LINDBERG GEOLOGIC CONSULTING
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Post Office Box 306
Cutten California 95534
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October 1, 2021 Project No: 0420.00

Mr. Jason Goforth
Post Office Box 172
Petrolia, California 95558

Subject: Hydrologic Isolation of Existing Well from Surface Waters
702 Chambers Road, Petrolia, Assessor's Parcel Number 105-071-006

To Whom It May Concern:

As requested, Lindberg Geologic Consulting assessed your existing permitted well on the above-referenced parcel to estimate the potential for hydrologic connectivity with adjacent wells, surface waters or wetlands, and if pumping this well could affect adjacent wells, wetlands, or surface waters in Mill Creek. Mill Creek is a tributary of the Mattole River (Figure 1). In our opinion the subject well is unlikely to be hydrologically connected to nearby wells, wetlands and surface waters in any manner that could affect the adjacent wetlands and or surface waters in Mill Creek. Fisch Drilling of Hydesville drilled this well under county permit (#16/17-0721) in August 2017. Fisch is a licensed (C-57 #683865) well-drilling contractor. Fisch submitted the well completion report (DWR 188) on August 16, 2017 (attached). Fisch Drilling estimated the yield of the well at 20 gallons per minute on August 11, 2017, based on a 4-hour pumping test. The well location is shown on Figures 1 - 3. The driller has expressed his opinion that this well has "no hydraulic connection to any surface water or any part of a larger shallow homogeneous aquifer."

Borehole diameter is 10 inches, and drilled depth is 160 feet. A bentonite surface seal was installed from grade to 20 feet below the ground surface (bgs). From the surface to the total depth, the well was constructed of 5.5-inch diameter, PVC pipe, and from 22 feet bgs to the total completed depth of 160 feet bgs, the annulus was backfilled with #3 well sand. The well is cased through the shallow subsurface aquifer from which the nearest neighbors draw water. This well is screened (0.032" slots) from 140 to 160 feet. Depth to static water level in the completed and developed well was 18 feet bgs in 2017, suggesting the deep aquifer is under artesian pressure.

Parcel 105-071-006 (Figure 2) encompasses approximately 37 acres. The subject well is located at latitude 40.320425° north, and longitude 123.269634° west. This well is in the southwest ¼ of Section 2, T2S., R5E, HB&M (Figure 2). Based on the Humboldt County WebGIS mapping, this well is approximately 1,000 feet southeast of the nearest mapped perennial stream, Mill Creek. This well is also approximately 600 feet south of an unnamed ephemeral tributary to Mill Creek, and approximately 110 feet north of another unnamed ephemeral of Mill Creek tributary (Figure 1). Based on interpolation from the USGS Petrolia topographic quadrangle map (Figure 1), and the Humboldt County WebGIS, well elevation is approximately 200 feet above sea level. Elevation of the perennial branch of Mill Creek at the nearest point to the well is approximately 110 feet. The elevation of the nearest ephemeral tributary of Mill Creek is estimated to be less than 200 feet.

On the geologic map (Figure 4) the area is underlain by a Quaternary alluvial terrace, which we interpret to be ancient, abandoned floodplain of the Mattole River. This terrace has been uplifted by tectonics, and the river has down cut, keeping pace with sea level fluctuations. Terrace deposits (Qal) are described by McLaughlin (2000) as consisting of “Alluvial deposits of Holocene and late Pleistocene (?) age. Consisting of clay, silt, sand, gravel, and boulders, deposited in stream beds, alluvial fans, terraces, flood plains and ponds; and soils formed on these deposits. Includes largely Holocene deposits in modern stream channels and on flood plains.”

On this parcel, McLaughlin (2000) mapped the ancient alluvial terrace deposits as underlain by Coastal Belt Franciscan mélange. In the field, alluvial terrace deposits are relatively uniform and consist of fine to medium grain sediments (silt and sand with clay). Alluvial deposits continue southeast to the modern Mattole River, based on the geologic mapping by McLaughlin (2000).

Materials reported on the geologic log of the well completion report suggest the alluvial terrace deposits are approximately 60 feet thick, terminating below the “blue rounded gravel” shown on the driller’s log from 37 to 58 feet. From 58 to 142 feet, the formation consists of low transmissivity shale. Below 142 feet of depth, the driller noted “fractured sandstone” to 157 feet, then “Franciscan formation” from 157 to 160 feet, the total depth of this well.

