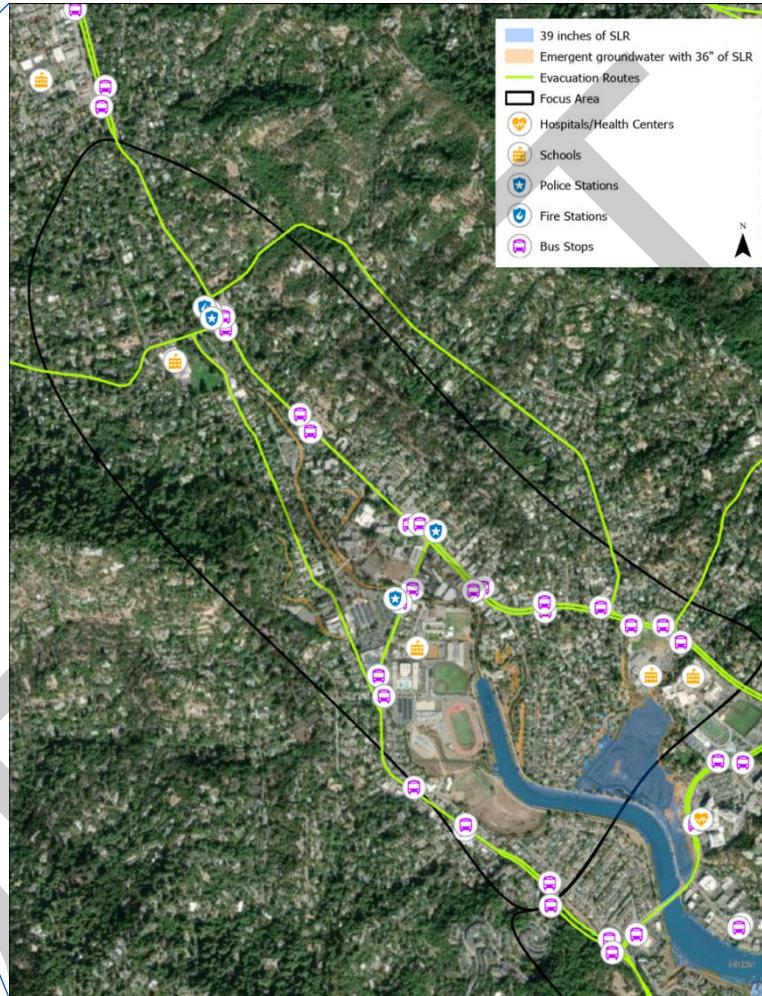
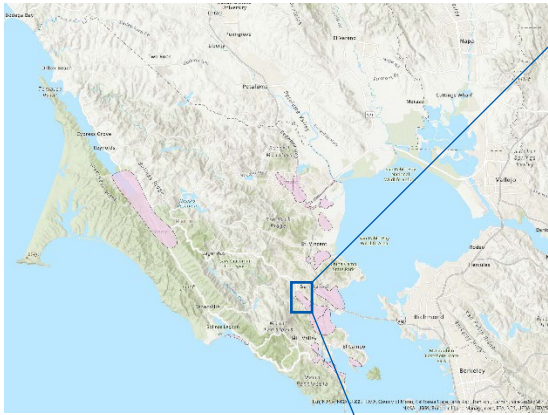


Groundwater Rise Exposure



| Focus Area | Permanent Physical Exposure - SLR First Inundation | Physical Exposure - GW Shallow (surface - 3 ft below surface) | Physical Exposure - GW Emergent | Temporary Physical Risk - 100 yr floodplain | Temporary Physical Risk - CoSMoS 100 yr | Physical Risk - Number of Hazards | Physical Risk - Average | Equity Priority Community Factors |
|------------|----------------------------------------------------|---------------------------------------------------------------|---------------------------------|---------------------------------------------|-----------------------------------------|-----------------------------------|-------------------------|-----------------------------------|
| Inverness | 30 in | not impacted | not impacted | Y | 20 in. | 2 | 1.7 | 18% - 23% Low Income |

3.1.7 Kentfield Focus Area



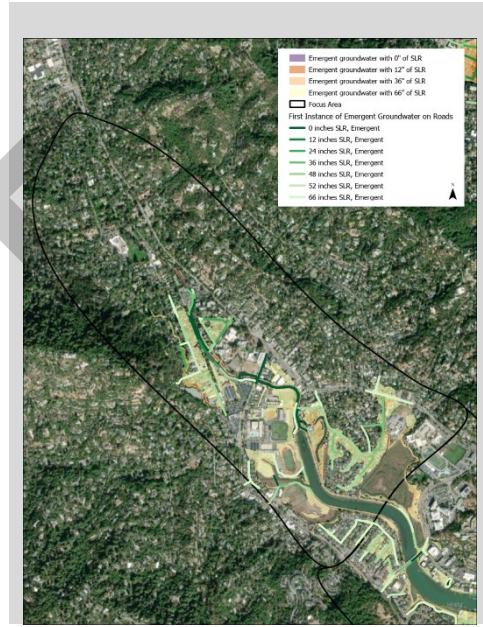
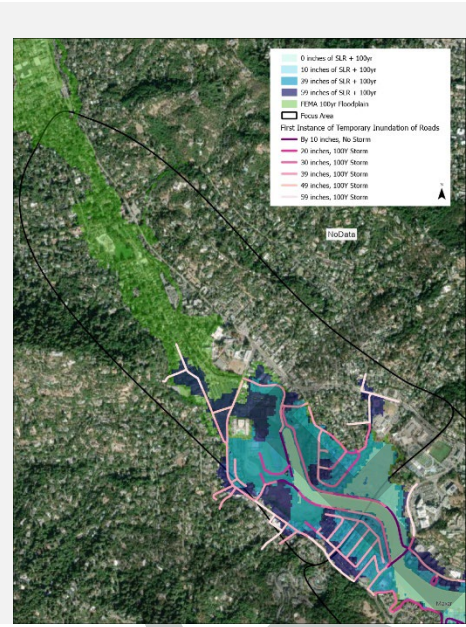
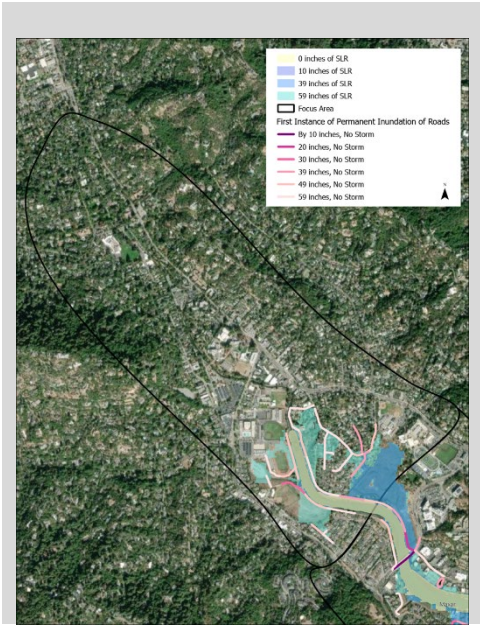
The site includes:

- 4 schools
- 2 fire stations
- 3 police stations
- 1 municipal
- 21 bus stops
- 1 ingress/egress route

Permanent Inundation Exposure

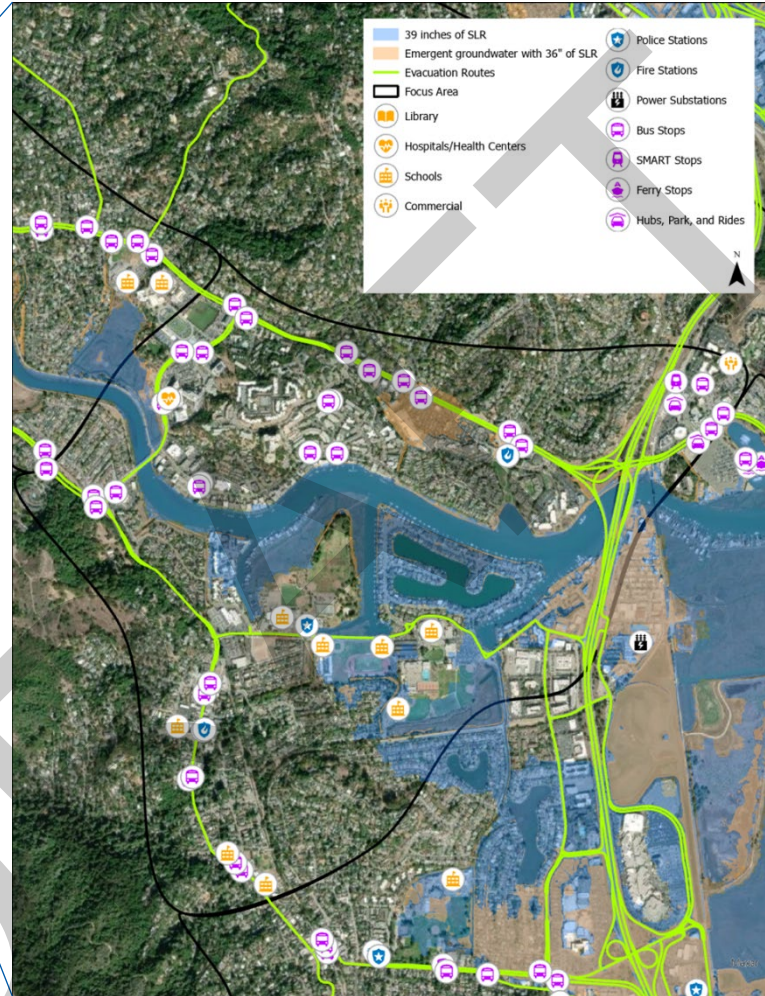
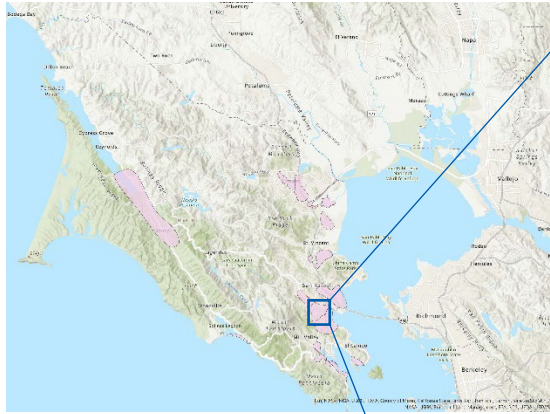
Temporary Flood Exposure

Groundwater Rise Exposure



| Focus Area | Permanent Physical Exposure - SLR First Inundation | Physical Exposure - GW Shallow (surface - 3 ft below surface) | Physical Exposure - GW Emergent | Temporary Physical Risk - 100 yr floodplain | Temporary Physical Risk - CoSMoS 100 yr | Physical Risk - Number of Hazards | Physical Risk - Average | Equity Priority Community |
|------------|----------------------------------------------------|---------------------------------------------------------------|---------------------------------|---------------------------------------------|-----------------------------------------|-----------------------------------|-------------------------|---------------------------|
| Kentfield | 49 in | present day | 48 in. | In FEMA 100 yr Floodplain | 30 in | 3 | 2.3 | No |

