Engineering Geologic Evaluation—Revision 2

McKay Community Forest
Non-Industrial Timber Management Plan
(1-22NTMP-003 HUM)
Eureka, California

Prepared for:

County of Humboldt

January 2024
022122.200

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McKay Community Forest, Non-Industrial Timber Management Plan (1-22NTMP-003 HUM), Eureka, California

Prepared for:

County of Humboldt

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1/15/24

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QA/QC:GDS_GDS
Reference: 022122.200

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Abbreviations and Acronyms

Units of Measure

Term	Definition
mm/yr	millimeters per year

Additional Terms

Term	Definition
CAL FIRE	California Department of Forestry and Fire Protection
CCR	California Code of Regulations
CEQA	California Environmental Quality Act
CGS	California Geological Survey
County	County of Humboldt
FSP	Forest Stewardship Plan
LiDAR	light detection and ranging
MCF	McKay Community Forest
NTMP	non-industrial timber management plan
PWA	Pacific Watershed Associates
RPF	registered professional forester
THP	timber harvest plan
WLPZs	Watercourse and Lake Protection Zones

1.0 Introduction

This report presents the results of the engineering geologic evaluation of the McKay Community Forest (MCF) non-industrial timber management plan (NTMP) conducted by SHN. The intent of this report is to discuss geologic conditions and hazards within the MCF, to discuss potential impacts related to proposed management, and to provide recommendations, as necessary, to mitigate potential earth-related impacts. Ultimately, our investigation and proposed mitigations are meant to minimize the potential impacts to local watercourses with regard to management- and landslide-derived sediment.

This is the third report provided for this NTMP, as the scope of the investigation has expanded following first review and pre-harvest inspection comments from the California Geological Survey (CGS). Previous reports were dated December 13, 2021, and October 27, 2022. This report summarizes the previous reports, as well as extensive property-wide landslide mapping that occurred subsequent to the most recent report; therefore, this report is intended to replace the previous reports as a stand-alone report that is consistent with CGS Note 45 (1999), "Guidelines for Engineering Geologic Reports for Timber Harvesting Plans."

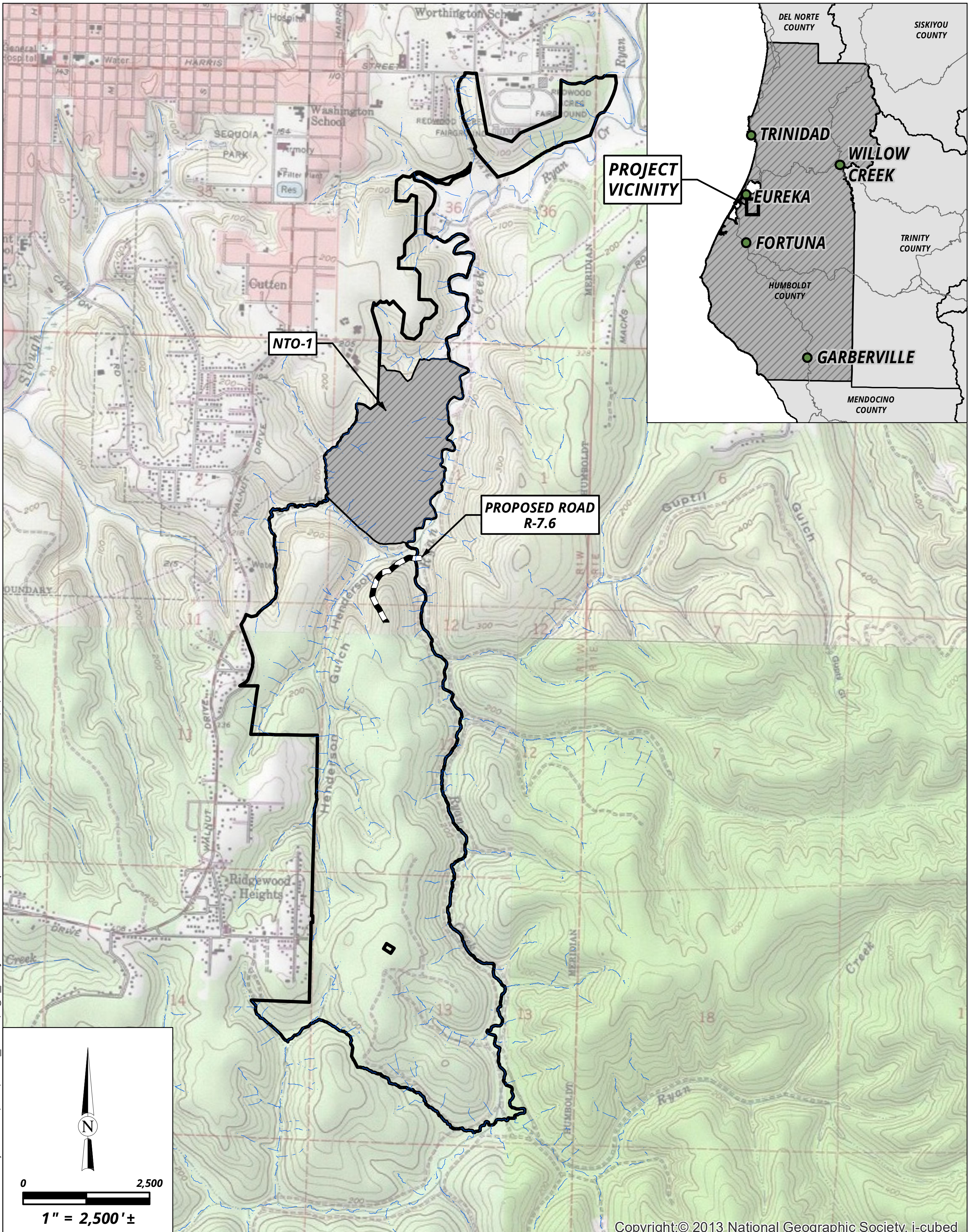
The subject NTMP is a long-term management plan; therefore, we expect the management described herein to occur over a period of many years, not all at once. Strategic management activities in specific areas in future years will be accompanied by regulatory notifications prepared by the project forester, which will require review of current conditions. This will be a necessary step for this property due to the sensitivity of the landscape and the proximity to significant fish-bearing watercourses. The initial area defined for timber management, "NTO-1," has been identified in the NTMP and is discussed in this report.

The scope of our investigation included a review of pertinent and available regional geologic maps and literature, review of an extensive record of industrial logging and associated geologic reporting, analysis of a variety of aerial imagery, site reconnaissance, and the preparation of this report presenting our observations and conclusions and intended to meet the criteria provided in CGS Note 45. Our study is inherently focused on documenting geologic and geomorphic conditions in the NTMP area, qualitatively evaluating slope stability conditions in these areas, and assessing the potential for sediment delivery to watercourses as a result of landslide processes. Included in the literature review for this NTMP was review of an extensive record of geologic reports for industrial timber harvest plans at the site, as well as a road assessment for the entire MCF (PWA, 2014).

In our report, we use the landslide terminology presented in CGS Note 50 (1997) and in Cruden and Varnes (1996). Landslide age classes used herein are based on the scheme presented in Keaton and DeGraff (1996).

2.0 McKay Community Forest

The MCF is a 1,194-acre tract of forest land owned by the County of Humboldt (County) and is located east of Eureka, California, between the community of Cutten and the Redwood Acres Fairgrounds (Figure 1). The McKay Community Forest will be managed under a Forest Stewardship Plan (County, 2022) that is intended to define the County of Humboldt's long-term goals and objectives.



County of Humboldt
McKay Community Forest NTMP
Eureka, California

Project Location Map

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Figure
1

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> "The Forest Stewardship Plan (FSP) addresses how silviculture, fire risk reduction, wildlife habitat restoration, carbon sequestration, monitoring, and adaptive management will be implemented over the term of the plan. The Forest Stewardship Plan also addresses how forest management goals, objectives and conservation measures will be integrated with other management goals and how the County intends to strive for compatibility with the neighborhoods bordering the McKay Community Forest." (County, 2022).

Further, "The McKay Community Forest will be managed for multiple purposes including public access, non-motorized recreation, timber production, fish and wildlife habitat, carbon sequestration, education and research, and soil and watershed conservation using forest stewardship principles" (County, 2022).

And finally,

> "The FSP is not a regulatory permit and is not a legally binding instrument but the proposed management activities described herein serve as the basis for the development of regulatory permits for forest management implementation. The primary regulatory permit that will govern and implement forest management on the McKay Community Forest is a Non-Industrial Timber Management Plan or NTMP, which is a technical permit and document describing how the County intends to comply with the California Forest Practice Rules and associated laws and regulations; as such, an approved NTMP is a legal document that satisfies the requirement to adhere to the California Environmental Quality Act (CEQA) and the Forest Practice Rules for projects conducted in the state of California. Information within this document will be used to prepare an NTMP." (County, 2022)

3.0 Site and Plan Description

The McKay Community Forest NTMP encompasses nearly 1,200 acres east of Eureka in Humboldt County; the area occupied by commercially valuable timber species (excluding wetlands) is 1,061 acres. The MCF is an elongate, north-south oriented area that extends across portions of the Arcata South, Eureka, and Fields Landing 7.5-minute United States Geological Survey quadrangles (see Figure 1). The area is adjacent to the Myrtletown, Cutten, and Ridgewood Heights neighborhoods, as well as the Redwood Acres facility, and occurs within the Ryan Creek watershed. Ryan Creek flows directly to Humboldt Bay.

The MCF has a long history of industrial timber management:

> "The history of logging on the MCF extends back to the 1850s and spans the use of oxen, steam donkeys, tractor skidding, and modern methods. In the early period logs were transported to Eureka Slough and rafted through Humboldt Bay to mills along the Eureka waterfront, including the Occidental Mill. Logs were conveyed by railroad to a log-dump at the foot of Park Street on Eureka Slough from the 1880s to the 1930s.