In our professional opinion, based on our experience, site observations, and review of pertinent information available, this well has a negligible likelihood of having any direct connection to nearby wells or surface waters. Our conclusion is supported by the fact that the well on 105-071-006 is cased through the upper producing zone. Depth to the water producing zone in fractured sandstone at 142 to 157 feet is approximately 84 feet below the base of the blue rounded gravel” upper production zone.

To the best of our knowledge, the nearest two wells, on parcels 105-071-007 and 105-101-004, are less than 100 feet deep, and are thus producing water from a perched aquifer in the quaternary alluvium. The well installation report for parcel 105-071-007 puts its depth at only 70 feet. Based on distances estimated from Google Earth satellite imagery, the well on parcel 105-071-007, is more than 250 feet east-southeast of the subject well. The well on parcel 105-101-004 is more than 380 feet east-southeast of the subject well. The well on parcel 105-071-007 is 70 feet. Because we could find no records in the DWR database of the well on parcel 105-101-004, we assume it to be unpermitted and less than 90 feet deep, based on the DWR report of average depth for a domestic well in the section.

The nearest neighboring well is greater than 250 feet southeast of the subject well. The subject well was completed 84 feet deeper than the nearest neighboring well, in fractured sandstone bedrock; the nearest neighboring well was completed in sand and gravel, and shale and blue clay, at a depth of 70 feet. More than 80 feet of shale separate the water producing zones in the two wells. Hydraulic conductivity in shale is reported to range from 1×10^{-13} meter per second (m/s) to 2×10^{-9} m/s, several orders of magnitude lower than sand and gravel (9×10^{-7} to 2×10^{-4} m/s). Wells on parcels 105-071-007 and 105-101-004, and on 105-101-013 all appear to be drawing from the shallow aquifer which is hydrologically distinct and separate from the deeper aquifer producing water at 105-071-006. The water source at 105-071-006 appears to be a subsurface aquifer isolated from the near-surface aquifer and not hydraulically connected to nearby domestic wells, surface waters, or wetlands.

In our professional opinion, it appears that the aquifer tapped by the subject well is recharged by water infiltrating from a distant source area upland of the Qal alluvial terrace deposits, probably to the north and northeast. The "Water Level and Yield of Completed Well" section of the Well Completion Report estimated the yield of this well at 20 gallons per minute (gpm) on August 11, 2017. A four-hour pump test conducted that day, shows the static water level dropped 106 feet, to 133 feet, when pumped at a rate of 20 gpm, suggesting no recharge from the shallow, sand and gravel aquifer at 45 to 60 feet.

In our opinion, the subject well is not hydrologically connected to, or influencing surface water flows or nearby wells, Mill Creek tributaries, or ephemeral wetlands. Given the horizontal distances involved, and the elevation differences between the water-producing zone in the subject well, other nearby domestic wells, and the surface waters of the nearby tributaries of Mill Creek and the Mattole River, the potential for hydrologic connectivity between nearby domestic wells, surface waters and groundwater in the shallow alluvial aquifer is negligible. Further, given the apparent limiting condition of 84 feet of low-transmissivity shale, the fractured sandstone aquifer is hydrologically distinct from the overlying aquifer in the Qal alluvial deposits

Please contact us if you have questions or concerns regarding our findings and conclusions.