3.1.8 Larkspur Focus Area



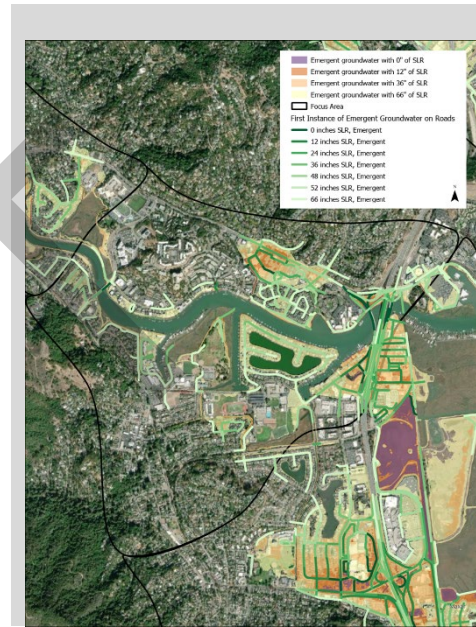
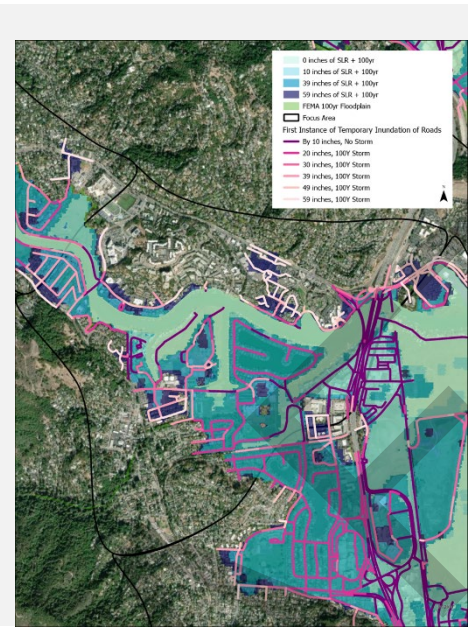
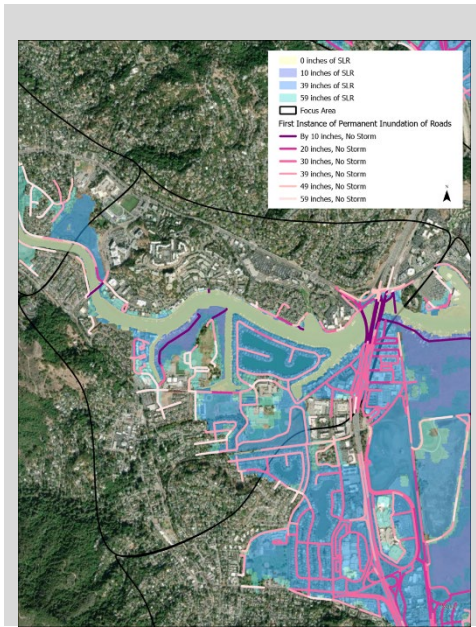
The site includes:

- 1 hospital
- 9 schools
- 1 commercial
- 1 police station
- 2 fire stations
- 1 municipal
- Highway 101
- 32 bus stops, including local and Golden Gate Transit (GGT)
- 1 SMART station
- 2 hub, park, and ride areas

Permanent Inundation Exposure

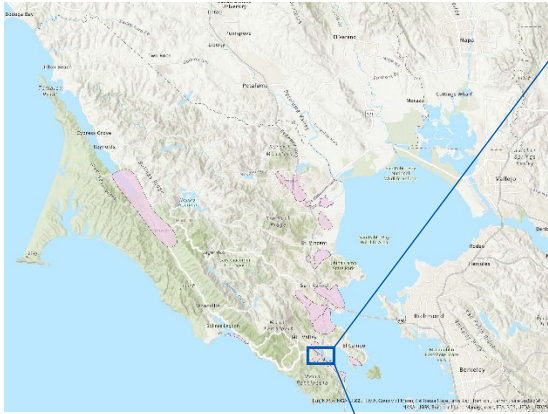
Temporary Flood Exposure

Groundwater Rise Exposure



| Focus Area | Permanent Physical Exposure - SLR First Inundation | Physical Exposure - GW Shallow (surface - 3 ft below surface) | Physical Exposure - GW Emergent | Temporary Physical Risk - 100 yr floodplain | Temporary Physical Risk - CoSMoS 100 yr | Physical Risk - Number of Hazards | Physical Risk - Average | Equity Priority Community |
|---------------------|----------------------------------------------------|---------------------------------------------------------------|---------------------------------|---------------------------------------------|-----------------------------------------|-----------------------------------|-------------------------|---------------------------|
| Larkspur (Hospital) | 39 in. | 12 in | 52 in | In FEMA 100 yr Floodplain | 10 in. | 3 | 2.5 | 21% - 36% low income |

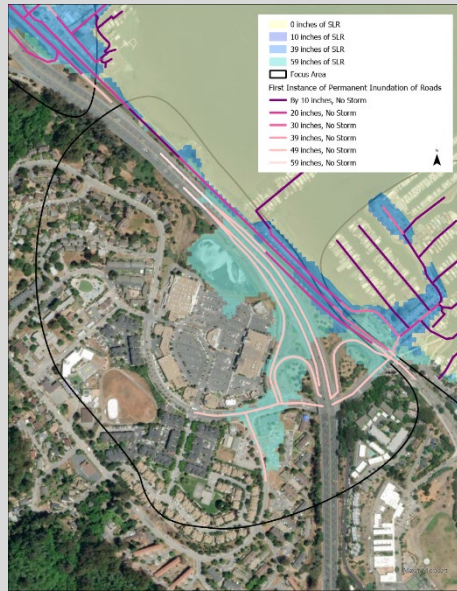
3.1.9 Marin City Focus Area



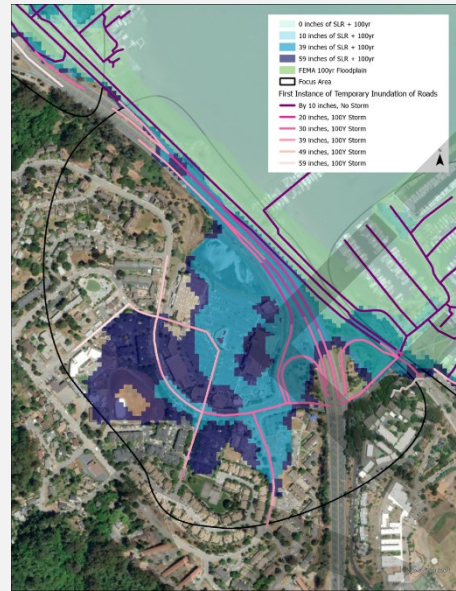
This site includes:

- Highway 101
- 10 bus stops including local and Golden Gate Transit (GGT)
- 1 library
- 1 school
- 1 police station
- 1 commercial shopping center
- 1 ingress/egress route

Permanent Inundation Exposure



Temporary Flood Exposure

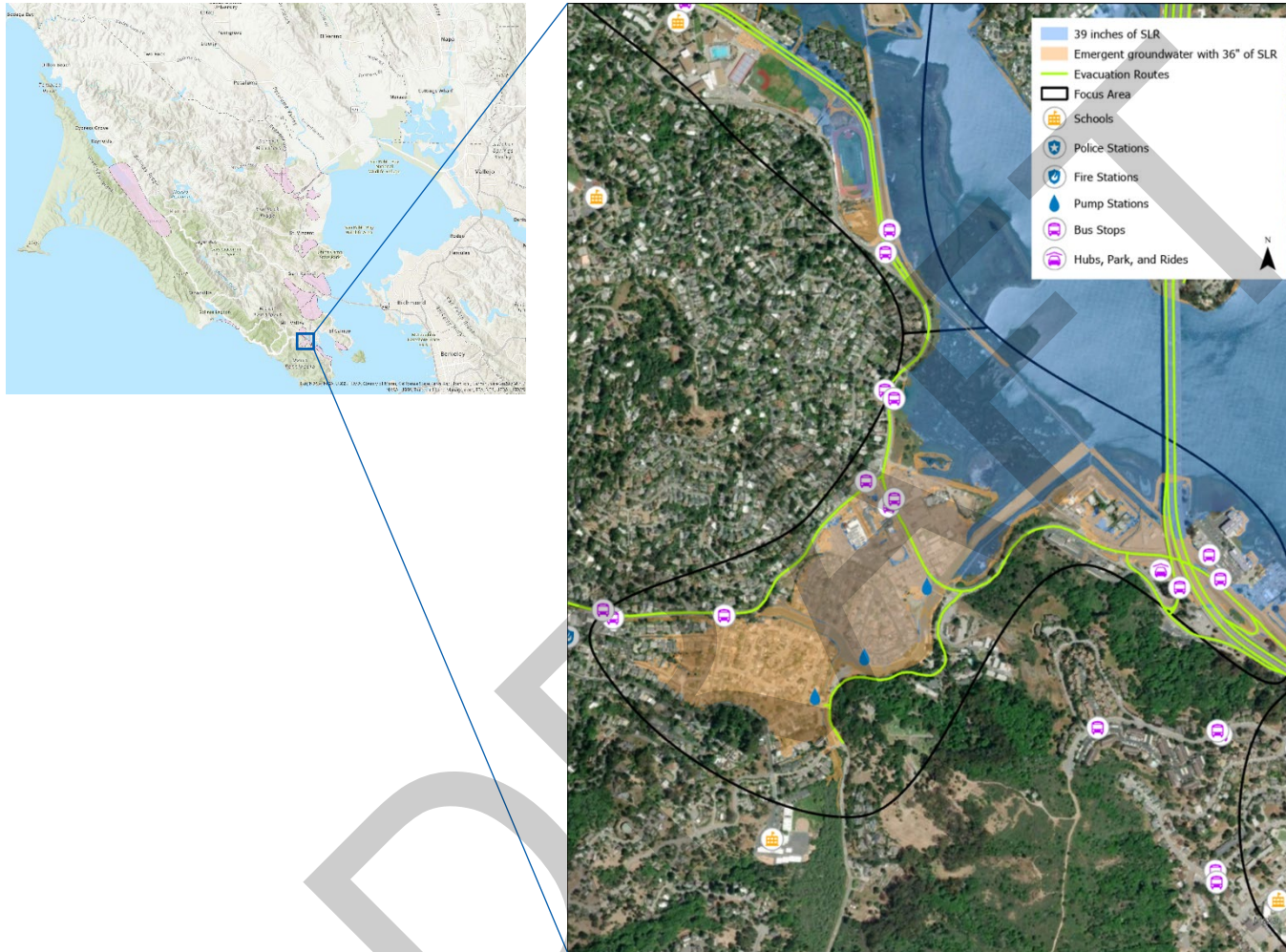


Groundwater Rise Exposure



| Focus Area | Permanent Physical Exposure - SLR First Inundation | Physical Exposure - GW Shallow (surface - 3 ft below surface) | Physical Exposure - GW Emergent | Temporary Physical Risk - 100 yr floodplain | Temporary Physical Risk - CoSMoS 100 yr | Physical Risk - Number of Hazards | Physical Risk - Average | Equity Priority Community |
|------------|----------------------------------------------------|---------------------------------------------------------------|---------------------------------|---------------------------------------------|-----------------------------------------|-----------------------------------|-------------------------|------------------------------------------------------------------------------------------|
| Marin City | 20 in | present day | 12 in | In FEMA 100 yr Floodplain | present day | 3 | 2.7 | Highest MTC Equity Priority Area >66% Low Income 10% - 20% Zero Vehicle Households |