> "The ranch was converted back to forestland by planting Sitka spruce trees in the 1990s. Green Diamond Resource Company (as its predecessor Simpson Timber Company) took ownership of the McKay Tract from Louisiana-Pacific Corporation in 1998. Louisiana-Pacific was formed in 1972 through a re-organization of Georgia-Pacific Corporation, which had acquired the property from Pacific Conservation Company in 1967. Previous owners included McKay & Company (under principal owner Allan McKay) and Ryan, Duff & Company (co-owned by James Ryan) which began acquiring property in the 1850s.
>
> "Most of the old-growth forest in the McKay Tract was harvested by the 1930s. Over two-thirds of the tract was commercially thinned between 1969 and 1984, and nearly half the tract was harvested using clear-cut or shelterwood methods between 1975 and 1989. Since 1989, timber harvesting regulations and methods responded to changes in the Forest Practice Rules and adaptation of a Habitat Conservation Plan." (County, 2022).

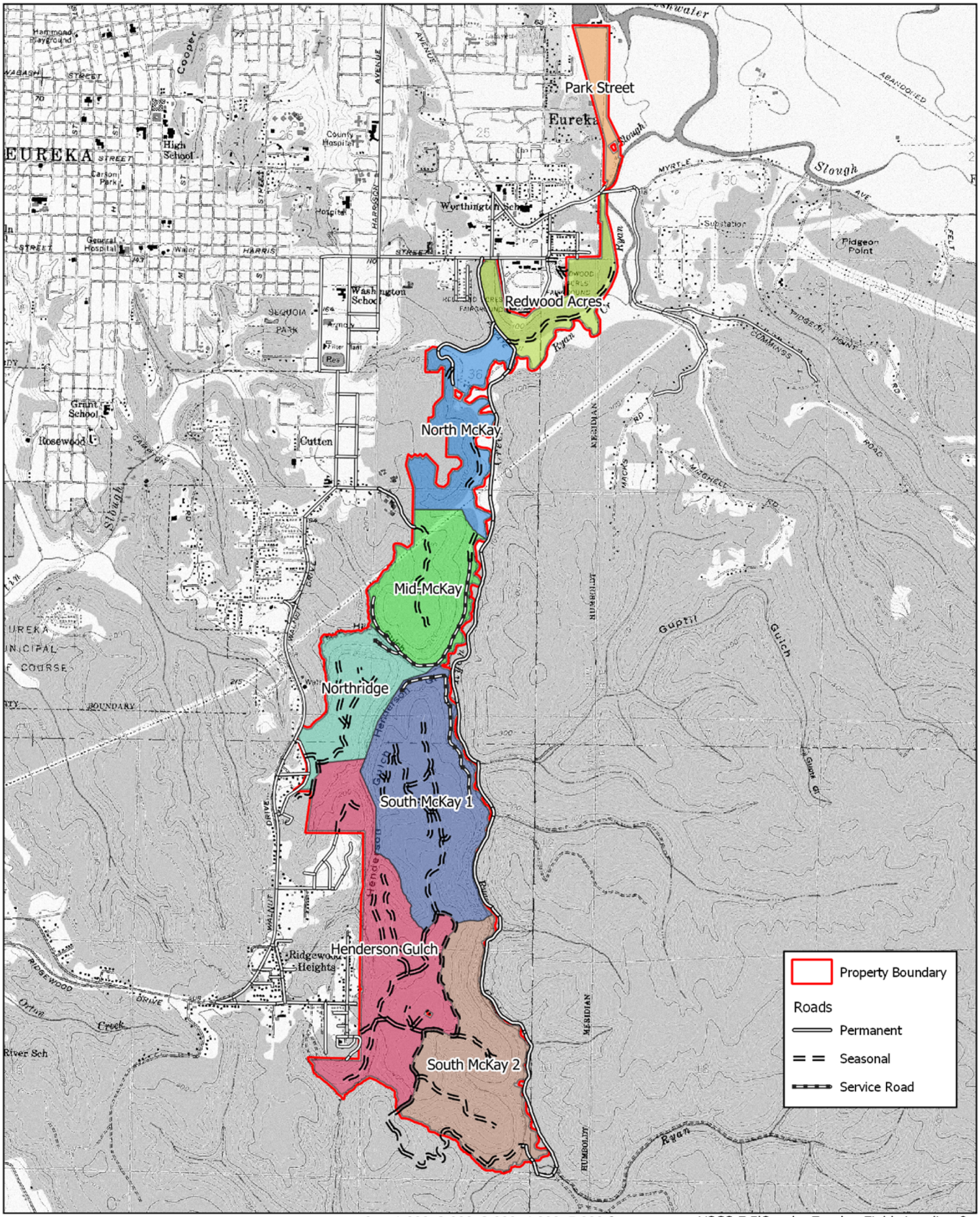
The MCF consists mostly of second- and third-growth redwood (*Sequoia sempervirens*) forest, plus wetlands and riparian lowlands. In addition to redwood, other conifer species found on the forest include Douglas-fir (*Pseudotsuga menziesii*), grand fir (*Abies grandis*), western hemlock (*Tsuga hetrophylla*) and Sitka spruce (*Picea sitchensis*).

Topography within the MCF is characterized by three distinct landforms, with flat upland plateaus, moderate to steep valley sidewall slopes, and broad floodplains along low gradient mainstem streams that lead to estuaries adjacent to Humboldt Bay. Watercourses within the NTMP area include portions of Ryan Creek, Ryan Slough, Bob Hill Gulch, and Henderson Gulch. Drainage morphology transitions through the project area, from steep-sided, narrow (V-shaped in cross-section) stream valleys in the upper watersheds and in tributary sub-basins, to the broad alluvial valley surrounding Ryan Creek. Ryan Creek has a low stream gradient to its confluence with Humboldt Bay and it follows a meandering course through terraced alluvial lowlands to get there. The annual rainfall averages 38 inches with the majority falling between November and March.

3.1 McKay Community Forest Management

For timber management purposes, the MCF has been subdivided into seven sub-units. From north to south, these are: Redwood Acres, North McKay, Mid McKay, Northridge, South McKay 1, Henderson Gulch, and South McKay 2 units. These management units reflect geographically identifiable areas with unique silviculture/yarding characteristics or specific management objectives (Figure 2).

Management of the MCF involves multiple uses that require consideration beyond timber management. The County intends to develop a network of trails for public access and recreation, some of which follow existing roads. To the extent these proposed trails occur in close proximity to unstable areas or sensitive watercourses, they are subject to regulatory review related to this NTMP (relative to the cumulative impacts assessment) and are discussed in this report. The following discussion is separated into individual sections focused on timber management and non-timber community forest uses.



0 1,000 2,000 3,000 4,000 5,000 ft

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McKay Management Units

USGS 7.5'Quads: Eureka, Fields Landing & Arcata South
Sec. 36; T5N, R1W; HB&M
Sec. 1, 2, 11, 12, 13, 14; T4N, R1W; HB&M
Contour Interval: 40 Feet

County of Humboldt
McKay Community Forest NTMP
Eureka, California

Management Units

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Figure
2

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A detailed inventory of the existing road network within the portion of the original McKay tract that later became the MCF was completed by Pacific Watershed Associates (PWA, 2014) to characterize potential sediment sources. This report was commissioned by Green Diamond Resource Company prior to selling the property to Humboldt County to establish the MCF. The 2014 PWA report was used to inform the timber road inventory in the NTMP (County, in preparation).

3.1.1 Timber Management

Following the goals and objectives of community forest management, sustainable, low-impact harvest and yarding methods will be used. The extensive existing road network will be used whenever possible to minimize impacts related to road building. It is anticipated that approximately 50 to 100 acres of MCF will be harvested annually under light to moderate harvest intensity, resulting in a 10- to 15-year management cycle. Silviculture in the MCF is proposed as selection, including both single-tree and group selection (dependent on slope, proximity to watercourses or unstable areas, and so on).

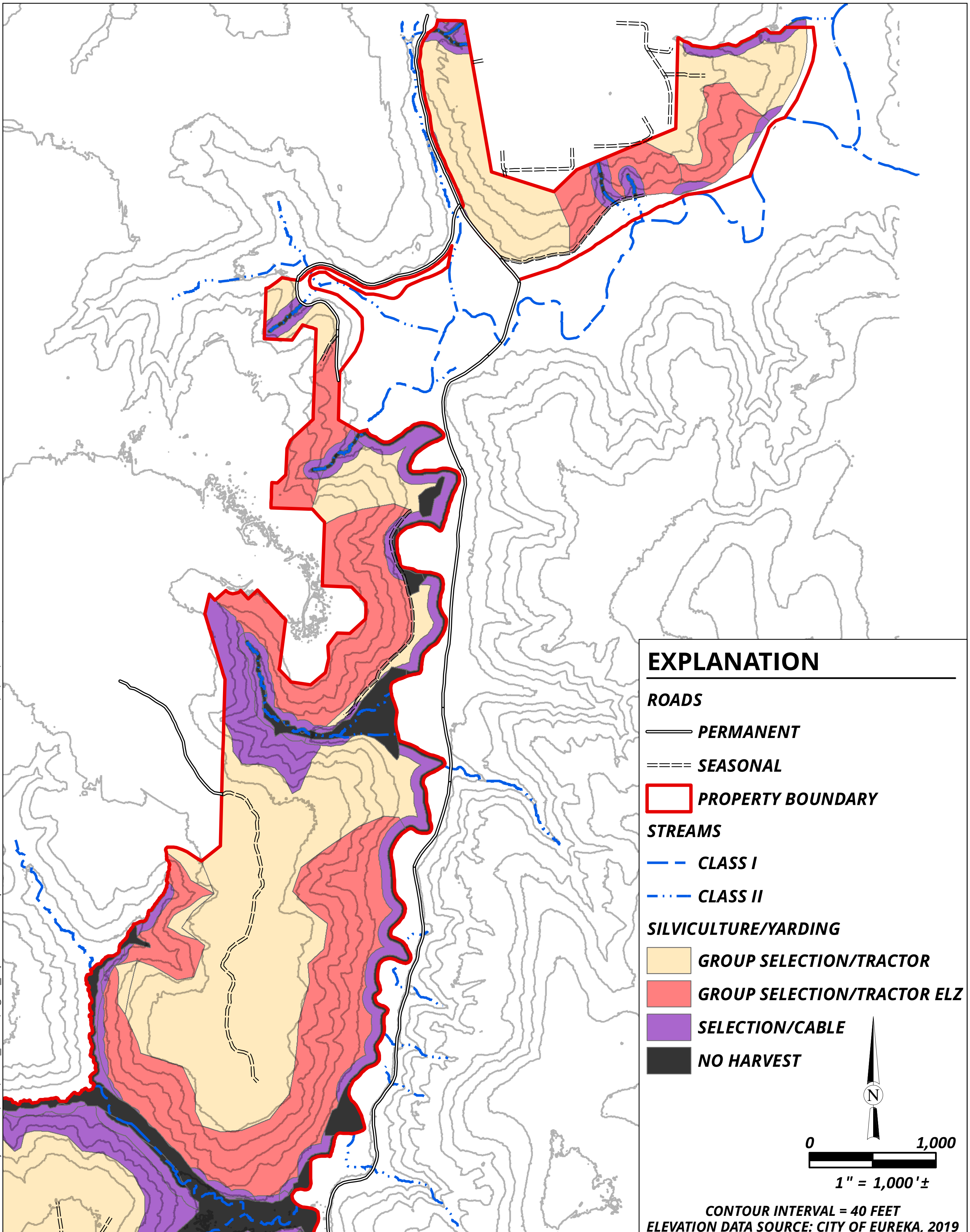
Relative to silviculture, yarding, and roads, the following prescriptions will apply within MCF (consistent with California Forest Practice Rule 2023 constraints). Maps showing the intended logging methods for the northern, middle, and southern parts of MCF are included as Figures 3a, 3b, and 3c.