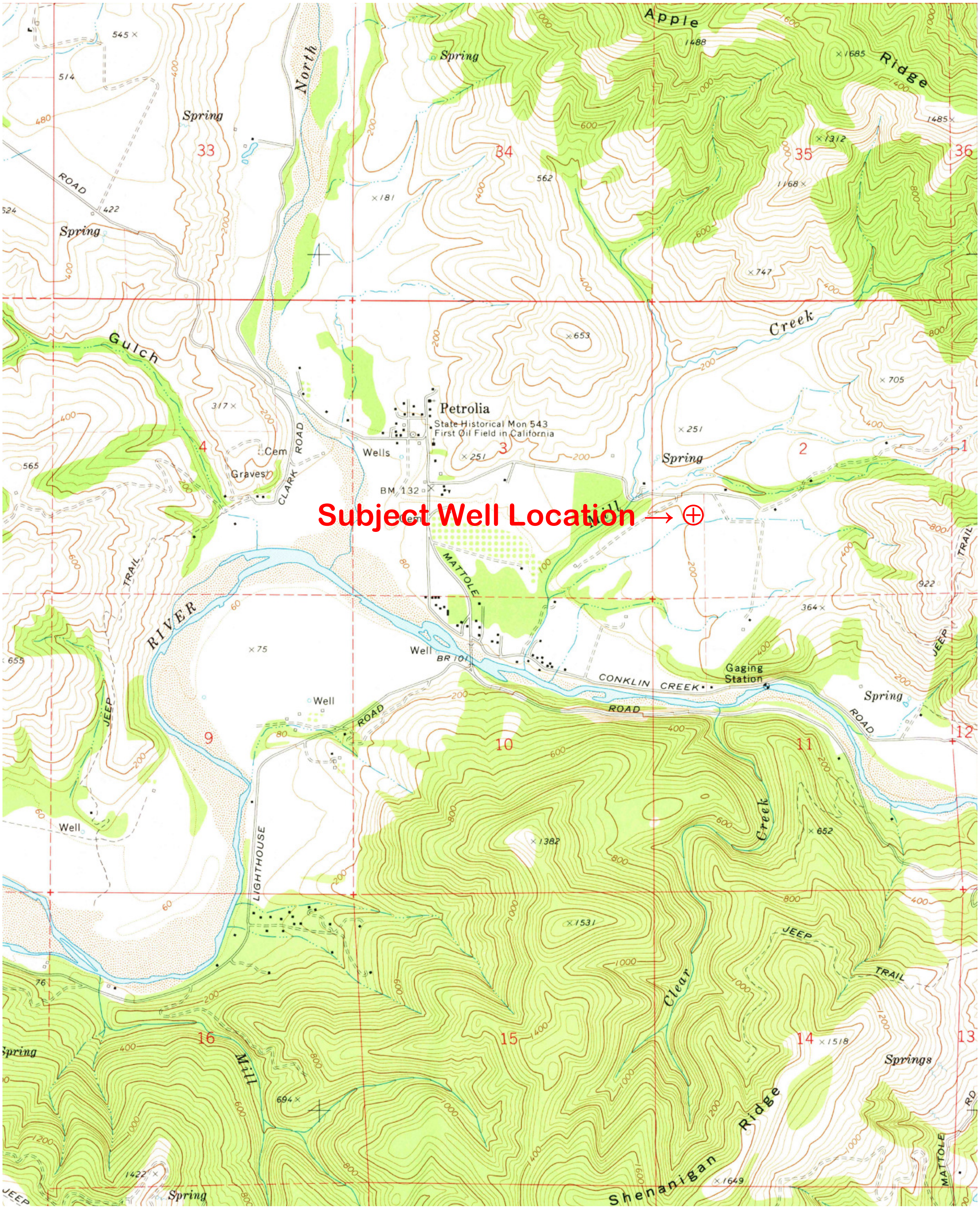
Sincerely,

David N. Lindberg, CEG
Lindberg Geologic Consulting

DNL:sll

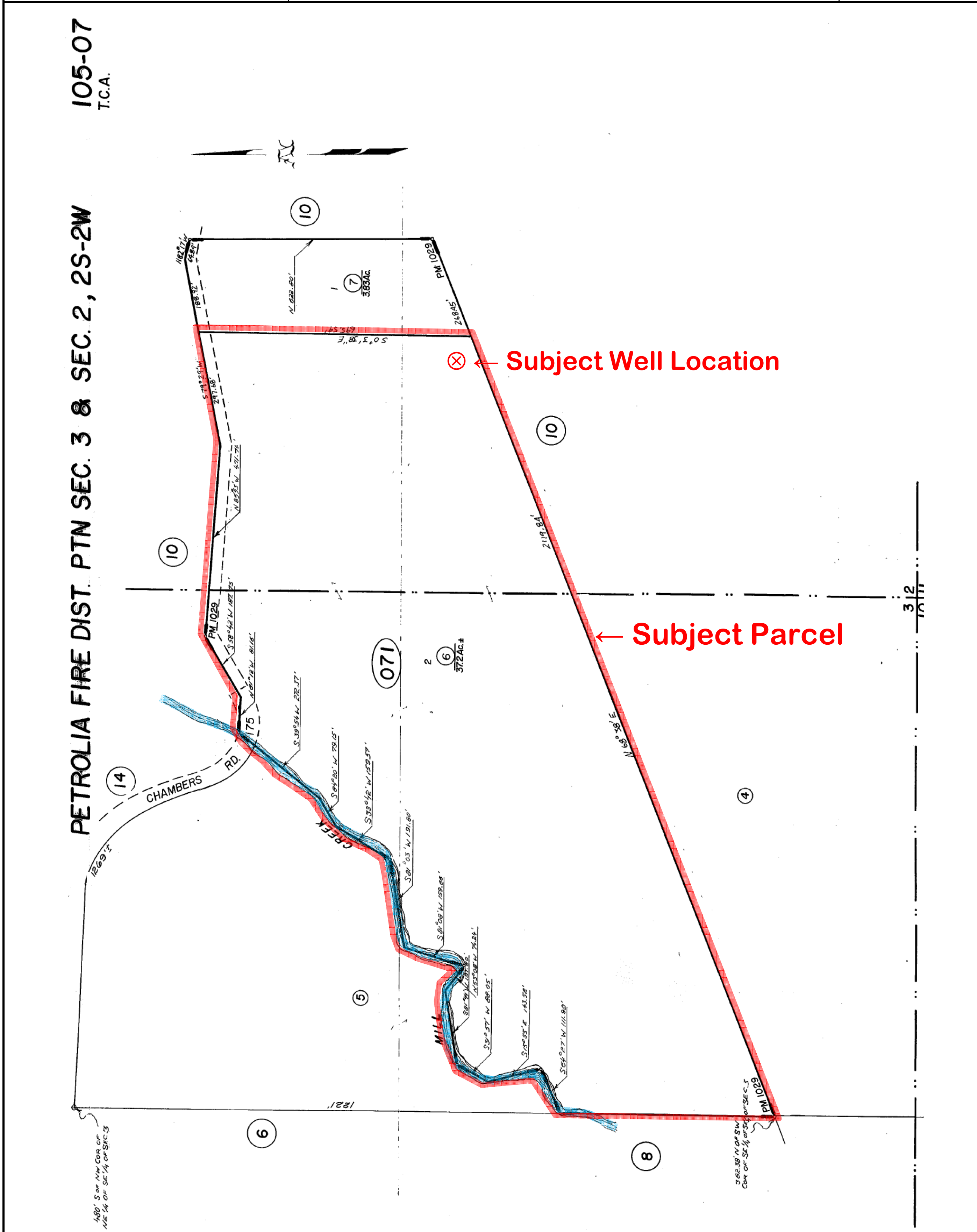
Attachments:
Figure 1: Topographic Map of Well Location
Figure 2: Assessor's Parcel Map of 105-071-006
Figure 3: Satellite Image of Wellsite and Vicinity
Figure 4: Geologic Map

Lindberg Geologic Consulting	Engineering Geologic Well Hydrologic Isolation Report	Figure 1
Post Office Box 306	702 Chambers Road, APN: 105-071-006, Petrolia	October 1, 2021
Cutten, CA 95534	Mr. Jason Goforth, Client	0420.00
(707) 442-6000	Topographic Map of Well Location (locations approximate)	1" ≈ 350'