3.1.10 Mill Valley – Manzanita / Tam Junction Focus Area



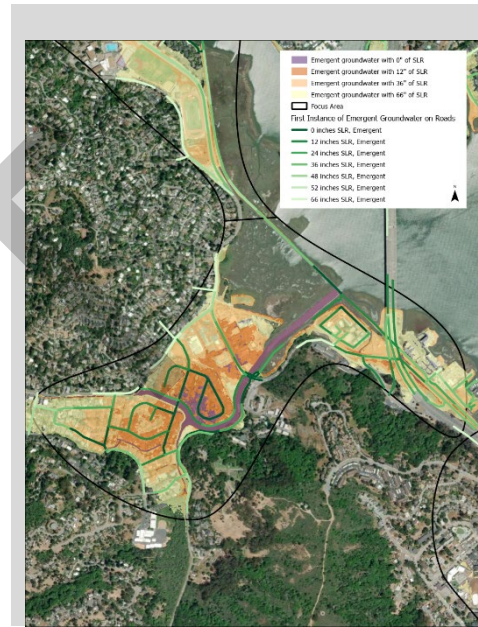
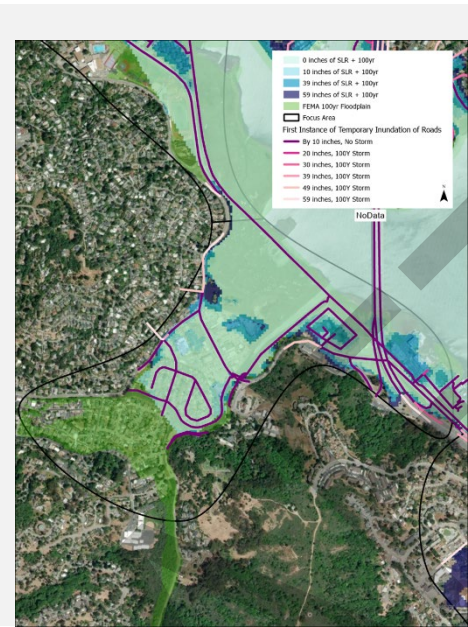
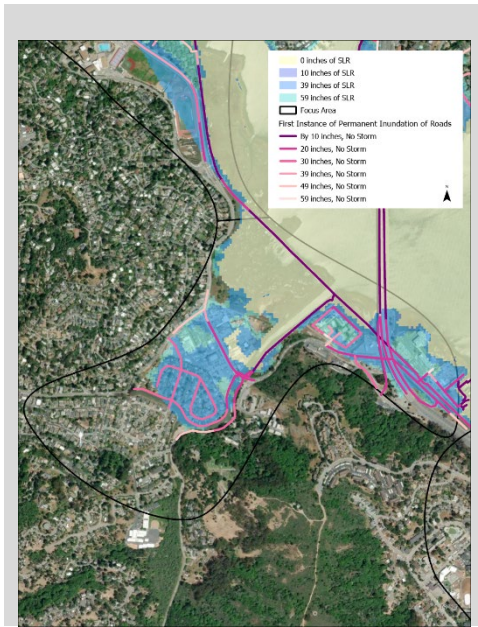
This site includes:

- 3 pump stations
- 14 bus stops, including local and Golden Gate Transit (GGT)
- 1 hub, park, and ride area
- 1 ingress/egress route

Permanent Inundation Exposure

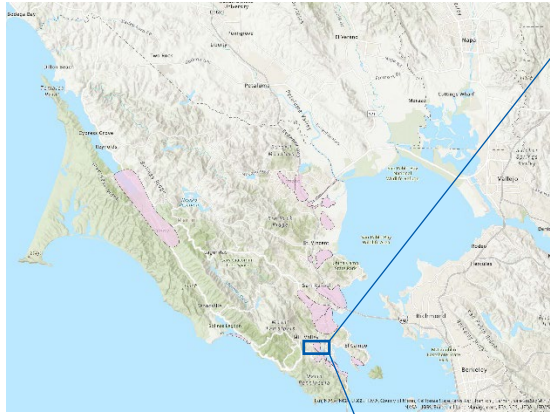
Temporary Flood Exposure

Groundwater Rise Exposure



| Focus Area | Permanent Physical Exposure - SLR First Inundation | Physical Exposure - GW Shallow (surface - 3 ft below surface) | Physical Exposure - GW Emergent | Temporary Physical Risk - 100 yr floodplain | Temporary Physical Risk - CoSMoS 100 yr | Physical Risk - Number of Hazards | Physical Risk - Average | Equity Priority Community |
|--------------------------------------|----------------------------------------------------|---------------------------------------------------------------|---------------------------------|---------------------------------------------|-----------------------------------------|-----------------------------------|-------------------------|---------------------------|
| Mill Valley - Manzanita / Tam Valley | By 10 in | present day | present day | In FEMA 100 yr Floodplain | present day | 3 | 3.3 | No |

3.1.11 Mill Valley – Miller Ave Focus Area



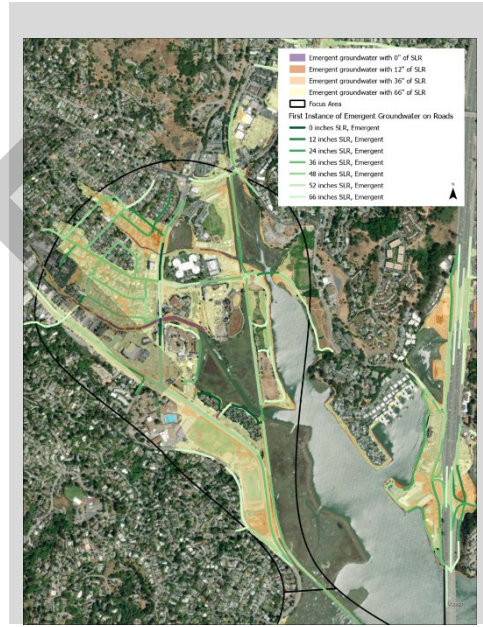
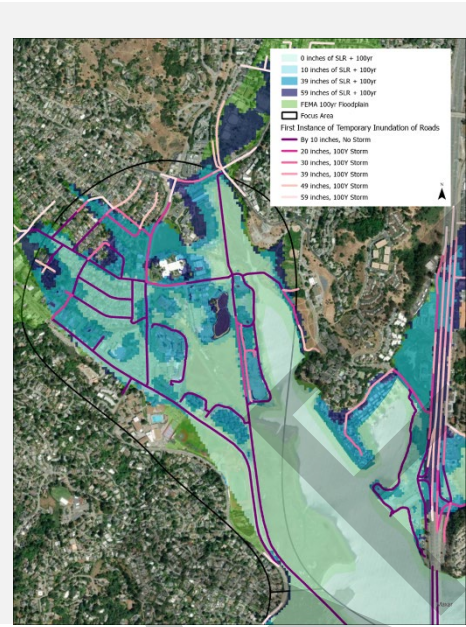
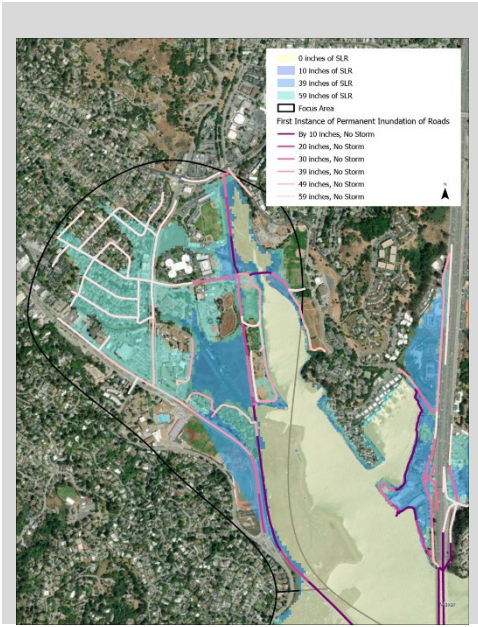
This site includes:

- 18 bus stops, including local and Golden Gate Transit (GGT)
- 2 pump stations
- 1 wastewater treatment plant
- 1 power substation
- 2 schools

Permanent Inundation Exposure

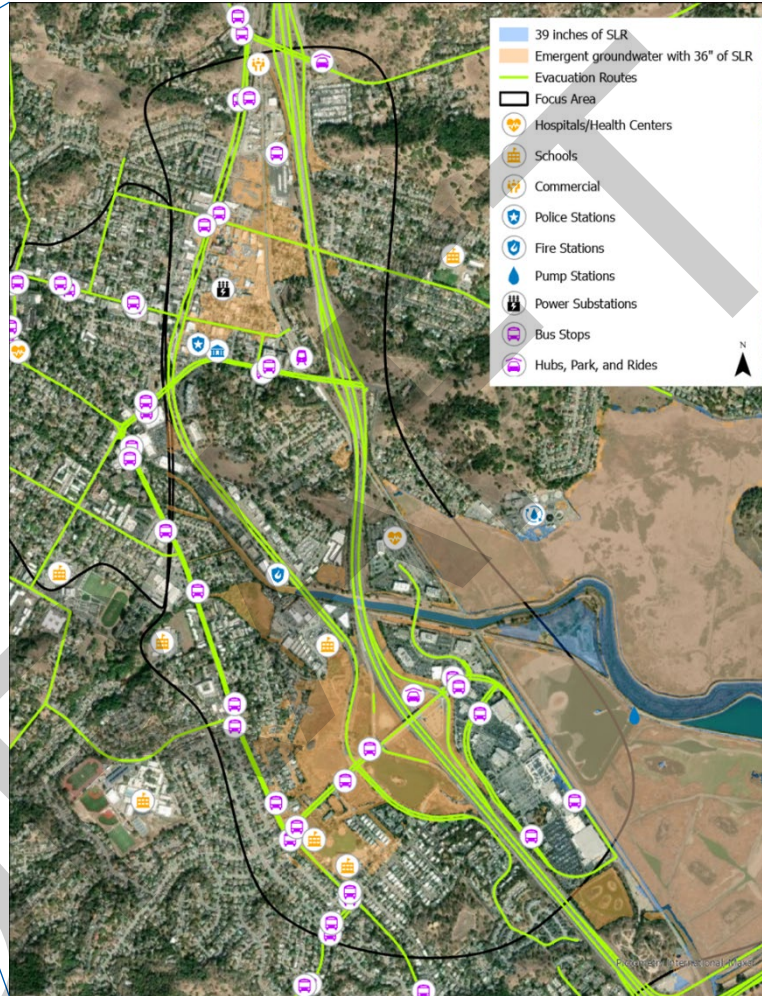
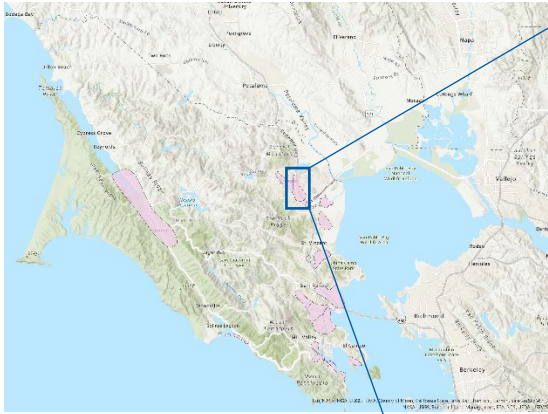
Temporary Flood Exposure