At the time of this reporting, the initial timber management unit has been defined, and is discussed in this report as "NTO-1."

In all cases, if the geologic conditions are such that interpretation of geologic hazard exceeds the prudent application of the training and experience of the registered professional forester (RPF), a professional geologist will be consulted.

3.1.1.1 Silviculture

- Under the selection silviculture method, trees are removed individually or in small groups sized from one-quarter (0.25) acre to two and one-half (2.5) acres maximum. For the subject NTMP, the distribution of silviculture types reflects slope gradient, because steeper valley sidewall slopes are intended for single-tree selection silviculture (for example, no groups will be placed on steeper slopes).
- Th entire NTMP area is Site Class I; therefore, at least 125 square feet per acre of conifer basal area shall be retained as a minimum stocking standard.
- Not more than 20% to 33% of the total area harvested with the selection method under any harvest operation shall be covered by small group clearings.
- Unstable areas will be subject to single-tree selection silviculture with a required minimum retention of 150 square feet of basal area (hardwood or conifer). As most recently unstable areas are poorly stocked and/or in close proximity to streams, harvest associated with unstable areas will be extremely limited.
- The entire NTMP area has been evaluated for mass wasting potential, during previous (Green Diamond/Simpson) timber harvest plans (THPs) or by SHN during the preparation of this report, using remote analysis and field reconnaissance. In the NTMP area, most unstable areas occur within Watercourse and Lake Protection Zones (WLPZs), which offer the highest level of protection, but where they extend beyond these areas, unstable areas will be flagged. Harvest trees on unstable areas will be individually marked by the RPF.



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County of Humboldt
McKay Community Forest NTMP
Eureka, California

Operations Map North
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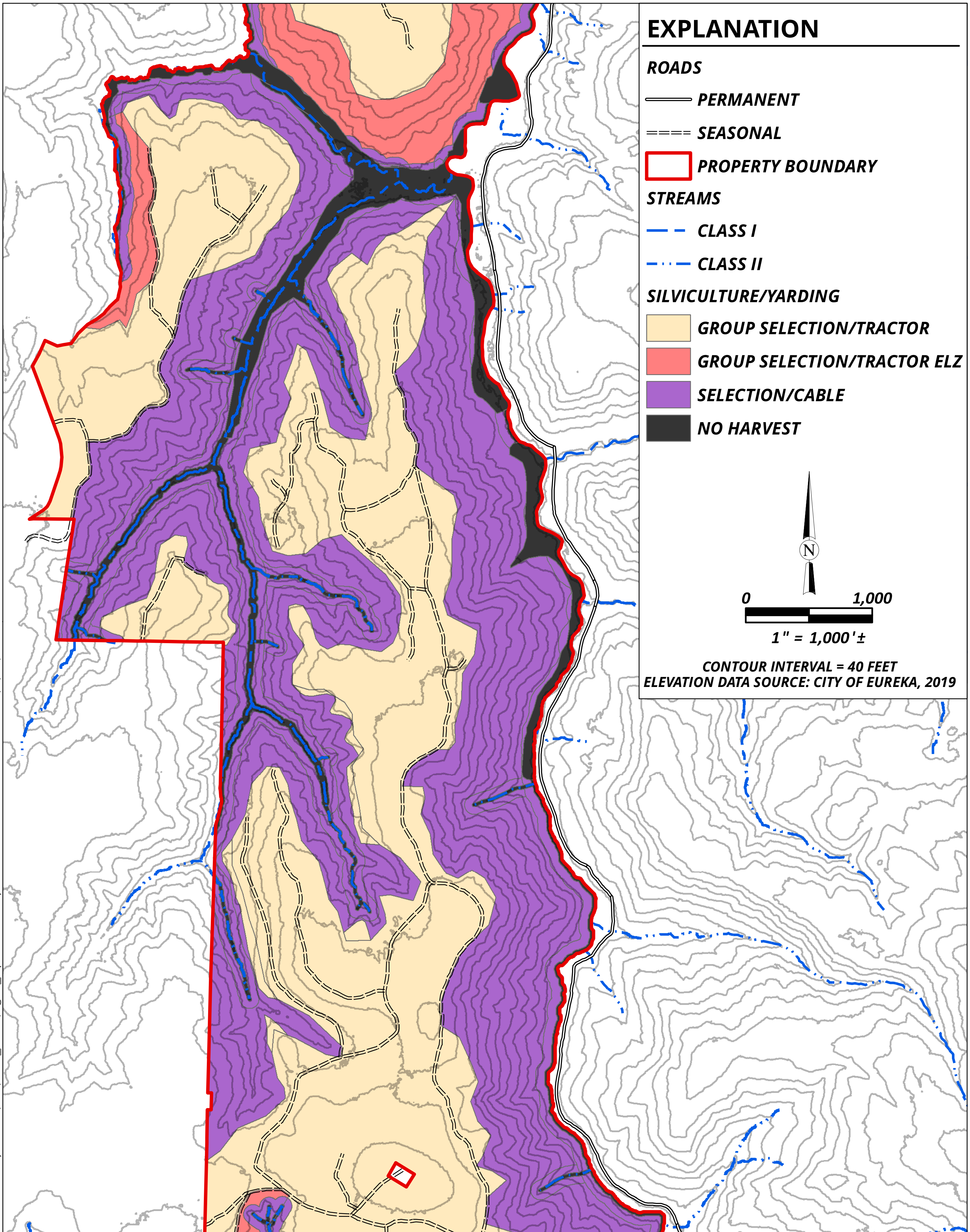
Figure 3A



County of Humboldt
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Operations Map
Middle
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Figure
3B

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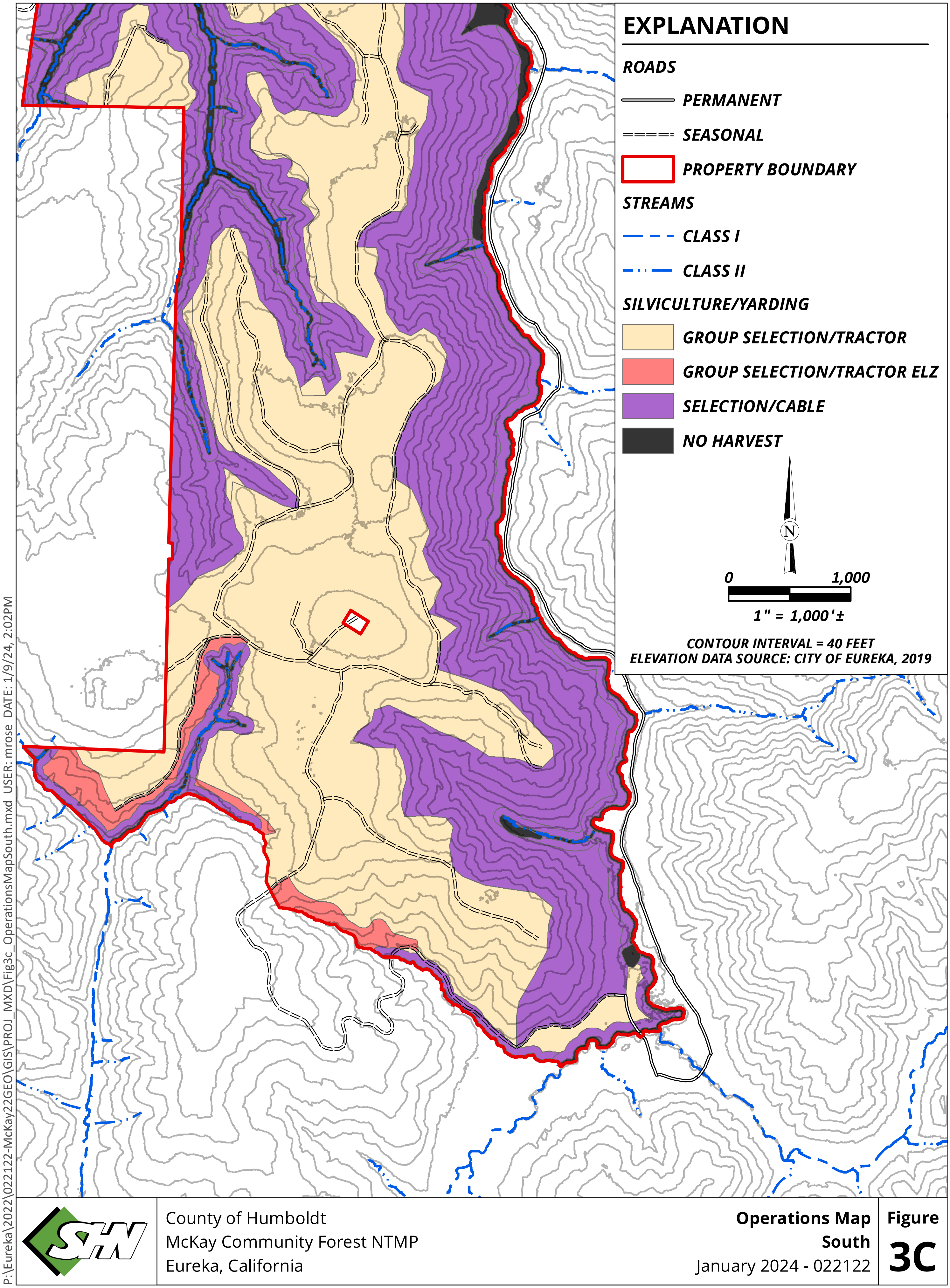