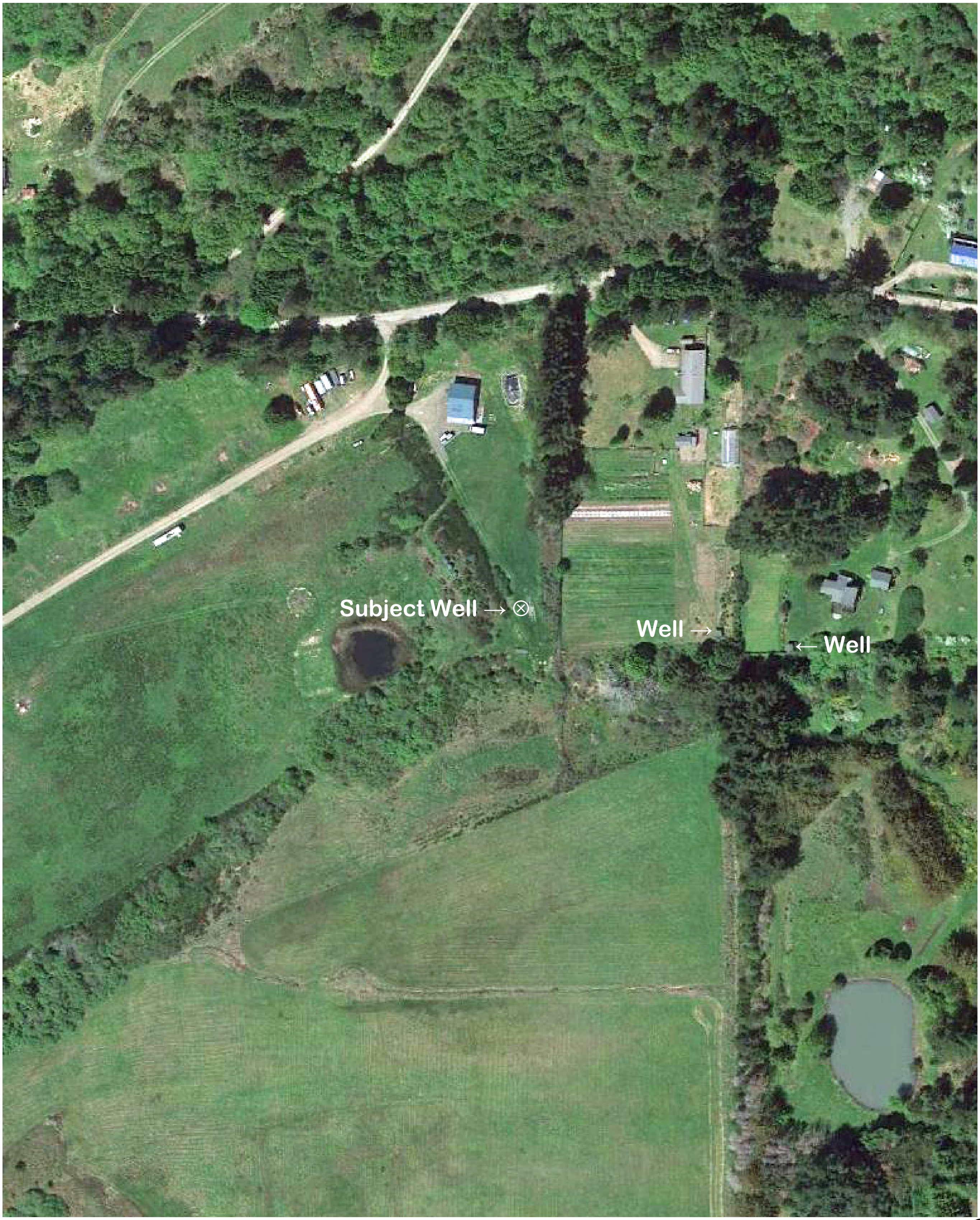


Modified from: USGS "Petrolia, Calif.", 7.5' Quadrangle, (1969). N ≅ ⬆

Lindberg Geologic Consulting	Engineering Geologic Well Hydrologic Isolation Report	Figure 2
Post Office Box 306	702 Chambers Road, APN: 105-071-006, Petrolia	October 1, 2021
Cutten, CA 95534	Mr. Jason Goforth, Client	0420.00
(707) 442-6000	Humboldt County Assessor's Parcel Map (locations approximate)	1" ≈ 200'