Groundwater Rise Exposure



| Focus Area | Permanent Physical Exposure - SLR First Inundation | Physical Exposure - GW Shallow (surface - 3 ft below surface) | Physical Exposure - GW Emergent | Temporary Physical Risk - 100 yr floodplain | Temporary Physical Risk - CoSMoS 100 yr | Physical Risk - Number of Hazards | Physical Risk - Average | Equity Priority Community |
|--------------------------|----------------------------------------------------|---------------------------------------------------------------|---------------------------------|---------------------------------------------|-----------------------------------------|-----------------------------------|-------------------------|-----------------------------------|
| Mill Valley - Miller Ave | By 10 in | present day | present day | In FEMA 100 yr Floodplain | present day | 3 | 3.3 | 10% - 20% Zero Vehicle Households |

3.1.12 Novato - Downtown Focus Area



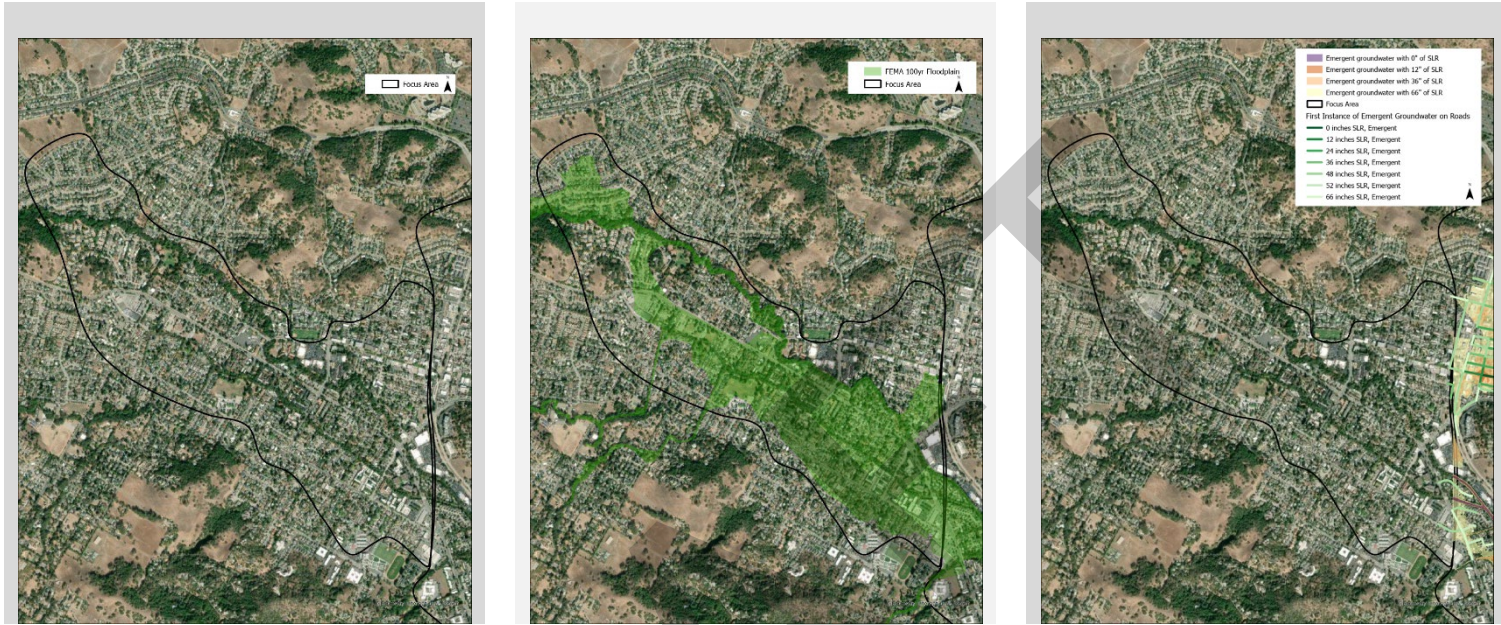
The site includes:

- 1 library
- 1 hospital/health center
- 6 schools
- 27 bus stops

Permanent Inundation Exposure

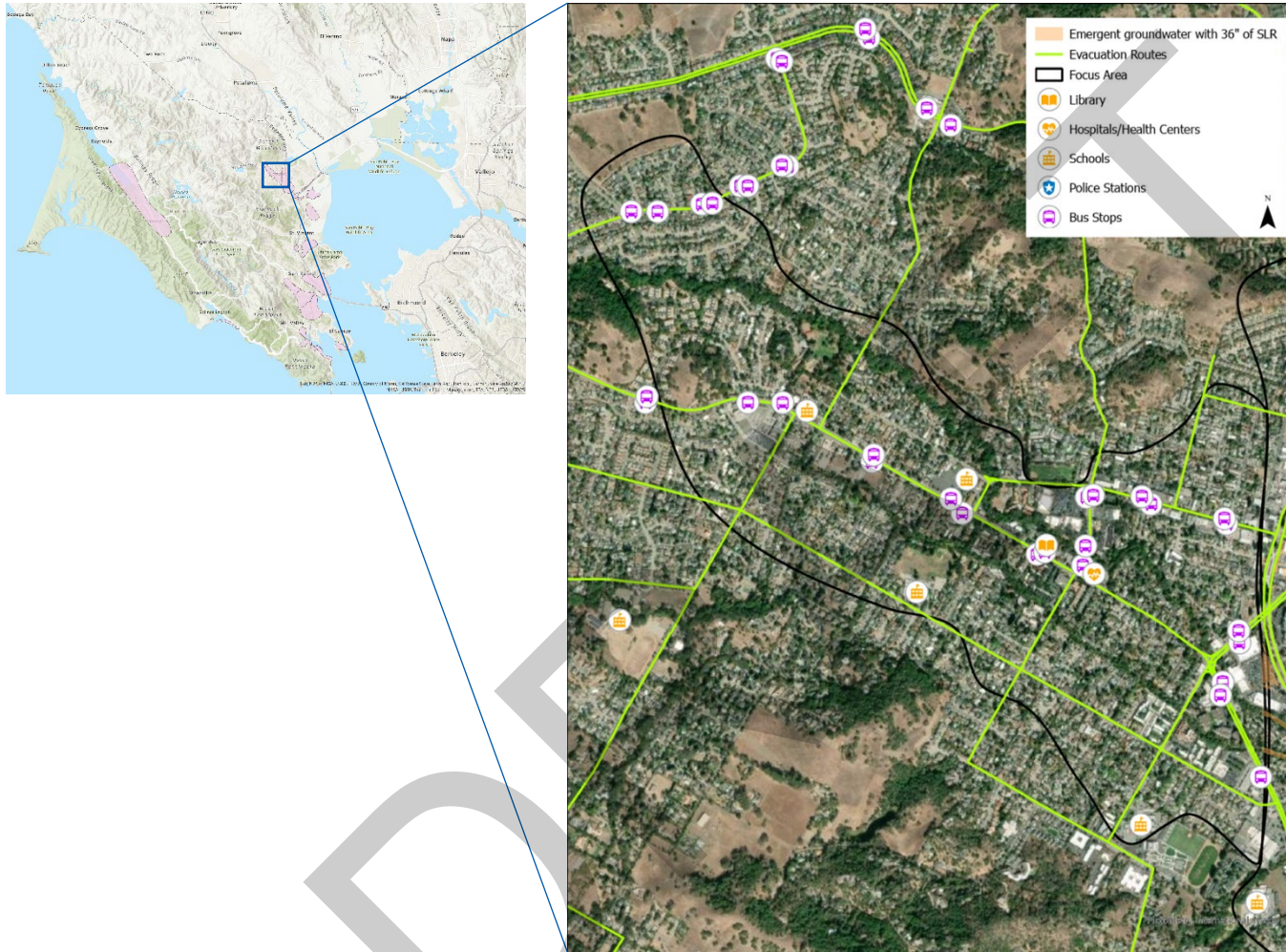
Temporary Flood Exposure

Groundwater Rise Exposure



| Focus Area | Permanent Physical Exposure - SLR First Inundation | Physical Exposure - GW Shallow (surface - 3 ft below surface) | Physical Exposure - GW Emergent | Temporary Physical Risk - 100 yr floodplain | Temporary Physical Risk - CoSMoS 100 yr | Physical Risk - Number of Hazards | Physical Risk - Average | Equity Priority Community |
|--------------------------|----------------------------------------------------|---------------------------------------------------------------|---------------------------------|---------------------------------------------|-----------------------------------------|-----------------------------------|-------------------------|------------------------------------------------------|
| Novato - Downtown | not impacted | not impacted | not impacted | In FEMA 100 yr Floodplain | not impacted | 1 | 0.7 | 37% - 66% Low Income >21% Zero Vehicle Households |

3.1.13 Novato – West Focus Area



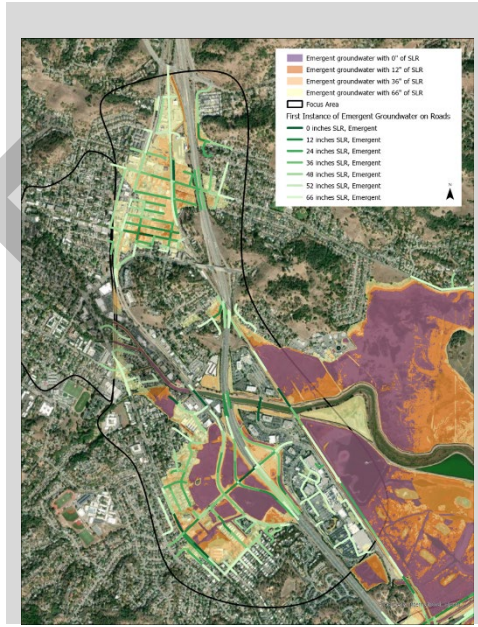
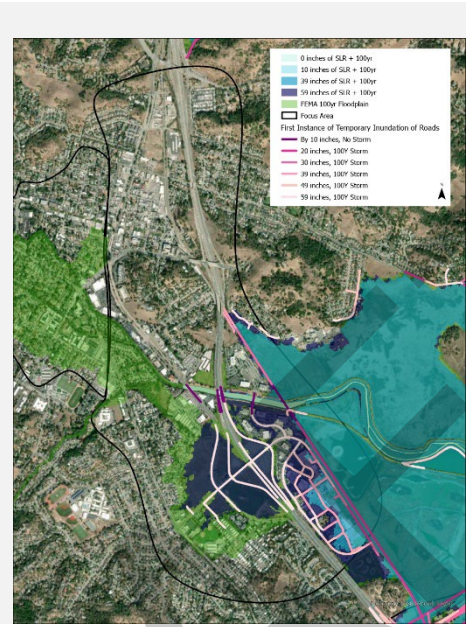
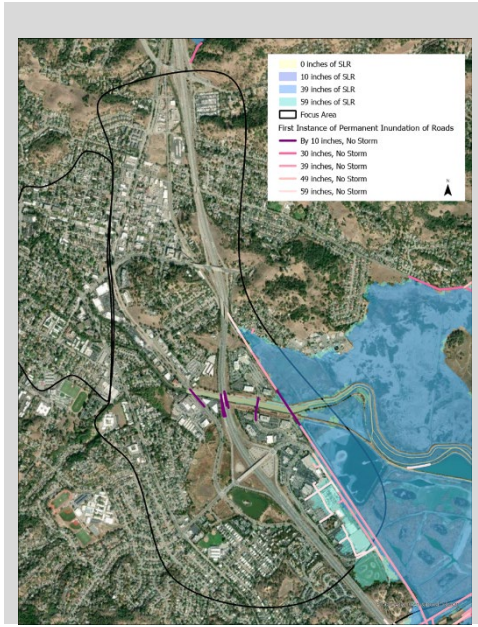
The site includes:

- 40 bus stops, including local and Golden Gate Transit (GGT)
- 1 hospital/health center
- 4 schools
- 1 power substation
- 1 fire station
- 1 police station
- 1 municipal
- 1 commercial
- 1 park, ride, and hub area
- 1 SMART station
- 1 ingress/egress route

Permanent Inundation Exposure

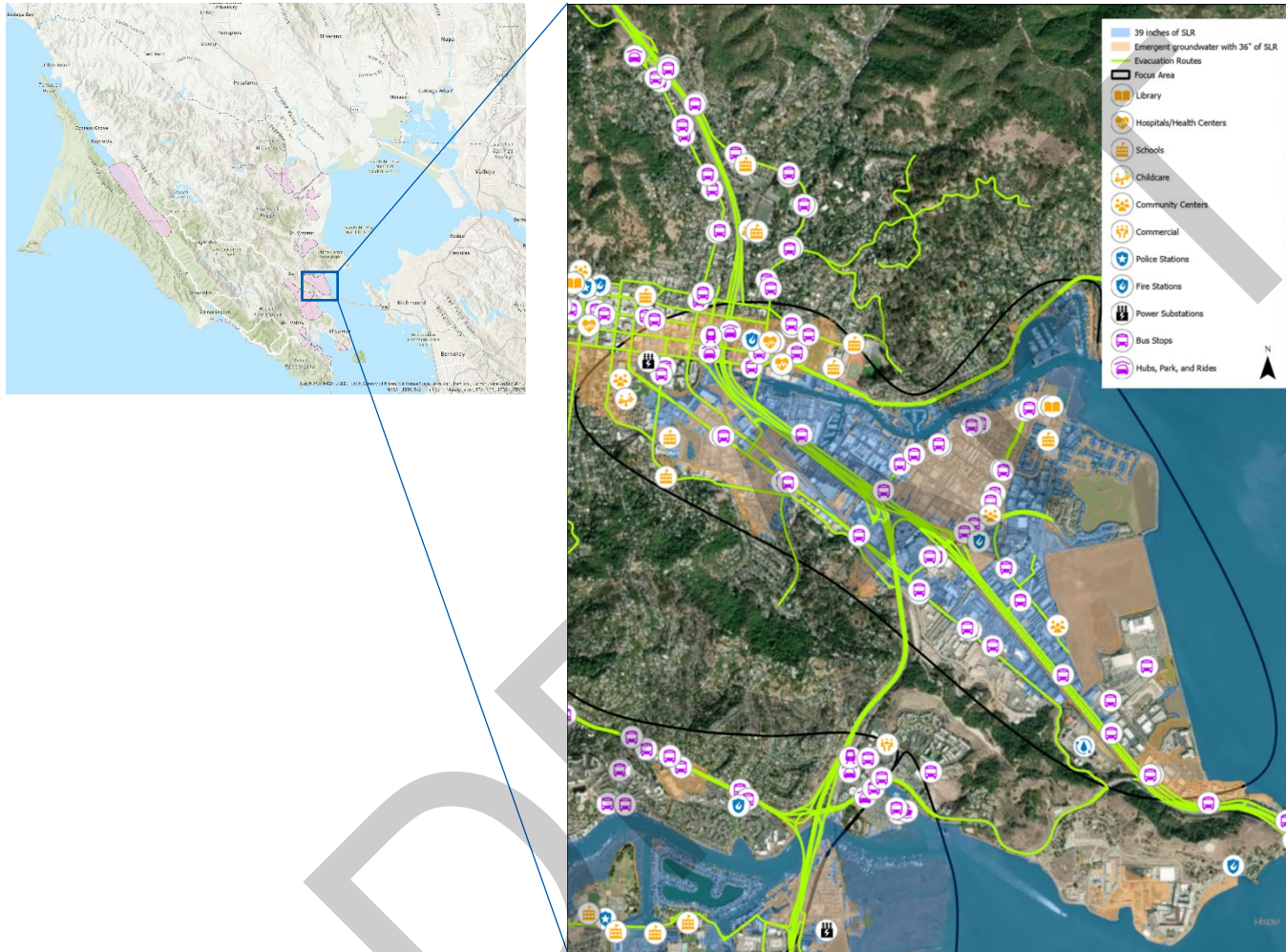
Temporary Flood Exposure

Groundwater Rise Exposure



| Focus Area | Permanent Physical Exposure - SLR First Inundation | Physical Exposure - GW Shallow (surface - 3 ft below surface) | Physical Exposure - GW Emergent | Temporary Physical Risk - 100 yr floodplain | Temporary Physical Risk - CoSMoS 100 yr | Physical Risk - Number of Hazards | Physical Risk - Average | Equity Priority Community |
|---------------|----------------------------------------------------|---------------------------------------------------------------|---------------------------------|---------------------------------------------|-----------------------------------------|-----------------------------------|-------------------------|------------------------------------------------------|
| Novato - West | By 10 in | present day | 24 in. | In FEMA 100 yr Floodplain | 20 in. | 3 | 3.2 | 21% - 36% Low Income >21% Zero Vehicle Households |

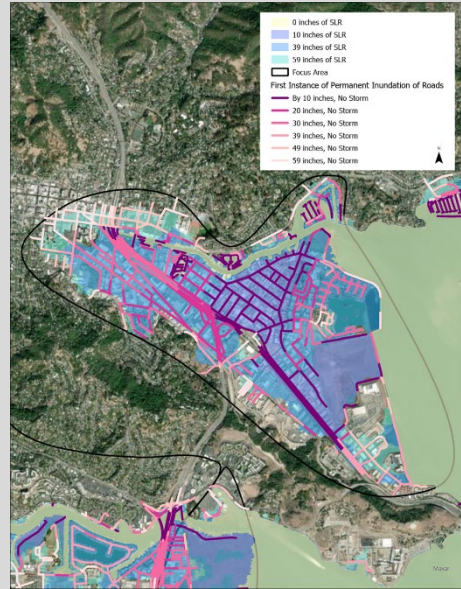
3.1.14 San Rafael – Canal Neighborhood Focus Area



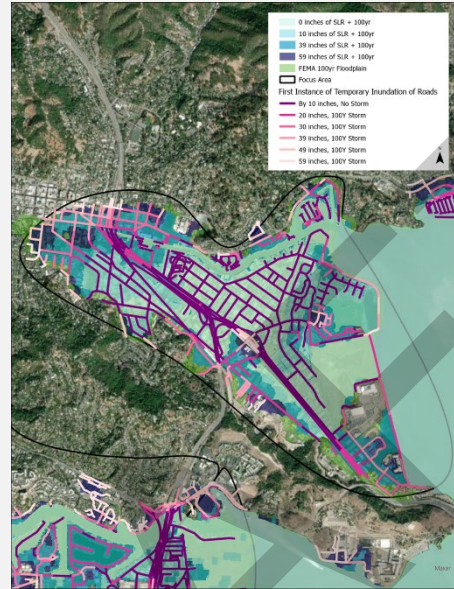
This site includes:

- Highway 101 and Highway 580
- Richmond-San Rafael Bridge is less than a mile away from the southern end of focus area.
- 71 bus stops, including local and Golden Gate Transit (GGT)
- 1 SMART station
- 4 hub and park locations
-