County of Humboldt
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Operations Map South

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Figure 3C

3.1.1.2 Yarding

- Heavy equipment that is equipped with a blade shall not operate on skid roads or slopes that are so steep as to require the blade to be used for braking (Generally less than a 50% slope).
- Tractor roads shall be limited in number and width to the minimum necessary for removal of logs. Existing roads or skid trails will be used whenever feasible.
- Heavy equipment shall not operate on unstable areas. If such areas are unavoidable, the RPF shall consult with a professional geologist and develop specific measures to minimize the effect of operations on slope instability.
- Tethered tractor operations are proposed as optional within tractor equipment limitations zones and cable yarding areas but shall not be used on unstable areas.
- Within areas designated as tractor equipment limitation zones, non-tethered heavy equipment shall be restricted to existing skid trails.
- Slash and debris from timber operations shall not be bunched adjacent to residual trees required for silvicultural or wildlife purposes or placed in a location where they could discharge into a Class I or II watercourse, or lake.
- Where tractor roads are constructed, only those roads shall be used for the skidding of logs to landings.
- Where water breaks cannot effectively disperse surface runoff, other erosion controls shall be installed as needed.
- In cable yarding areas, there should be no ground disturbance within unstable areas. Full suspension of logs should be achieved over unstable ground.

3.1.1.3 Logging Roads

The existing network of roads within the MCF is included as Figures 4a, 4b, and 4c.

- Logging roads and landings shall be planned and located within the context of a systematic layout pattern that considers 14 California Code of Regulations (CCR) § 923(b), uses existing logging roads and landings where feasible and appropriate, and provides access for fire and resource protection activities.
- Logging roads and landings shall be planned and located to minimize the following:
    - Duplicative roads and total road mileage
    - The number of logging road watercourse crossings
    - Construction and reconstruction near watercourses, lakes, marshes, wet meadows, and other wet areas
    - Construction and reconstruction across steep areas that lead without flattening to Class I, II, III, or IV watercourses and lakes
    - Construction and reconstruction on unstable areas or in connected headwall swales
    - Construction and reconstruction near nesting sites of rare, threatened, or endangered bird species
    - Construction and reconstruction near populations of rare, threatened, or endangered plants

- Ground disturbance and the size of cuts and fills
- The potential for affecting surface hydrology, including, but not limited to, concentrating or diverting runoff or draining the logging road or landing surface directly into a watercourse or lake

- Logging roads and landings shall be planned and located to avoid unstable areas and connected headwall swales.
- As part of the planning and use of logging roads, landings, and watercourse crossings in the logging area, the RPF or supervised designee shall 1) locate and map significant existing and potential erosion sites and 2) specify feasible treatments to mitigate significant adverse impacts from the road or landing.
- All logging road and landing surfaces shall be adequately drained through the use of logging road and landing surface shaping in combination with the installation of drainage structures or facilities and shall be hydrologically disconnected from watercourses and lakes to the extent feasible.

3.1.2 Non-timber MCF Uses

Figures 4a, 4b, and 4c include County-proposed multi-use trails (designated hiking and mountain bike trails). While the development of these community forest trails is addressed in separate environmental assessments, the potential effects relative to cumulative impacts in the context of timber management in the watershed makes these uses relevant in the assessment of this NTMP. As such, where proposed non-timber-related trails are near unstable areas or watercourses, they are discussed in this report.

Hiking and mountain bike trails are low impact uses relative to the potential for sedimentation. Narrow walking/biking surfaces require only minor cuts and have low impacts relative to topographic (or hydraulic) disruption. Where these trails may occupy existing roads or skid trails, they will allow upgrade and maintenance opportunities that do not currently exist. Heavy equipment is rarely used for trail work; lighter grade machinery or hand work is standard practice for trail work. Where existing watercourse crossings require upgrades in limited access areas, we understand that work will be completed with hand tools. Where legacy Humboldt-style log watercourse crossings are present in remote areas to be converted to trails, access limitations for mechanized equipment are a consideration relative to the feasibility of various mitigation options.

4.0 Geologic Setting

The MCF is within the Northern Coast Ranges Province of California. Northwest-trending ranges and intervening drainages reflect the dominant regional structural trend associated with this province. In the northern part of the province, where the site occurs, the structural trend is dominated by northwest-trending, southeast-dipping thrust faults that accommodate regional crustal shortening. The site is located in a complex tectonic setting just north of the Mendocino Triple Junction, the intersection of three crustal plates, and west of the Cascadia subduction zone (CSZ).

Basement rock beneath the Humboldt Bay region is the Paleocene-Eocene Yager terrane, a part of the Coastal belt of the Franciscan Complex (Blake et al., 1985; Clarke, 1992). The Franciscan Complex is a regional bedrock unit that consists of a series of "terranes," which are discrete blocks of highly deformed oceanic crust that have been welded to the western margin of the North American plate over the past

140 million years. Yager terrane bedrock is in excess of 1,000 feet below the ground surface in the vicinity of Humboldt Bay and is exposed in valley bottoms southeast of the site.

Yager terrane bedrock in the Humboldt Bay region is unconformably overlain by a late Miocene to middle Pleistocene age sequence of marine and terrestrial deposits referred to as the Wildcat Group. The marine portion of the Wildcat Group includes some 6,000 to 8,000 feet of mudstone and lesser amounts of sandstone that were deposited in a deep coastal basin (for example, the Eel River basin). Gradationally overlying the marine portion of the Wildcat Group are 2,500 to 3,250 feet of nonmarine sandstone and conglomerate, which represent the uppermost part of the Wildcat depositional sequence. The Wildcat Group is truncated at its top by an unconformity of middle Pleistocene age and is overlain by coastal plain and fluvial deposits of middle to late Pleistocene age. In the Eureka area, these middle and late Pleistocene age deposits are referred to as the Hookton Formation. Hookton Formation sediments are described as gravel, sand, silt, and clay which have a characteristically yellow-orange color (Ogle, 1953).

Along the coast of northern California between Cape Mendocino on the south and Big Lagoon, about 60 miles to the north, a sequence of uplifted late Pleistocene age marine terraces is preserved. Sea level has fluctuated throughout the late Pleistocene in response to the advance and retreat of large continental ice sheets. Marine terraces preserved along the coast represent the planar near-shore platforms eroded during the highest extent of these previous sea level fluctuations, superimposed on a coastline being uplifted by regional tectonics. Marine terraces in the region range in age from about 64,000 years old, to as much as 240,000 years old.

The City of Eureka occupies a series of northward-dipping marine terrace surfaces eroded onto the Hookton Formation. These terrace surfaces are differentiated based on subtle elevation changes, as well as increases in soil profile development within the terrace sediments of older terraces. Mapping presented in Carver and Burke (1992) suggests that the terrace along the western edge of the project area is associated with the 120,000-year-old “Savage Creek” terrace. Marine terraces in the region are typically associated with 10 to 20 feet of predominantly silty sand and gravelly sand covering the abrasion platform (for example, “marine terrace deposits” in this report).

4.1 Seismic Setting

The project site is located in a region of high seismicity; the Mendocino triple junction region is perhaps the most seismically active area in the conterminous United States (Freymueller and others, 1999; Furlong and Schwartz, 2004; Dengler, 2008). Historical seismicity and paleoseismic studies in the area suggest there are six distinct sources of damaging earthquakes in the Eureka region 1) the Gorda Plate, 2) the Mendocino fault, 3) the Mendocino Triple Junction, 4) the northern end of the San Andreas fault, 5) faults within the North American Plate (including the Mad River and Little Salmon fault zones), and 6) the Cascadia subduction zone (Dengler et al., 1992).

The most significant seismic sources relative to this site are the Little Salmon fault and the CSZ. The Little Salmon fault is the closest known active fault to the site; its surface trace is mapped approximately 3.5 miles to the southwest, although the fault dips beneath the site. The fault appears to be the most active fault in the Humboldt Bay region and is capable of generating very large earthquakes. The Little Salmon fault is a northwest-trending, northeast-dipping reverse fault (the northeast side of the fault slides up and over the southwest side of the fault along a northeast-dipping fault plane). Paleoseismic studies of the Little Salmon fault indicate that the fault deforms late Holocene sediments at the southern end of Humboldt Bay (Clarke and Carver, 1992). Estimates of the amount of fault slip for individual earthquakes along the fault range from 15 to 23 feet (4.5 to 7 meters). Radiocarbon dating suggests that earthquakes have occurred on the Little Salmon fault about 300, 800, and 1,600 years ago. Average slip rate for the Little Salmon fault for the past 6,000 years is between 6 and 10 millimeters per year (mm/yr). Based on currently available fault parameters, the maximum magnitude earthquake for the Little Salmon fault is thought to be about 7.3 (Geomatrix Consultants, 1994).