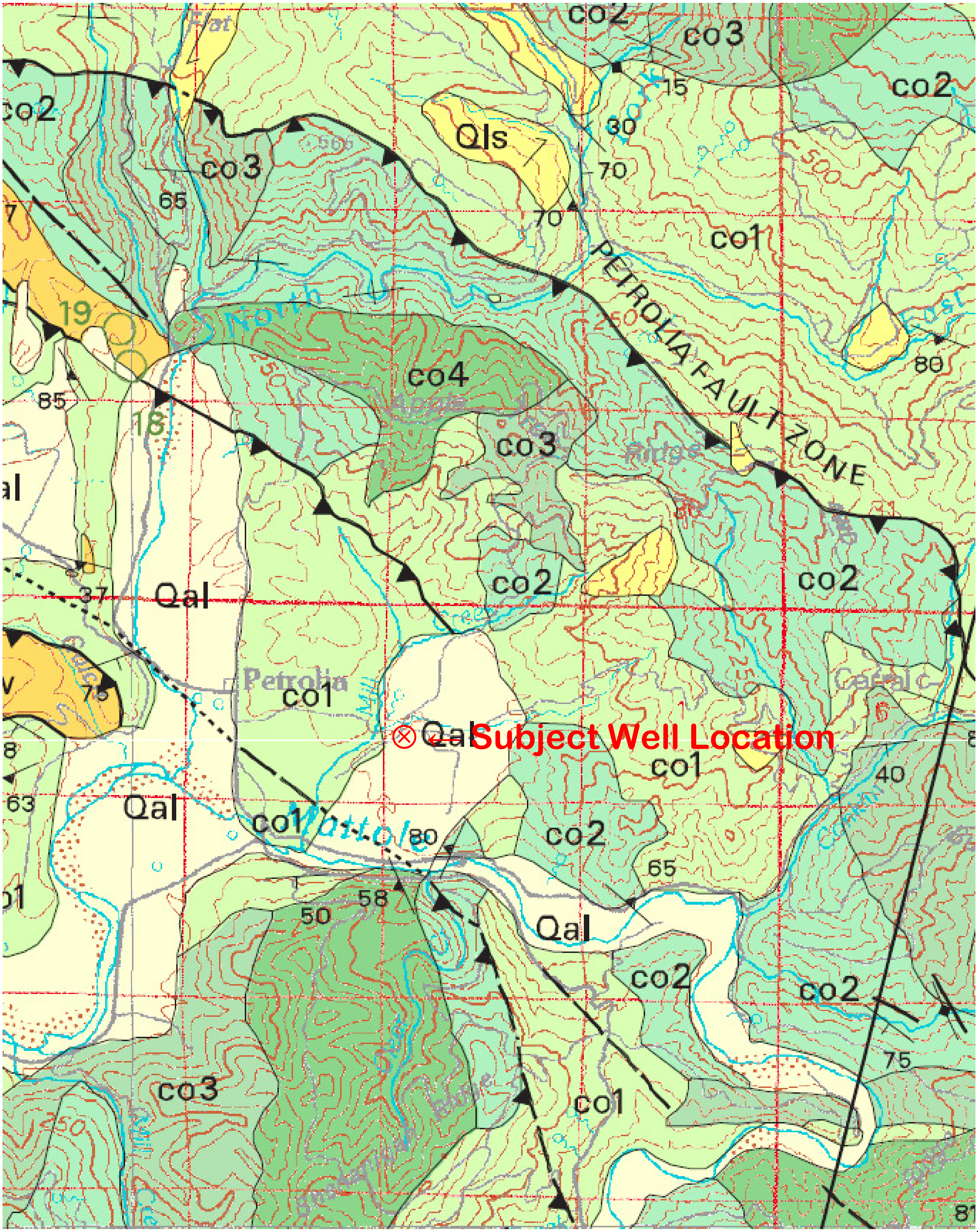


Lindberg Geologic Consulting	Engineering Geologic Well Hydrologic Isolation Report	Figure 3
Post Office Box 306	702 Chambers Road, APN: 105-071-006, Petrolia	October 1, 2021
Cutten, CA 95534	Mr. Jason Goforth, Client	0420.00
(707) 442-6000	Satellite Image Site Plan (locations approximate)	1" ≈ 350'



Modified from: Google Earth Imagery of April 30, 2019. N ≅

Lindberg Geologic Consulting	Engineering Geologic Well Hydrologic Isolation Report	Figure 4
Post Office Box 306	702 Chambers Road, APN: 105-071-006, Petrolia	October 1, 2021
Cutten, CA 95534	Mr. Jason Goforth, Client	0420.00
(707) 442-6000	Geologic Map of Project Area (locations approximate)	1" ≈ 3,800'