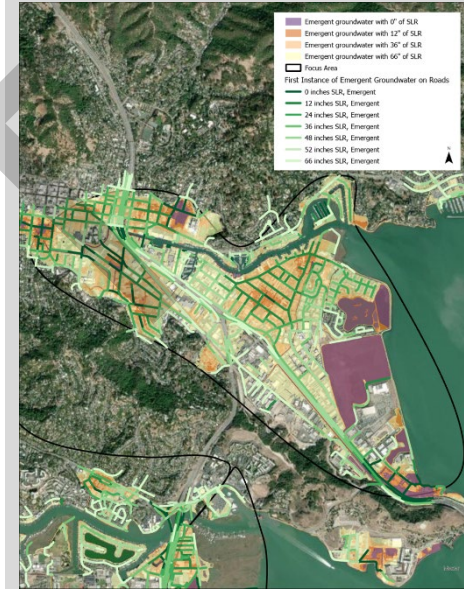
Permanent Inundation Exposure



Temporary Flood Exposure

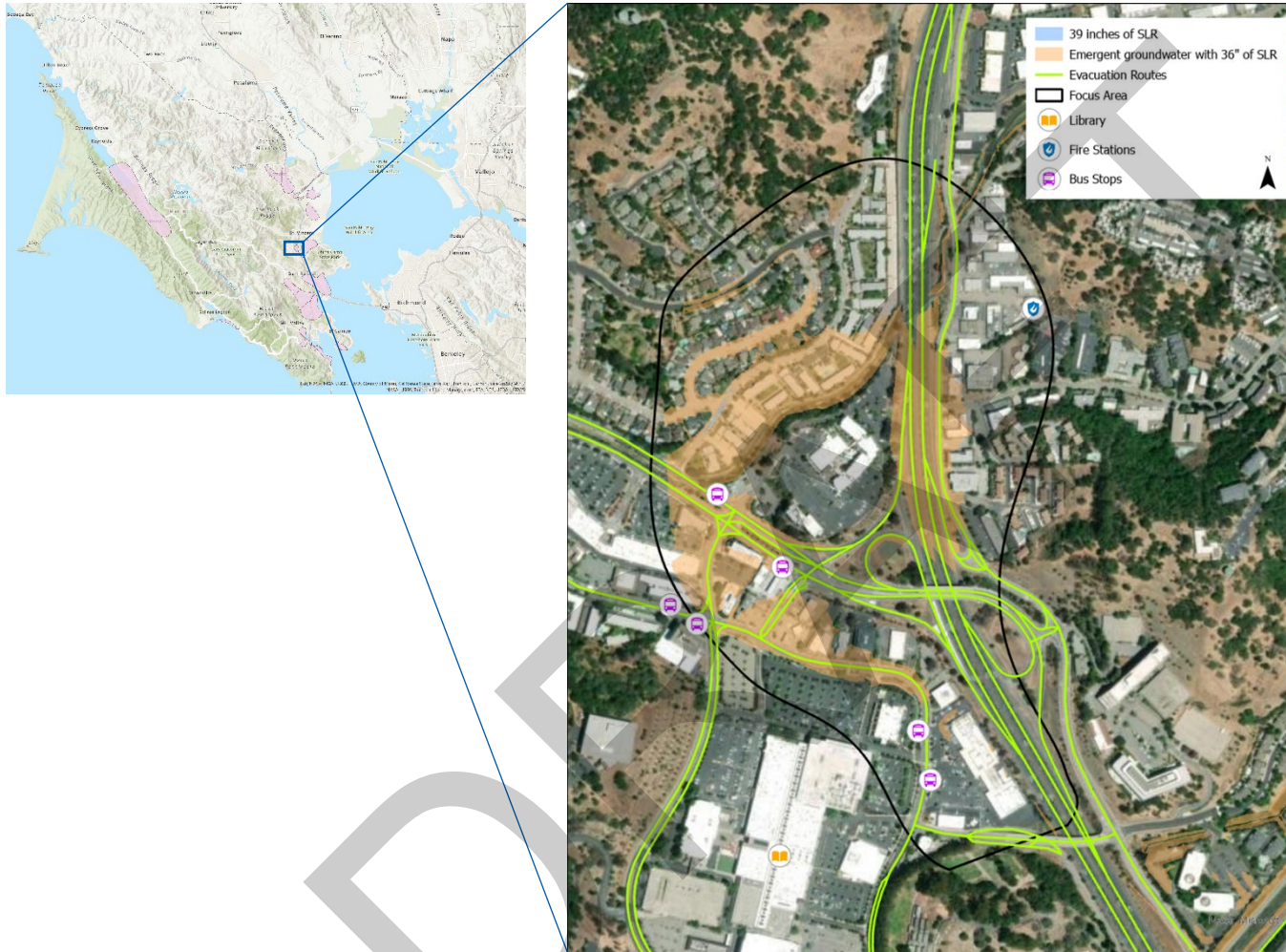


Groundwater Rise Exposure



| Focus Area | Permanent Physical Exposure - SLR First Inundation | Physical Exposure - GW Shallow (surface - 3 ft below surface) | Physical Exposure - GW Emergent | Temporary Physical Risk - 100 yr floodplain | Temporary Physical Risk - CoSMoS 100 yr | Physical Risk - Number of Hazards | Physical Risk - Average | Equity Priority Community |
|---------------------------------|----------------------------------------------------|---------------------------------------------------------------|---------------------------------|---------------------------------------------|-----------------------------------------|-----------------------------------|-------------------------|-------------------------------------------------------------------------------------|
| San Rafael - Canal Neighborhood | By 10 in | present day | 12 in | In FEMA 100 yr Floodplain | present day | 3 | 3.3 | Highest MTC Equity Priority Area >66% Low Income >21% Zero Vehicle Households |

3.1.15 San Rafael North Focus Area



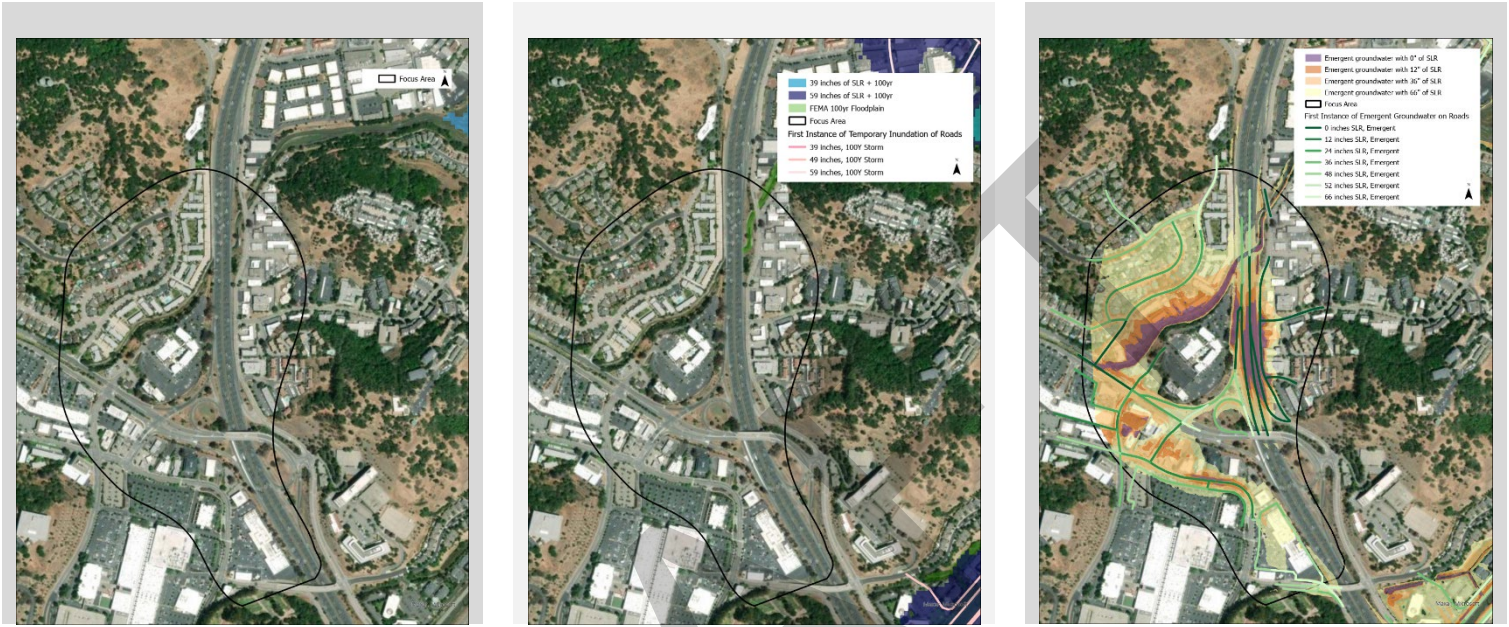
The site includes:

- Highway 101
- 1 fire station
- 6 bus stops, including local and Golden Gate Transit (GGT)

Permanent Inundation Exposure

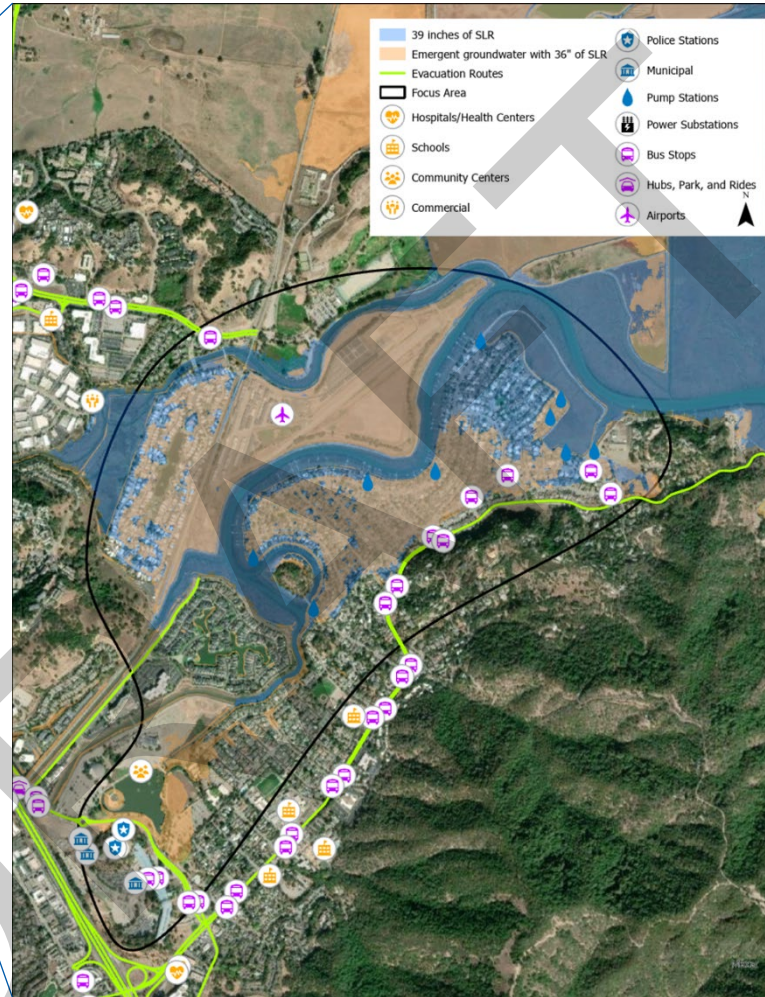
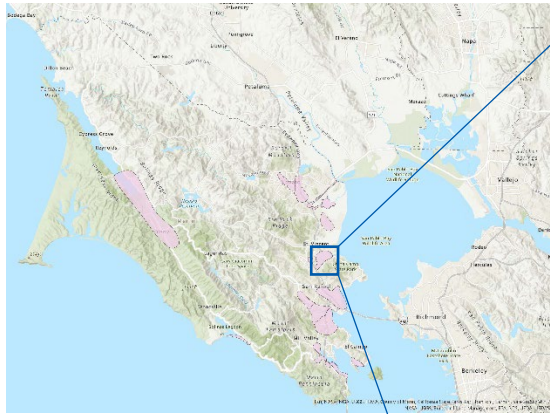
Temporary Flood Exposure

Groundwater Rise Exposure



| Focus Area | Permanent Physical Exposure - SLR First Inundation | Physical Exposure - GW Shallow (surface - 3 ft below surface) | Physical Exposure - GW Emergent | Temporary Physical Risk - 100 yr floodplain | Temporary Physical Risk - CoSMoS 100 yr | Physical Risk - Number of Hazards | Physical Risk - Average | Equity Priority Community |
|--------------------|----------------------------------------------------|---------------------------------------------------------------|---------------------------------|---------------------------------------------|-----------------------------------------|-----------------------------------|-------------------------|---------------------------------------------------------------------------------------|
| San Rafael - North | not impacted | present day | present day | In FEMA 100 yr Floodplain | not impacted | 2 | 2.0 | High MTC Equity Priority Area 37% - 65% Low Income >21% Zero Vehicle Households |

3.1.16 Santa Venetia Focus Area



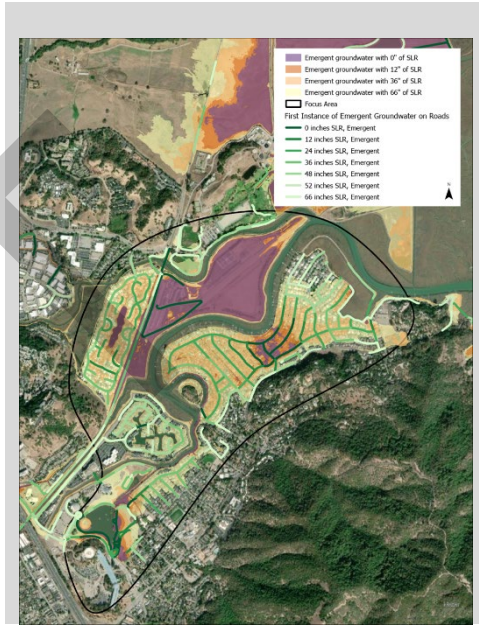
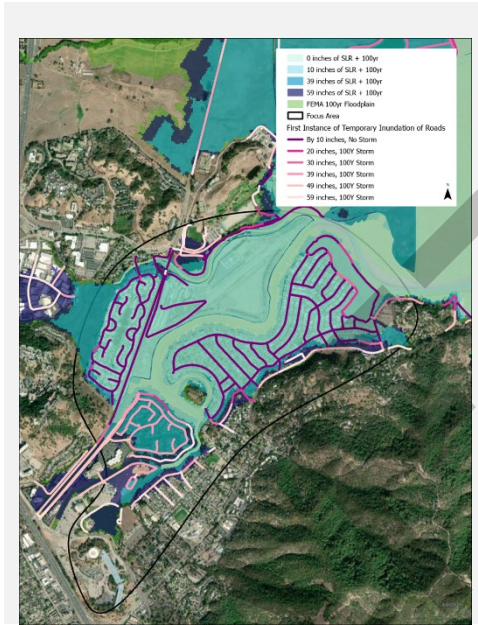
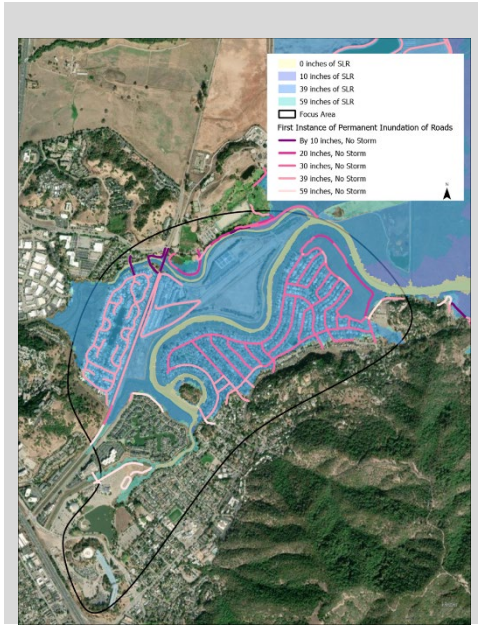
The site includes:

- 13 bus stops
- 1 airport
- 2 police stations
- 9 pump stations
- 1 ingress/egress route

Permanent Inundation Exposure

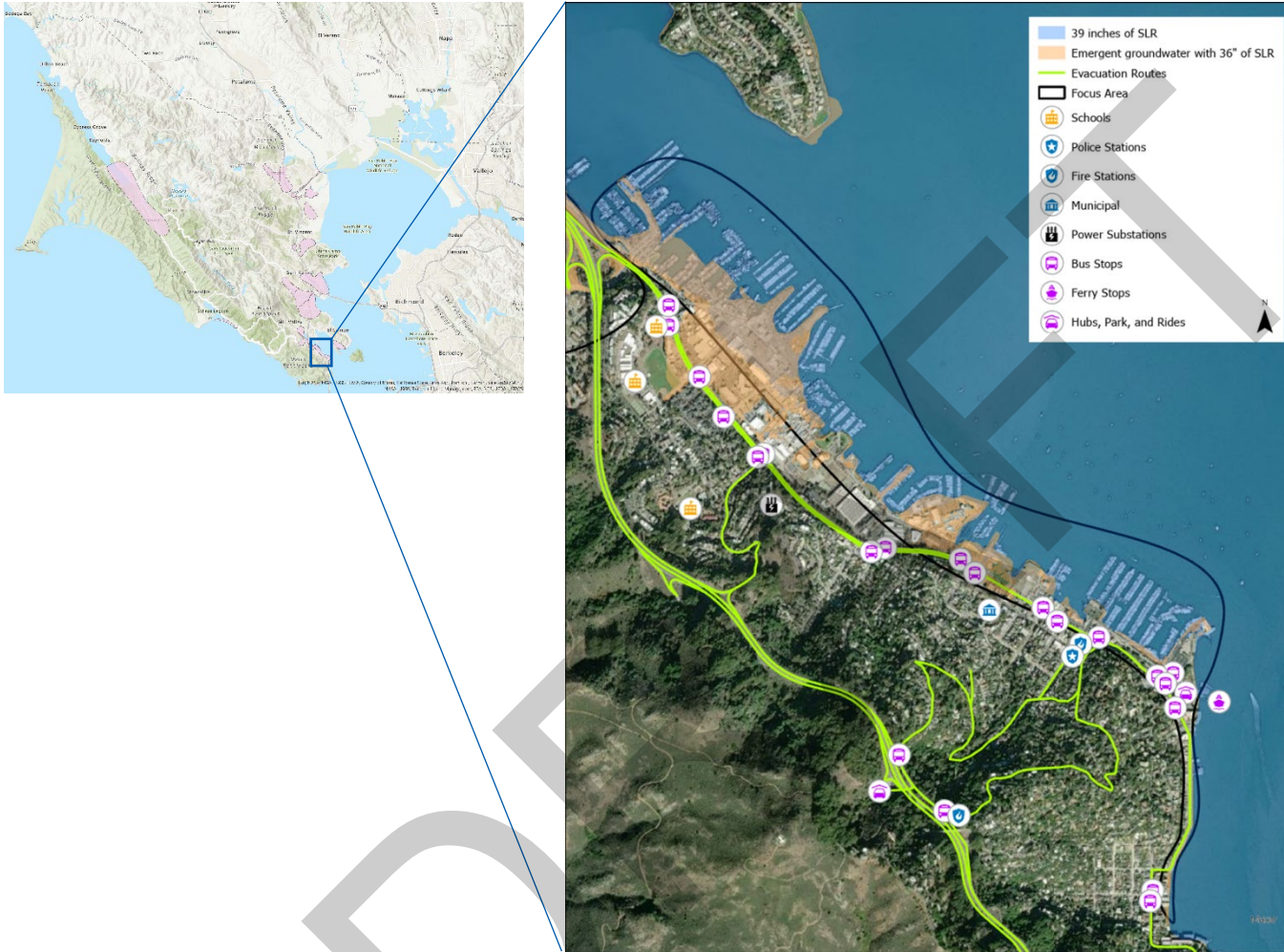
Temporary Flood Exposure

Groundwater Rise Exposure



| Focus Area | Permanent Physical Exposure - SLR First Inundation | Physical Exposure - GW Shallow (surface - 3 ft below surface) | Physical Exposure - GW Emergent | Temporary Physical Risk - 100 yr floodplain | Temporary Physical Risk - CoSMoS 100 yr | Physical Risk - Number of Hazards | Physical Risk - Average | Equity Priority Community |
|--------------|----------------------------------------------------|---------------------------------------------------------------|---------------------------------|---------------------------------------------|-----------------------------------------|-----------------------------------|-------------------------|-----------------------------------------------------------|
| Santa Venita | 30 in. | present day | 12 in. | In FEMA 100 yr Floodplain | 10 in. | 3 | 2.9 | 12% - 20% Low Income 10% - 20% Zero Vehicle Households |

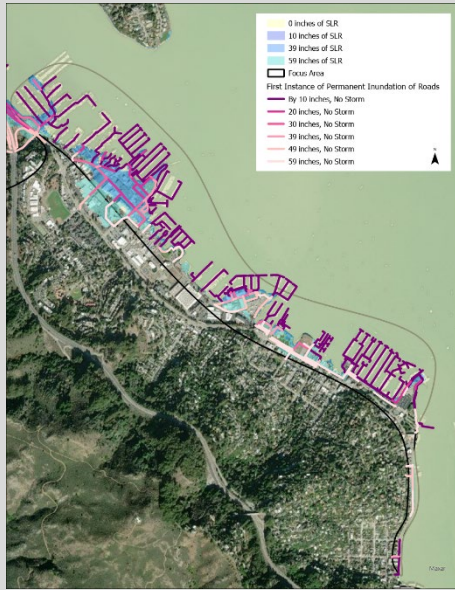
3.1.17 Sausalito Focus Area



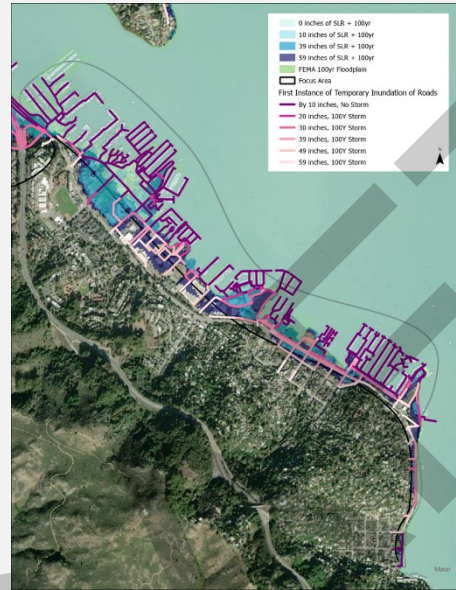
This site includes:

- 16 bus stops
- 1 park and ride hub area
- 3 arterials, Bridgeway, Richardson Street, and San Carlos Avenue, 7 collectors, and a network of local streets
- 1 ingress/egress route