The CSZ represents the most significant potential earthquake source in the north coast region. A great subduction event may rupture along all or parts of the coast from Cape Mendocino to British Columbia and may generate an earthquake up to magnitude 9.5. Recent estimates suggest 17 earthquakes have occurred along the southern and central segments of the CSZ in the past 6,700 years, with earthquake recurrence on the order of 510 to 540 years (Nelson et al., 2021). The most recent major CSZ earthquake occurred on January 27, 1700, and is interpreted as a greater than M9 full-length CSZ rupture. That earthquake is documented in local native tribal oral history and in Japanese historical tsunami records and is documented in the field by land level changes from California to British Columbia (Atwater et al., 2005).

Other significant nearby faults within the northwest-trending fold-and-thrust belt include the Freshwater fault, about 3 miles northeast of the MCF, and the Fickle Hill fault, the nearest fault within the "Mad River fault zone," which is about 6 miles northeast of the site. The Freshwater fault is not considered an "active" fault by the State; the Fickle Hill fault, as with other faults in the Mad River fault zone, are considered to be active (rupture event in past 11,000 years).

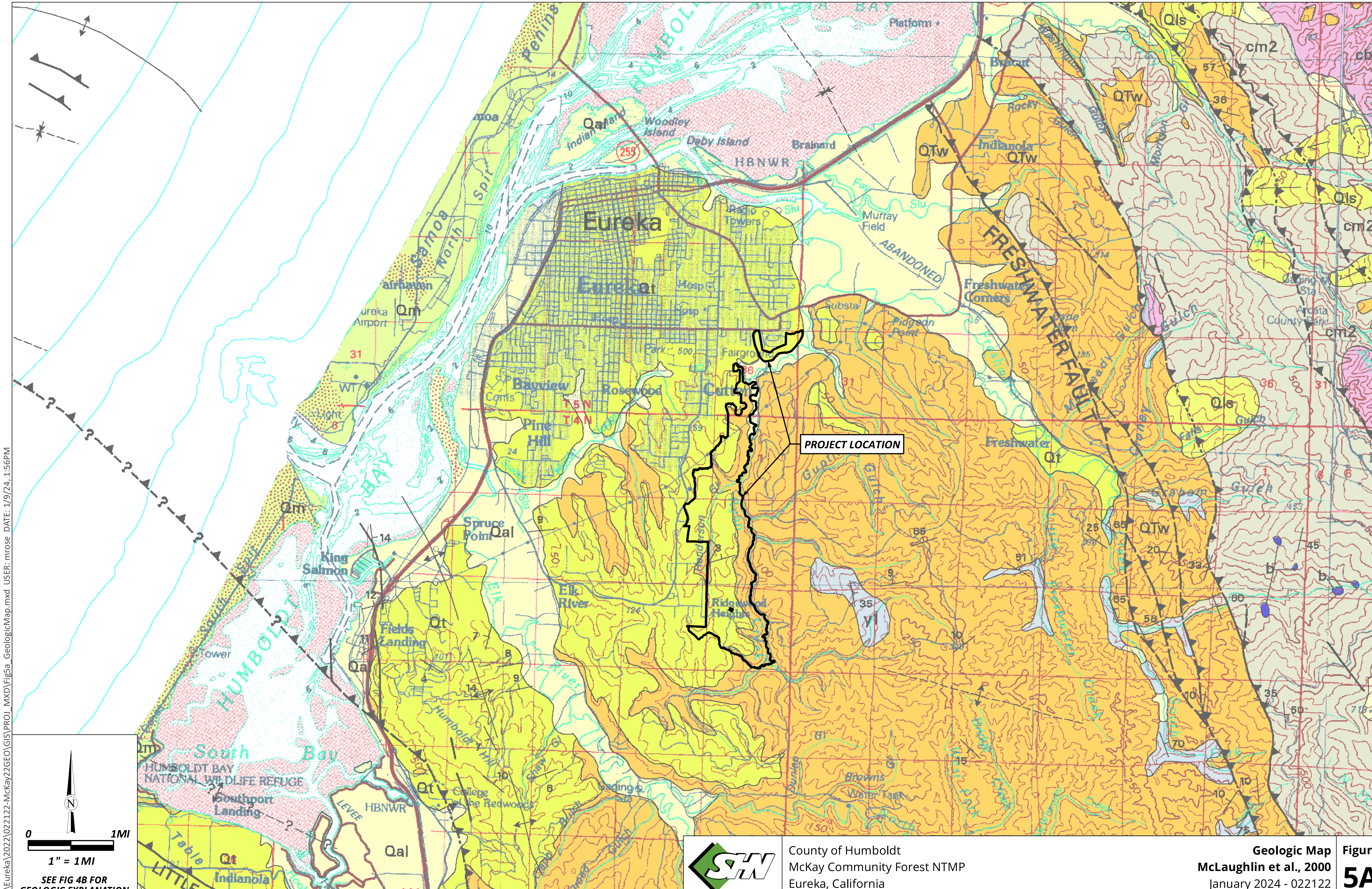
Due to the location of the project, it is inevitable that slopes within the NTMP area will be subject to ground shaking sometime in the future—conceivably, in the near future.

4.2 Site Geology

Published mapping shows that the MCF is underlain by a layered sequence of Tertiary to Pleistocene age units, each separated by an erosional contact (unconformity) that represents a gap in geologic time (Figure 5). The lowest unit exposed in the MCF is the "undifferentiated" Wildcat Group (Ogle, 1953; Kilbourne and Morrison, 1985). The Quaternary to Tertiary aged Wildcat exposed in the Ryan Creek watershed is typically described as massive to poorly bedded, blue-gray compact clayey siltstone and silty claystone with thin sandy interbeds. This unit underlies the lowland areas and valley sidewall slopes; the presence of this fine-grained material in these areas is a major consideration relative to management of the MCF and the potential for sediment impacts in area watercourses.

Overlying the Wildcat Group and mantling the interfluvial ridges is the early to middle Pleistocene age Hookton Formation (Ogle, 1953; Kilbourne and Morrison, 1985). The Hookton Formation occurs as a relatively thin interfluvial mantle of generally sandy, gravely, shallow marine sediments with dense soil consistency. This material is apparent on upper valley sidewall slopes.

The contact between the Wildcat and Hookton formation sediments is apparent in the field, based on differences in rock type and consistency, and forms a distinct hydraulic boundary (aquitard) that restricts the downward flow of groundwater (the Wildcat sediments are less permeable than the surficial Hookton Formation). Groundwater tends to flow laterally toward valley wall slopes, where it emerges as common seeps and springs. This interface is the primary generation point for debris sliding and mass wasting throughout the watershed.



County of Humboldt
McKay Community Forest NTMP
Eureka, California

Geologic Map
McLaughlin et al., 2000
January 2024 - 022122

Figure
5A

GEOLOGIC MAP EXPLANATION

QUATERNARY AND TERTIARY OVERLAP DEPOSITS

Qal — **Alluvial deposits (Holocene and late Pleistocene?)**-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

Qm — **Undeformed marine shoreline and aolian deposits (Holocene and late Pleistocene)**-Gravel and sand deposited in marine terraces, on benches, and on dunes along present shorelines. In northern Eureka quadrangle, near Arcata, includes older late Pleistocene dune sands (Carver and others, 1984)

Qt — **Undifferentiated nonmarine terrace deposits (Holocene and Pleistocene)**-Dissected and (or) uplifted gravel, sand, silt, and clay, deposited in fluvial settings. In western Eureka quadrangle (Sheet 1) unit includes minor shallow marine intertongues and warped and tilted beds of late Pleistocene Hookton and Rohnerville Formations of Ogle (1953), in addition to younger late Pleistocene and Holocene fluvial terrace units a few feet to a few tens of feet higher than normal modern high-water level

QTw — **Marine and nonmarine overlap deposits (late Pleistocene to middle Miocene)**-Thin-bedded to massive, weakly lithified siltstone, fine- to medium-grained sandstone, silty to diatomaceous mudstone and locally soft, scaly mudstone. Locally includes lenses of pebble to boulder conglomerate, carbonate concretions, abundant molluscan fossils, woody debris, and horizons of rhyolitic volcanic ash that are greater than 1 meter thick in some areas. Includes the Wildcat Group (Ogle, 1953), the Bear River beds (Haller, 1980), and related outlier Neogene deposits isolated along faults near Briceland, Garberville, Benbow, Piercy, Bridgeville and northeast of Weott. Unit also includes minor fault-bounded blocks along or near the coast between Bear River and the Mattole River that are incorporated into melange of the Coastal terrane; the Neogene Falor Formation northeast of Eureka (Manning and Ogle, 1950); and equivalent deposits in the offshore area deposited in shelf, slope, and slope basin settings. A few poorly exposed erosional remnants of shallow marine to brackish water strata mapped along high ridge crests overlying the Franciscan Complex in the 1:24,000 Zenia quadrangle are tentatively assigned to this unit. South of this map, unit correlates with valley-fill, perched gravel and shallow marine to nonmarine coal-bearing sedimentary rocks of Quaternary and Tertiary age in the Round Valley area of Covelo 1:100,000 quadrangle (Jayko and others, 1989)

Yager terrane (Eocene to Paleocene?)