Modified from: McLaughlin *et al.*, 2000. N ≅

Lindberg Geologic Consulting	Engineering Geologic Well Hydrologic Isolation Report	Figure 4a
P. O. Box 306	702 Chambers Road, APN: 105-071-006, Petrolia	October 1, 2021
Cutten, CA 95534	Mr. Jason Goforth, Client	0420.00
(707) 442-6000	Geologic Map Explanation	No Scale

DESCRIPTION OF MAP UNITS

QUATERNARY AND TERTIARY OVERLAP DEPOSITS

- **Qal** Alluvial deposits (Holocene and late Pleistocene?)
- **Qm** Undeformed marine shoreline and aolian deposits (Holocene and late Pleistocene)
- **Qt** Undifferentiated nonmarine terrace deposits (Holocene and Pleistocene)
- **Qls** Landslide deposits (Holocene and Pleistocene)
- **QTog** Older alluvium (Pleistocene and [or] Pliocene)
- **QTw** Marine and nonmarine overlap deposits (late Pleistocene to middle Miocene)
- **Ti** Volcanic rocks of Fickle Hill (Oligocene)

COAST RANGES PROVINCE

FRANCISCAN COMPLEX

-- Coastal Belt --

Coastal terrane(Pliocene to Late Cretaceous)

Sedimentary, igneous, and metamorphic rocks of the Coastal terrane (Pliocene to Late Cretaceous):

- **co1** Melange
- **co2** Melange
- **co3** Broken sandstone and argillite
- **co4** Intact sandstone and argillite
- **cob** Basaltic Rocks (Late Cretaceous)
- **cols** Limestone (Late Cretaceous)
- **m** Undivided blueschist (Jurassic?)

King Range terrane (Miocene to Late Cretaceous)

- **Krp** Igneous and sedimentary rocks of Point Delgada (Late Cretaceous)
- **m** Undivided blueschist blocks (Jurassic?)

Sandstone and argillite of King Peak (middle Miocene to Paleocene[?]):

- **krk1** Melange and (or) folded argillite
- **krk2** Highly folded broken formation
- **krk3** Highly folded, largely unbroken rocks
- **krl** Limestone
- **krc** Chert
- **krb** Basalt

False Cape terrane (Miocene? to Oligocene?)

- **fc** Sedimentary rocks of the False Cape terrane (Miocene? to Oligocene?)

Yager terrane (Eocene to Paleocene?)

Sedimentary rocks of the Yager terrane (Eocene to Paleocene?):

- **y1** Sheared and highly folded mudstone
- **y2** Highly folded broken mudstone, sandstone, and conglomeratic sandstone
- **y3** Highly folded, little-broken sandstone, conglomerate, and mudstone
- **Ycgl** Conglomerate

-- Central belt --

Melange of the Central belt (early Tertiary to Late Cretaceous):

Unnamed Metasandstone and meta-argillite (Late Cretaceous to Late Jurassic):

- **cm1** Melange
- **cm2** Melange
- **cb1** Broken formation
- **cb2** Broken formation
- **cwr** White Rock metasandstone of Jayko and others (1989) (Paleogene and [or] Late Cretaceous)
- **chr** Haman Ridge graywacke of Jayko and others (1989) (Cretaceous?)
- **cfs** Fort Seward metasandstone (age unknown)
- **cls** Limestone (Late to Early Cretaceous)

- **cc** Chert (Late Cretaceous to Early Jurassic)
- **bs** Basaltic rocks (Cretaceous and Jurassic)
- **m** Undivided blueschist blocks (Jurassic?)
- **gs** Greenstone
- **c** Metachert
- **yb** Metasandstone of Yolla Bolly terrane, undivided
- **b** Melange block, lithology unknown

-- Eastern Belt --

Pickett Peak terrane (Early Cretaceous or older)

Metasedimentary and metavolcanic rocks of the Pickett Peak terrane (Early Cretaceous or older):

- **ppsm** South Fork Mountain Schist
- **mb** Chinquapin Metabasalt Member (Irwin and others, 1974)
- **ppv** Valentine Springs Formation
- **mv** Metabasalt and minor metachert

Yolla Bolly terrane (Early Cretaceous to Middle Jurassic?)