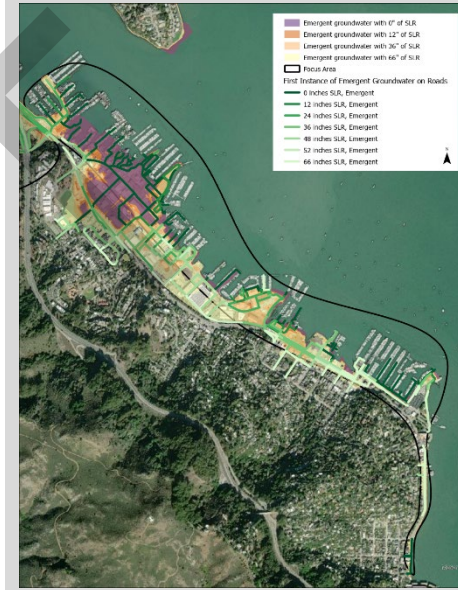
(A) Permanent Inundation Exposure



(B) Temporary Flood Exposure

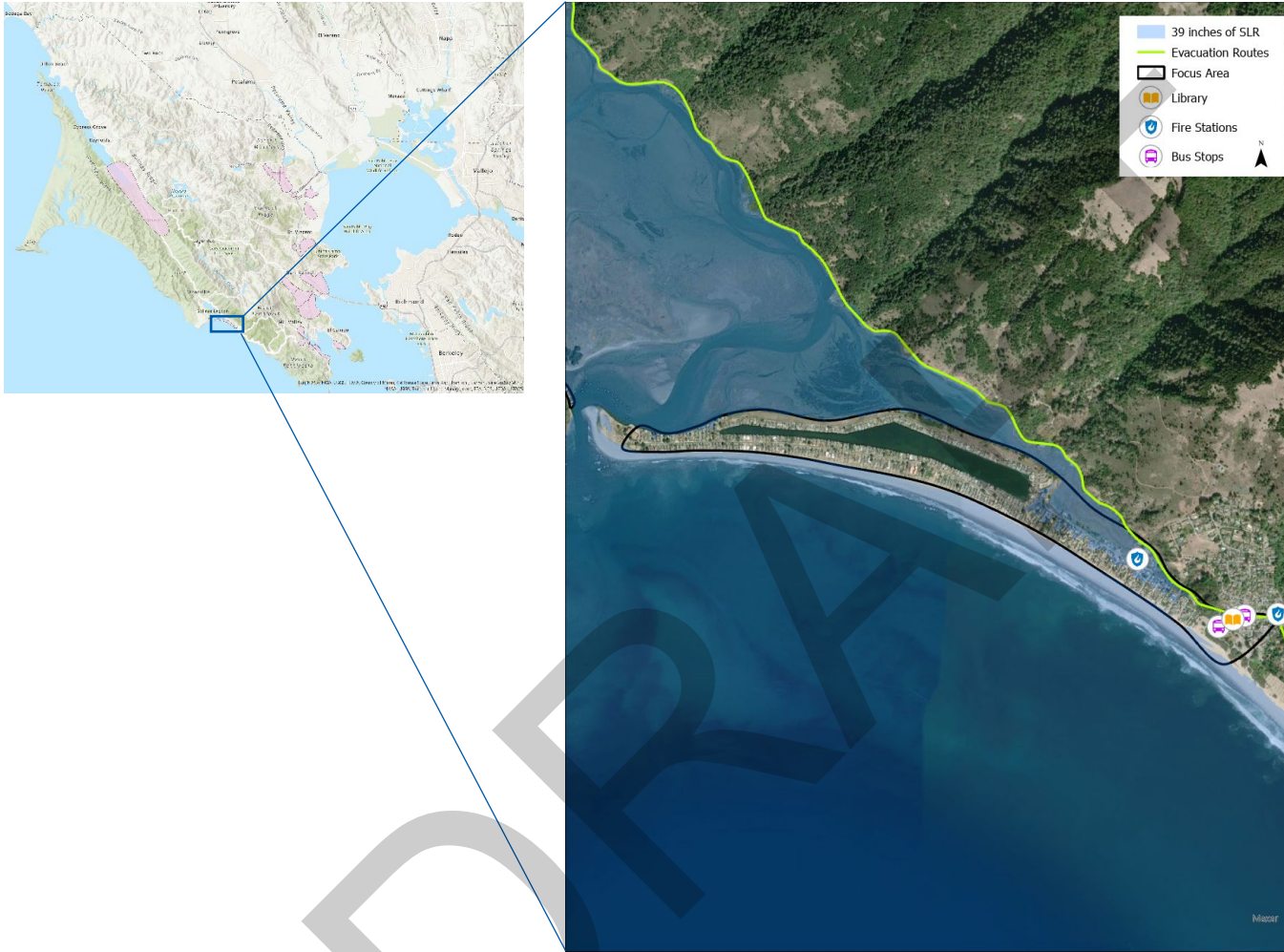


(C) Groundwater Rise Exposure



| Focus Area | Permanent Physical Exposure - SLR First Inundation | Physical Exposure - GW Shallow (surface - 3 ft below surface) | Physical Exposure - GW Emergent | Temporary Physical Risk - 100 yr floodplain | Temporary Physical Risk - CoSMoS 100 yr | Physical Risk - Number of Hazards | Physical Risk - Average | Equity Priority Community |
|------------|----------------------------------------------------|---------------------------------------------------------------|---------------------------------|---------------------------------------------|-----------------------------------------|-----------------------------------|-------------------------|---------------------------|
| Sausalito | 30 in. | present day | present day | In FEMA 100 yr Floodplain | present day | 3 | 3.1 | No |

3.1.18 Stinson Beach Focus Area



- This site includes:
- 3 bus stops
 - 1 fire station
 - 1 library
 - 1 ingress/egress route

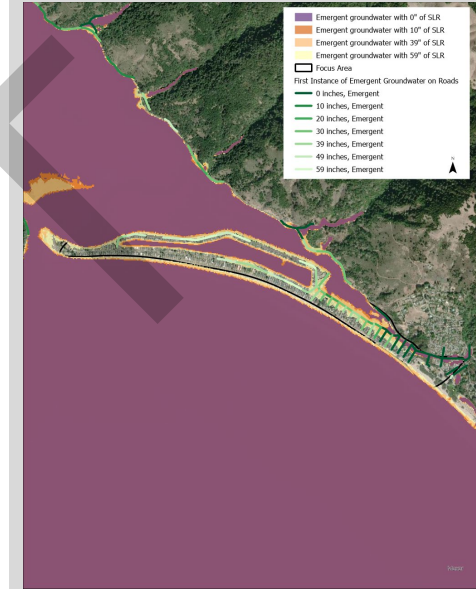
Permanent Inundation Exposure



Temporary Flood Exposure

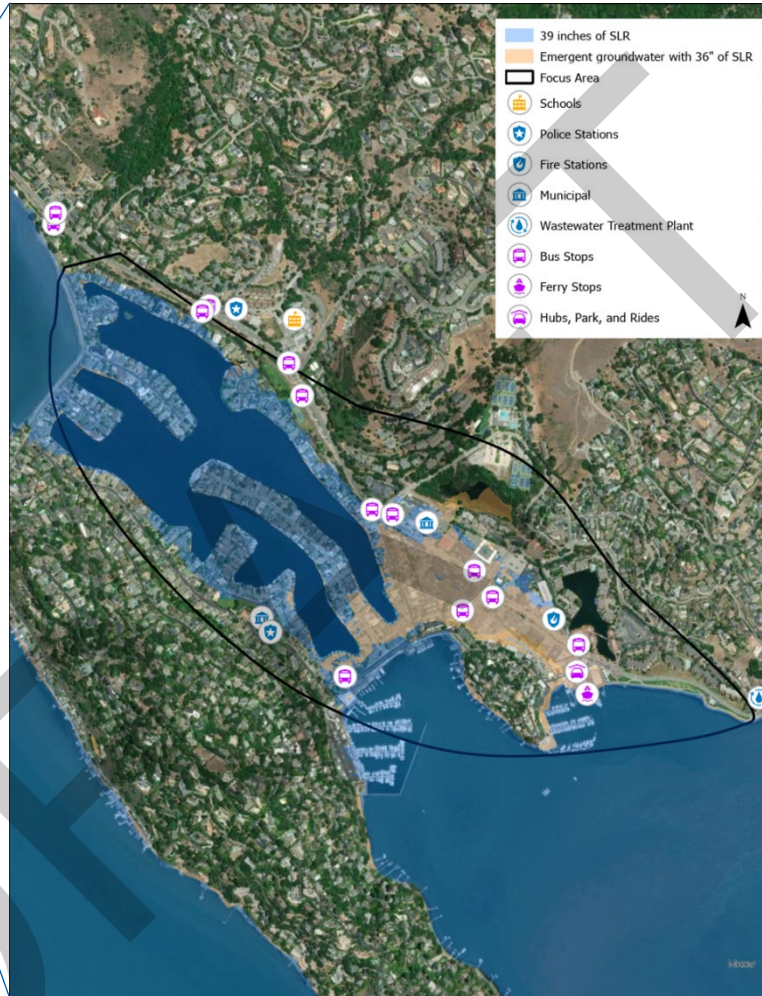
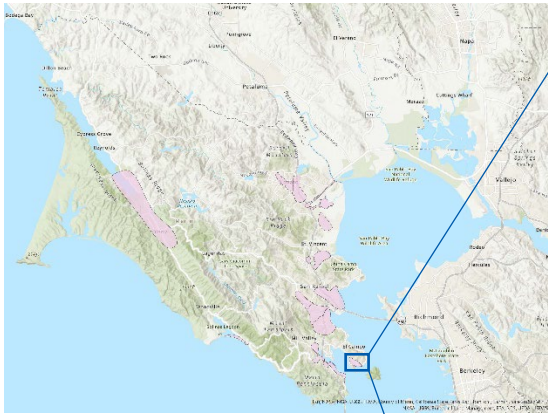


Groundwater Rise Exposure



| Focus Area | Permanent Physical Exposure - SLR First Inundation | Physical Exposure - GW Shallow (surface - 3 ft below surface) | Physical Exposure - GW Emergent | Temporary Physical Risk - 100 yr floodplain | Temporary Physical Risk - CoSMoS 100 yr | Physical Risk - Number of Hazards | Physical Risk - Average | Equity Priority Community |
|---------------|----------------------------------------------------|---------------------------------------------------------------|---------------------------------|---------------------------------------------|-----------------------------------------|-----------------------------------|-------------------------|---------------------------|
| Stinson Beach | By 10 in | present day | 36 in | In FEMA 100 yr Floodplain | 10 in. | 3 | 3.2 | 37% - 66% Low Income |

3.1.19 Tiburon Focus Area



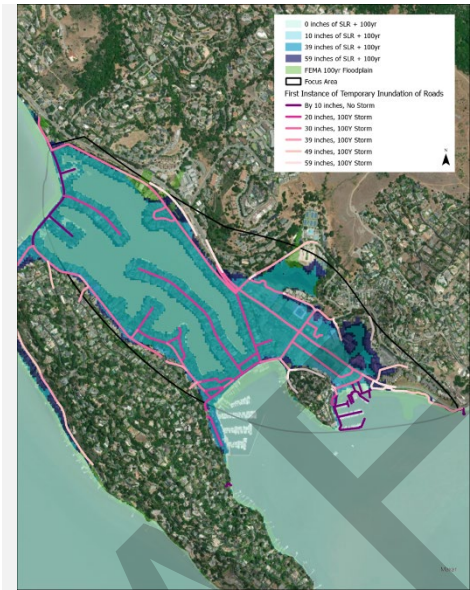
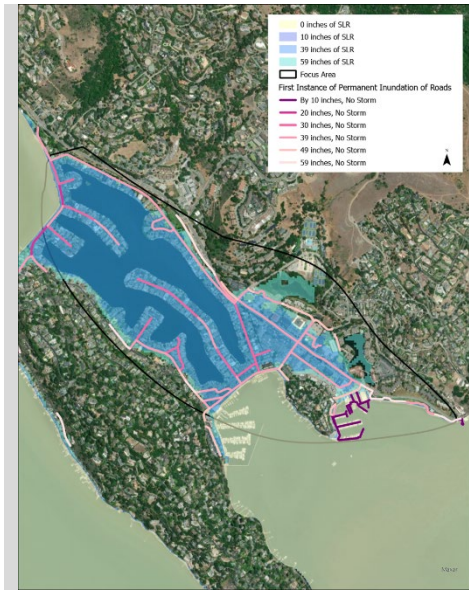
The site includes:

- 8 bus stops
- 2 municipal
- 1 fire station
- 1 police station
- 1 hub, park, and ride area
- 1 ferry stop
- 1 ingress/egress route

Permanent Inundation Exposure

Temporary Flood Exposure

Groundwater Rise Exposure



| Focus Area | Permanent Physical Exposure - SLR First Inundation | Physical Exposure - GW Shallow (surface - 3 ft below surface) | Physical Exposure - GW Emergent | Temporary Physical Risk - 100 yr floodplain | Temporary Physical Risk - CoSMoS 100 yr | Physical Risk - Number of Hazards | Physical Risk - Average | Equity Priority Community |
|------------|----------------------------------------------------|---------------------------------------------------------------|---------------------------------|---------------------------------------------|-----------------------------------------|-----------------------------------|-------------------------|---------------------------|
| Tiburon | 30 in. | present day | present day | In FEMA 100 yr Floodplain | 20 in. | 3 | 2.8 | No |

4. Next Steps

The process to designate the focus areas is an important step in refining and reconfirming locations across the entirety of Marin County that are vulnerable to coastal flood exposure, including vulnerability of permanent inundation due to sea level rise, temporary flooding from current day high tides, pluvial and fluvial flood exposure, and sea level rise-driven groundwater rise.

Through the creation of the GIS geodatabases that provide asset-level information on flood exposure, as well as the [Web Map](#), updated climate hazard exposure information is now available to TAM, the TAC and City/County of Marin for their own adaptation efforts. In the focus area profile sheets, the consultant team provides initial overview of each of the focus areas. The associated Focus Area Hazard Matrix excel file provides summary information for each focus area. There are any number of questions that can be asked of the exposure analysis. The focus areas provide one way to organize this information and bound it within an identified geography.

These focus areas will now drive discussion for the next phase of the project, Task 4, and will support TAM and the TAC to begin to map out adaptation opportunities across the Marin County.

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5. Appendix A: Hazard Matrix

(See associated excel file: Focus Area Hazard Matrix – TAC Review.xlsx)

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