Sedimnetary rocks of the Yager terrane (Eocene to Paleocene?)-Argillite and arkosic sandstone rhythmically interbedded, thin to medium bedded; massive to thickly bedded arkosic sandstone with minor interbeds of argillite; and minor lenses of polymict boulder to pebble conglomerate. Southwest of Garberville, unit highly folded, but locally may be penetratively sheared or broken. Argillite and interbedded fine-grained sandstone is commonly calcareous and may have abundant plant debris in places. Sandstone characteristically contains prominent detrital muscovite. Based on fossil dinoflagellates and on spores and pollen from carbonate concretions in argillite, age of terrane is late to middle Eocene. Locally the lower beds of the terrane may be as old as Paleocene (McLaughlin and others, 1994). The Yager terrane is divided into 3 subunits based principally on topographic expression in aerial photographs and outcrop data:

y1 — **Sheared and highly folded mudstone**-Includes minor rhythmically interbedded sandstone, locally with lenses of conglomerate. Exhibits irregular topography lacking a well-incised system of sidehill drainages

y2 — **Highly folded broken mudstone, sandstone, and conglomeratic sandstone**-Exhibits topography with sharp ridge-crests and well-incised sidehill drainages

y3 — **Highly folded, little-broken sandstone, conglomerate, and mudstone**-Exhibits sharp-crested topography with a regular, well-incised system of sidehill drainages

cm2 — **Melange**-Subequal amounts of metasandstone and meta-argillite. Exhibits irregular topography that lacks well incised sidehill drainages, but is less lumpy than unit cm1

MAP SYMBOLS

Contact-Dashed where approximate, dotted where concealed, queried where uncertain

Fault-Dashed where approximate, dotted where concealed, queried where uncertain

Thrust fault-Barbs on upper plate, dashed where approximate, dotted where concealed, queried where uncertain

Trace of the San Andreas fault associated with 1906 earthquake rupture-Dashed where approximate, queried where uncertain

Strike and dip of bedding:

Inclined-Ball denotes top of beds is known from sedimentary features

Vertical-Ball denotes top of beds is known from sedimentary features

Horizontal

Overturned-Ball denotes that top of beds is known from sedimentary features

Approximate-Based on photo interpretation or estimated dip in field

Joint-Strike and dip of joint

Strike and dip of cleavage-Ball denotes that top of flow is known from sedimentary or volcanic features

Shear foliation:

Inclined

Vertical

Folds:

Synclinal or synformal axis-showing direction of plunge

Anticlinal or antiformal axis-showing direction of plunge

Overturned syncline

Landslide-Arrows indicate direction of movement (Qls)

Melange Blocks:

Serpentinite

Chert

Blueschist

The site occurs along the eastern edge of the late Pleistocene age marine terrace underlying most of Eureka and extending beneath the Cutten and Ridgewood neighborhoods. A thin veneer of marine terrace sediments underlies the flat interfluvial plateaus that occur in the upland areas throughout the site.

Recent alluvium and stream channel deposits occur adjacent to floodplain terraces within the Ryan Slough, Henderson Gulch, and Bob Hill Gulch watersheds.

The low-angle bedding in the area is broadly warped across an east-west-trending anticline (Kilbourne and Morrison, 1985).

5.0 Slope Stability

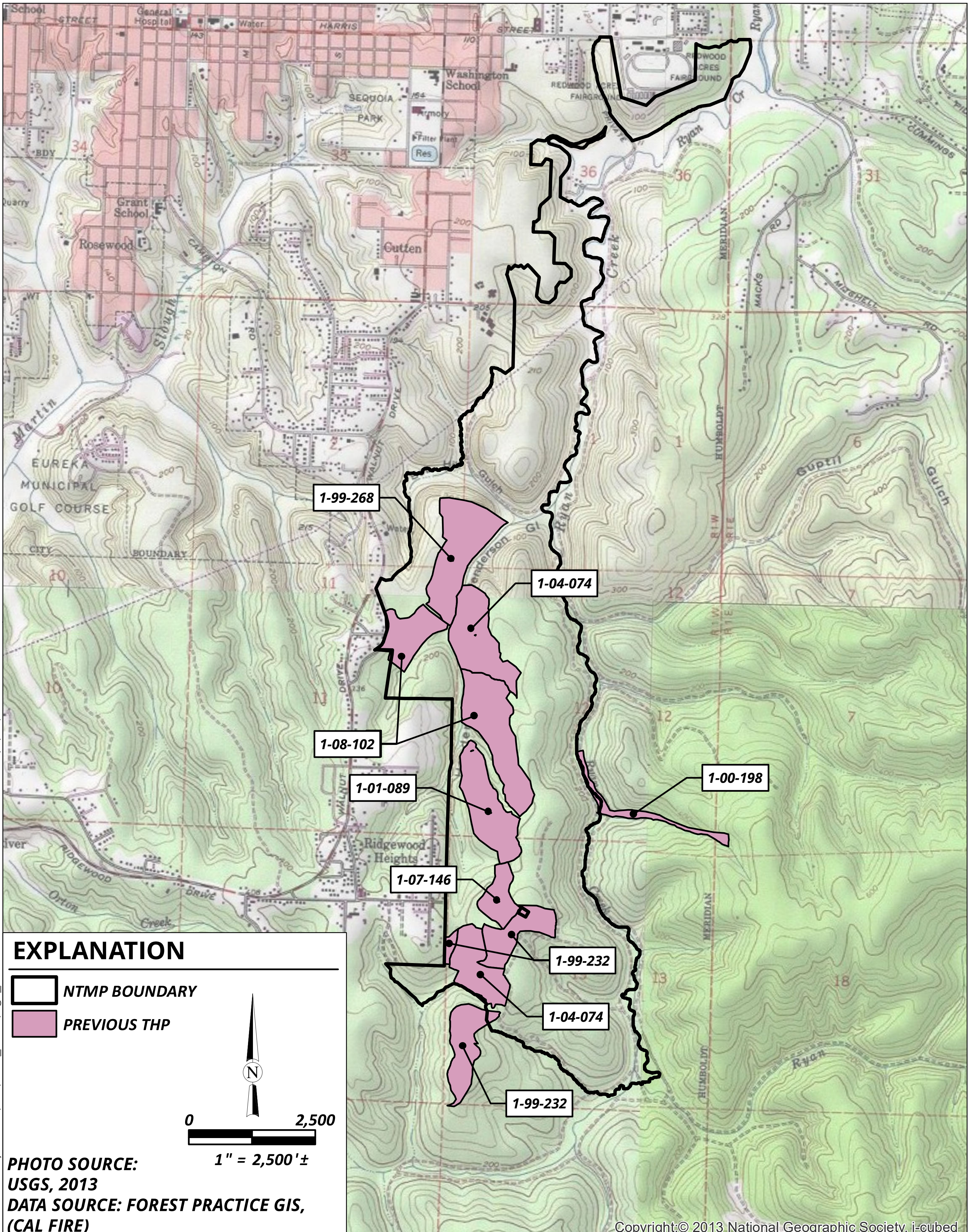
Because of the long history of industrial logging on the site, there is a significant record of geologic investigations within MCF. We reviewed at least 11 previous timber harvest plans (see Figure 6) that included mapping of "unstable areas" by professional geologists and registered professional foresters (as permitted under the Forest Practice Rules). Significant additional field mapping was completed during the completion of this investigation.

Published geomorphic (landslide) maps for available portions of the MCF (Fields Landing and Arcata South quadrangles) show debris slide slopes on the valley walls along major tributaries of Ryan Creek and Henderson Gulch. A "debris slide slope" is defined as a geomorphic feature characterized by steep slopes sculpted by numerous coalescing debris slides over geologic time. It does not imply the presence of active mass wasting, but rather the presence of a landform that reflects past landsliding. Few "active" slides are shown, all of which are small features.

The NTMP area is underlain by unique topographic and geologic conditions relative to those present throughout much of Humboldt County—a modest-relief landscape underlain by uniform, layered sedimentary materials. By extension, the slope stability conditions are relatively uniform, given that they are closely tied to slope and the nature of the underlying earth materials.

The NTMP-area spans a significant portion of the west bank of the lower reaches of Ryan Creek, as well as most of the Henderson Gulch watershed. The downstream reaches of Ryan Creek within the NTMP area transition into Ryan Slough and meander through a broad, low gradient floodplain, essentially the outer fringes of the Humboldt Bay estuary. To the south, the upstream reaches of the streams incise into a Pleistocene-age plateau underlain by two distinct stratigraphic units, the Hookton Formation and underlying "undifferentiated" Wildcat Group.

From a geologic standpoint, the Pleistocene-age plateau that defines the uplands and the subsequent incision of Ryan Slough and its tributaries is a relatively "recent" occurrence, in response to long-term tectonic uplift. As such, the geomorphic condition of the watersheds can be defined as somewhat "immature" and in a state of youthful evolution as a dendritic drainage pattern develops (through a thick, layered sequence of uniform, mostly fine-grained, moderately consolidated siltstone and sandstone). In this environment, primary Class I and II streams and tributaries are bordered by short, steep, closely spaced sub-basin canyons with narrow interfluvial ridges. These steep-sided, sub-basin canyons are forming at high angles (near-perpendicular) to the main streams and are, therefore, associated with steep stream gradients.



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County of Humboldt
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Previous THPs

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Figure 6

Upland slopes grade from flat to moderately sloping across the broad plateaus, but stream sidewalls typically become increasingly steep, especially in close proximity to the larger tributary streams. Due to the broad alluvial plain bordering the main Class I streams, especially in the northern part of the NTMP-area, mass wasting rates are generally low on adjacent slopes. In the many relatively short, steep-sided tributary canyons, however, debris slide potential becomes relatively high on steeper streamside slopes. The contact between Wildcat Group sediments and the overlying Hookton Formation at the heads of these tributary canyons is a frequent source of debris sliding.

Stream channels in the upper reaches of many of the tributary canyons have incised, presumably due to regional tectonic uplift and/or disruption by tractors and in-channel yarding during early logging. In these areas, a narrow inner stream valley occurs with near-vertical sidewalls that are subject to a high concentration of streamside landslides. Most of the stream channels in the tributary canyons maintain large accumulations of woody slash and debris from historic logging, and “subterranean” flow is occurring where the actual stream grade is buried.

It is worth noting that the MCF is a coastal watershed that is highly sensitive to long-term geologic conditions related to sea level changes. Through the late Pleistocene, sea level rose and fell by large amounts (hundreds of feet) during glacial periods (low sea level) and in the intervening interglacial periods (high sea level). During periods of low sea level, the coastline migrates westward (several miles during the last low sea level period >20,000 years ago) and stream base level in coastal watersheds drops significantly. Incision, increased stream power, and elevated levels of mass wasting would be expected during these periods. Alternatively, during periods of high sea level, base level for coastal streams would rise, stream gradients would decrease, and streams would lose stream power and begin to fill their canyons. Since about 6,000 years ago, sea level has been at its current, relatively high level, as we are experiencing a high sea level period. This would explain the presence of relatively small (meager) stream channels within relatively large, steep-sided tributary canyons (they were presumably formed under more erosive conditions during periods of low sea level).