Metasedimentary and metaigneous rocks of the Yolla Bolly terrane (Early Cretaceous to Middle Jurassic?):

- **ybt** Taliaferro Metamorphic Complex of Suppe and Armstrong (1972) (Early Cretaceous to Middle Jurassic?)
- **ybc** Chicago Rock melange of Blake and Jayko (1983) (Early Cretaceous to Middle Jurassic)
- **gs** Greenstone
- **c** Metachert
- **ybh** Metagraywacke of Hammerhorn Ridge (Late Jurassic to Middle Jurassic)
- **c** Metachert
- **gs** Greenstone
- **sp** Serpentinite
- **ybd** Devils Hole Ridge broken formation of Blake and Jayko (1983) (Early Cretaceous to Middle Jurassic)
- **c** Radiolarian chert
- **ybi** Little Indian Valley argillite of McLaughlin and Ohlin (1984) (Early Cretaceous to Late Jurassic)

Yolla Bolly terrane

- **yb** Rocks of the Yolla Bolly terrane, undivided

GREAT VALLEY SEQUENCE AND COAST RANGE OPHIOLITE

Elder Creek(?) terrane

- **ecms** Mudstone (Early Cretaceous)

Coast Range ophiolite (Middle and Late Jurassic):

- **ecg** Layered gabbro
- **ecsp** Serpentinite melange

Del Puerto(?) terrane

Rocks of the Del Puerto(?) terrane:

- **dpms** Mudstone (Late Jurassic)

Coast Range ophiolite (Middle and Late Jurassic):

- **dpt** Tuffaceous chert (Late Jurassic)
- **dpb** Basaltic flows and keratophyric tuff (Jurassic?)
- **dpd** Diabase (Jurassic?)
- **dpsp** Serpentinite melange (Jurassic?)
- **sp** Undivided Serpentinized peridotite (Jurassic?)

KLAMATH MOUNTAINS PROVINCE

Undivided Great Valley Sequence:

- **Ks** Sedimentary rocks (Lower Cretaceous)

GREAT VALLEY SEQUENCE OVERLAP ASSEMBLAGE

Hayfork terrane

Eastern Hayfork subterrane:

- **eh** Melange and broken formation (early? Middle Jurassic)
- **ehls** Limestone
- **ehsp** Serpentinite

Western Hayfork subterrane:

- **whu** Hayfork Bally Meta-andesite of Irwin (1985), undivided (Middle Jurassic)
- **whwg** Wildwood (Chanchelulla Peak of Wright and Fahan, 1988) pluton (Middle Jurassic)
- **whwp** Clinopyroxenite
- **whji** Diorite and gabbro plutons (Middle? Jurassic)

Rattlesnake Creek terrane

- **rcm** Melange (Jurassic and older)
- **rcls** Limestone
- **rcc** Radiolarian chert
- **rcis** Volcanic Rocks (Jurassic or Triassic)
- **rcic** Intrusive complex (Early Jurassic or Late Triassic)
- **rcp** Plutonic rocks (Early Jurassic or Late Triassic)
- **rcum** Ultramafic rocks (age uncertain)
- **rcpd** Blocky peridotite

Western Klamath terrane

Smith River subterrane:

- **srs** Galice? formation (Late Jurassic)
- **srv** Pyroclastic andesite
- **srgb** Glen Creek gabbro-ultramafic complex of Irwin and others (1974)
- **srpd** Serpentinized peridotite

MAP SYMBOLS

- Contact
- Fault
- Thrust fault
- Trace of the San Andreas fault associated with 1906 earthquake rupture

Strike and dip of bedding:

- Inclined
- Vertical
- Horizontal
- Overturned
- Approximate
- Joint
- Strike and dip of cleavage

Shear foliation:

- Inclined
- Vertical

Folds:

- Synclinal or synformal axis
- Anticlinal or antiformal axis
- Overturned syncline
- Landslide

Melange Blocks:

- Serpentinite
- Chert
- Blueschist
- Greenstone
- Fossil locality and number

GEOLOGY OF THE CAPE MENDOCINO, EUREKA, GARBERVILLE, AND SOUTHWESTERN PART OF THE HAYFORK 30 X 60 MINUTE QUADRANGLES AND ADJACENT OFFSHORE AREA, NORTHERN CALIFORNIA (McLaughlin et al., 2000)