The impacts of previous forest management at the site are the result of the coincidence of prolific redwood producing ground, the proximity to Eureka, and the ease of grading and developing skid trails in the moderately consolidated sedimentary rocks. The impacts are visible throughout the area; the concentration of skid trails across the entire landscape is very high. Skid trails are visible on the light detection and ranging (LiDAR) imagery throughout the area in very high detail; the “textured” appearance of the ground surface in the high-resolution imagery is due to the large number of intersecting trails. Skid trail remnants are apparent on all slopes, from top to bottom, and it appears that tractor use and yarding occurred in many stream channels. From a mass wasting standpoint, the primary lasting (sediment-related) impact of tractors on the landscape appears to be the result of disturbance along stream channels and along adjacent streamside slopes.

In the field (and aerial photography), recently unstable areas are notable for their obvious vegetation contrast marked by the absence of conifer and the abundance of, specifically, alder patches. Every recently unstable area we observed in the field was characterized by distinct canopy breaks and an apparent concentration of alder. This key characteristic was discussed in the field with the RPF and County staff, who are aware of this pattern.

Slope height and steepness both increase in the southern part of the NTMP area, both of which elevate the potential for near-stream debris sliding. South of the confluence of Henderson Gulch and Ryan Creek, the elevation of the upland plateau increases relative to stream grade and the gradual upstream incision in the watersheds increases the depth of the stream valleys and the height of the adjacent valley walls. The geomorphic development and expression of this area appears to reflect increased bedrock consolidation within the lower units of the undifferentiated Wildcat (underlying Yager Fm. bedrock outcrops just east of the NTMP-area), as slopes in this area increase significantly in steepness but retain relatively planar morphology.

We did not observe evidence of large, active (or recently active) deep-seated landslides in the NTMP-area, nor is there apparent visual evidence in available aerial or remote sensing imagery. There does not appear to be a significant potential for deep-seated landsliding in this area under the current conditions. Through recent geologic history, it is likely that larger scale landsliding would occur coincident to periods of low relative sea level, when stream base level would have been significantly lower. Where older (dormant-mature age) landslides occur in the landscape, they have been largely over-printed by more recent debris slides and are no longer relevant to current land management. Speculative interpretations of large, older slides are not included on the landslide maps in this report.

5.1 Aerial Photograph Review

In order to evaluate historical landsliding and land use conditions in the NTMP area, we reviewed existing timber harvest evaluations and reviewed limited available aerial imagery, online imagery, and topographic maps. Due to the size of the MCF, an initial preliminary reconnaissance-level evaluation was completed for the entire area.

We reviewed stereo pairs from 1942, 1948, 1954, 1962, 1981, 1984, 1988, 1996, and 2000, from the aerial photograph archive at the CGS Eureka office.

- The 1942 photos show no indication of active logging activity although it is apparent that most, if not all, old growth forest has been removed. Evidence of recent logging is apparent in the southwestern part of the MCF. A ranch house is present in the watershed and a north-south road runs the length of Ryan Creek. Development in Cutten is sparse, and there is little development in Ridgewood. An early oval track is visible at Redwood Acres at the north end of the MCF. There is no visible recent landslide.
- The 1948 aerial photos show an absence of notable management or timber harvest in the project area. There is no visible landslide. There continues to be development in Cutten, and additional roads are appearing in Ridgewood.
- The 1954 photos show no apparent management or harvest in the MCF area. There is no visible recent landslide. Cutten is becoming more substantially developed and the first homes appear in Ridgewood.
- In the 1962 photos, timber harvest is apparent along the western edge of the MCF, just east of Beechwood Drive and Home Avenue in the Ridgewood area. A network of skid trails is apparent. No other management is apparent in the MCF; no landslide is visible. A southwest-northeast trending utility corridor has been developed by this time.
- The 1981 photos show the introduction of industrial logging to the area. Numerous active and recent harvests are apparent. Several clear cuts are apparent. There is active road and skid trail use in many areas of the watershed. Several small landslides are apparent because the removal of canopy allows observation of streamside areas that were previously covered by canopy.

- The 1984 dataset shows continued logging in the watershed. Areas in close proximity to the residential interface are being selectively logged. Road and skid trail use is continuing during this period throughout the area.
- Substantial areas within the watershed are being logged during the 1988 photo period. Clearcutting is widespread, even in steeper areas. Tractor and cable yarding are both occurring at this time.
- By 1996, the level of harvest is substantially reduced—most of the area appears to have been cut over. The road network throughout the watershed is extensive and highly visible. No significant landsliding is apparent.
- The 2000 dataset shows a clear-cut harvest area on the flat terrace surface southeast of Ridgewood but little other management. Most of the watershed appears to be in a state of regrowth and recovery.

5.2 Results of Field Mapping of Landslides

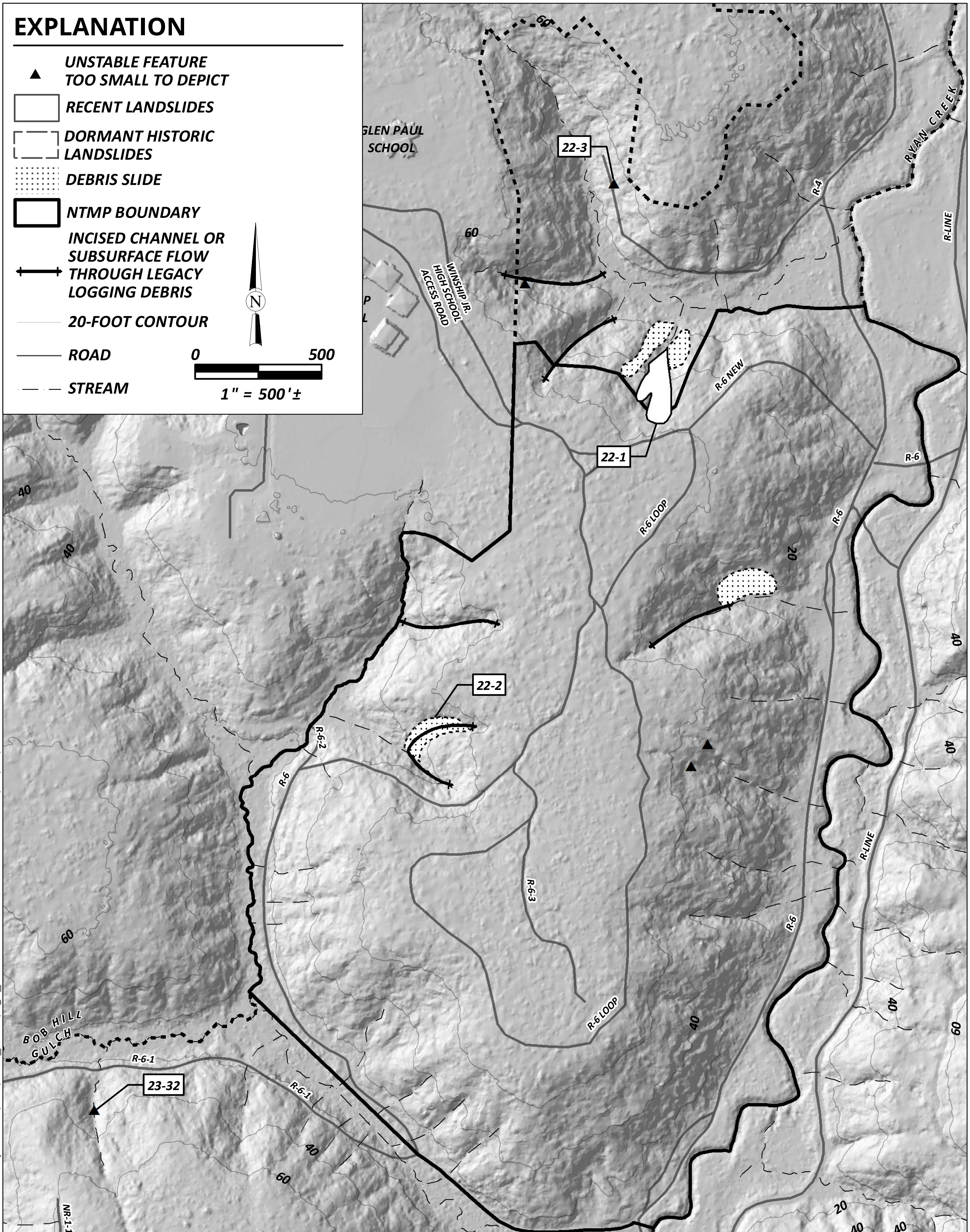
SHN completed a comprehensive assessment of the entire NTMP area using a variety of aerial and remote sensing (LiDAR) imagery to evaluate existing and potential unstable ground. To complete this task over the 1,194-acre area, we compiled landslide mapping from previous geologic investigations (from past harvest planning; see Figure 2), reviewed aerial images from multiple years, and interpreted high-resolution LiDAR imagery at multiple scales and hillshade aspects. Areas identified during the aerial mapping as likely unstable areas, not associated with a previous THP area, were visited in the field. Focused reconnaissance of the initial harvest area, NTO-1, was completed. Information from the mapping and documentation of these landslides is included in a Landslide Inventory Table (Appendix 1), and GIS shapefiles have been created for all unstable areas.

Unstable areas mapped and described in geologic reports from previous THP's were reviewed in the field by the RPF to evaluate for changed conditions (specifically, activity subsequent to the THP). These areas represent ground previously evaluated by geologists, and reviewed during PHI's; therefore, focused review by the RPF is appropriate. Where areas of recent landsliding or questionable conditions were observed by RPFs, SHN was notified, and these sites were visited by the project engineering geologist.

General management measures relative to unstable areas are discussed above in sections describing Silviculture (3.1.1.1), Yarding (3.1.1.2) and Logging Roads (3.1.1.3) and includes recommendations for avoidance of unstable areas and reduced harvest levels. Additional site-specific recommendations are included below, as appropriate.

5.2.1 NTO-1

We completed reconnaissance of the initial proposed harvest area (NTO-1) on July 14 and 25, 2022. A map of the area is included as Figure 7. NTO-1 occupies the area west of Ryan Creek and north of the confluence with Henderson Gulch. Bob Hill Gulch flows along the west side of the area and joins Henderson Gulch at the southern end of the unit. The area is directly southeast of Winship Middle School. NTO-1 occupies most of the "Mid-McKay" management unit (Figure 2).



County of Humboldt
McKay Community Forest NTMP
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NTO-1

January 2024 - 022122

Figure 7

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The central portion of NTO-1 is a broad plateau that extends to the northwest as a continuation of the terrace beneath Winship School and the Cutten area. The unit is largely surrounded by the stream valley walls leading to Ryan Creek, Henderson Gulch, and Bob Hill Gulch.

Existing roads within NTO-1 (the R-6 network) include a loop around the perimeter of the upper plateau surface, a road descending to the valley floor in the western part of the unit, and a road around most of the unit at the base of the valley wall slopes along the edge of the broad floodplains associated with Ryan Creek, Henderson Gulch, and Bob Hill Gulch. We understand the road segment that descends from the plateau to the valley bottom in the western part of the unit will be converted to a trail, and that the road segment at the valley bottom is proposed to be reconstructed to continue serving as a logging road. A new segment of logging road ("R-6 New") is proposed in the northeastern part of the unit.

Field stationing described herein is shown on Figure 7.

Station 22-1: A recent debris slide occurred at this site on the valley wall slope at the northern edge of NTO-1. This slide was observed by County staff shortly after the failure (sometime in the past few years). The raw head scarp of the slide is just over 20 feet high, and the slide is about 30 feet wide. The slide occurs at the edge of the upland plateau; the slope below is relatively steep, and the slide debris continued downslope for about 100 feet. The toe of the slide debris was still visible and back-tilted saplings were noted that had not yet straightened. Sandy Hookton Formation sediments with notable shell fragments are present in the head area of the slide. The continuation of the slide downslope from the head is well-expressed by clear lateral margins with intact conifer outside the immediate disturbed area. The height of the head scarp and steep gradient of the failure plane suggest a translation component to this failure.

A dormant-historic rotational failure was noted downslope of the head of the recent debris slide, adjacent to the east side of the toe of the feature. The older rotational failure was associated with a broad, 20+-foot-high scarp whose height and steepness had been affected by a skid trail across the slide body. The slide area was notable for the absence of significant conifer.

Adjacent stream canyons just west of Station 22-1 are outside of NTO-1 but are similar incised tributaries whose headwalls are relevant relative to the proximity to the proposed access road (R-6) from Winship Middle School.

Station 22-2: The two significant stream canyons along the western margin of NTO-1 are associated with planar sidewalls and distinct, incised stream channels in the headwall area. The incised channel at Station 22-2 is associated with steep (near-vertical) streamside slopes that form a narrow, shallow inner valley at the bottom of the larger stream valley. The channel and inner stream valley are choked with logging debris in many areas. Steep slopes lining the inner valley are susceptible to debris sliding; these occur well within the riparian corridor.

There are a series of closely spaced streams that drain the southern part of the headwall slope of the broad drainage at Station 22-2. These shallow, low gradient streams cross the descending segment of Road R-6, which we understand will be converted into a trail. These streams do not appear related to an unstable area, and do not pose a mass wasting concern; but they do represent a drainage consideration relative to trail development and maintenance (see Road Points 847 and 848 on Figure 4a).

Remainder of NTO-1: Slopes along the southern end of NTO-1 are generally of modest gradient, are marked with old growth stumps throughout, and have been heavily modified by past tractor use. The density of skid trails on this ground is very high; most existing trails largely maintain their shape.

An 8- to 10-foot-high vertical cut slope is present along the southern end of the unit and exposes relatively well-consolidated, fine-grained sandstone. The material is barely friable.

Drainage sub-basins on the east side of NTO-1 were evaluated where LiDAR imagery suggested possible debris slide slopes. Several of these areas were found to be largely benign, with steep planar slopes but not apparent recent landsliding. Steep headwall areas with very localized slide potential were observed, but unstable areas did not appear to persist downstream. Localized areas of debris sliding are mapped along the eastern slope of the NTO-1 area.

Overall, mass wasting potential in NTO-1 appears low. The unit is most notable for the number of old growth stumps and remnant skid trails, both of which occur in abundance throughout the area. Cut slopes on old skid trails generally retain their original condition with no significant erosion or debris sliding.

Road R-6: Where Road R-6 occurs on low gradient upland slopes, it is associated with very low erosion and mass wasting potential. Where the road approaches the heads of the gullies near Station 22-1, near Winship Middle School, a setback should be maintained (discussed below).

Proposed road segment "R-6 New," in the northeastern part of NTO-1, follows moderate gradient slopes that are not associated with any apparent mass wasting features. This appears as a reasonable, low-risk road alignment with a low potential for mass wasting-related impacts.

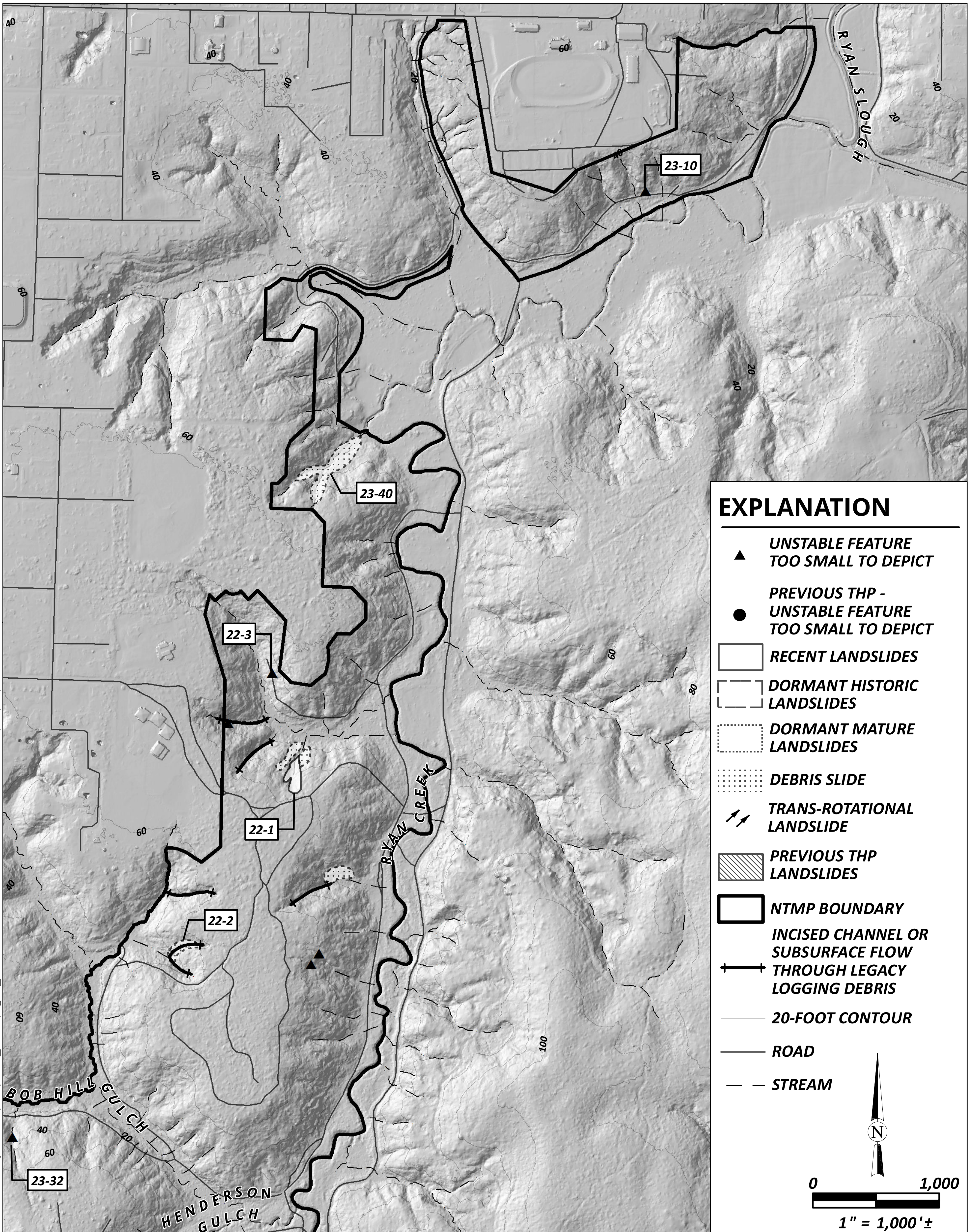
Along the lowland slopes at the base of NTO-1, the existing Road R-6 surface follows alluvial terraces along the back-edge of the Ryan Creek floodplain or is partially inset into the base of the slope. The road is essentially flat, or of very low gradient, and largely unmaintained; it is significantly potholed and poorly drained. We understand the road will be rebuilt, which appears reasonable from an engineering geologic standpoint. The lowland portions of Road R-6 are not affecting upslope areas and are largely benign relative to the mass wasting processes occurring in the watershed at this time.

Recommendations for NTO-1:

- Apply the unstable area, WLPZ, and steep slope provisions outlined above (Sections 3.1.1.1, 3.1.1.2, and 3.1.1.3) to the unstable areas in NTO-1; we expect these standards to provide sufficient mitigation of potential impacts.
- The head of the slide at Station 22-1 encroaches into the edge of the upper plateau surface and is associated with a relatively tall (20+ feet) head scarp. The adjacent drainage canyons to the west, which occur outside NTO-1, appear similar. Where the R-6 access road from Winship Middle School traverses the upland plateau adjacent to the heads of these drainage canyons (Road stations 600 to 750), maintain a 25-foot setback.

5.2.2 NTMP Remainder

Landslide maps for the remainder of the NTMP are included as Figures 8a, 8b, and 8c. Field stationing used in the following discussion is included on the landslide maps.



County of Humboldt
McKay Community Forest NTMP
Eureka, California

Landslide Map North
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Figure 8A

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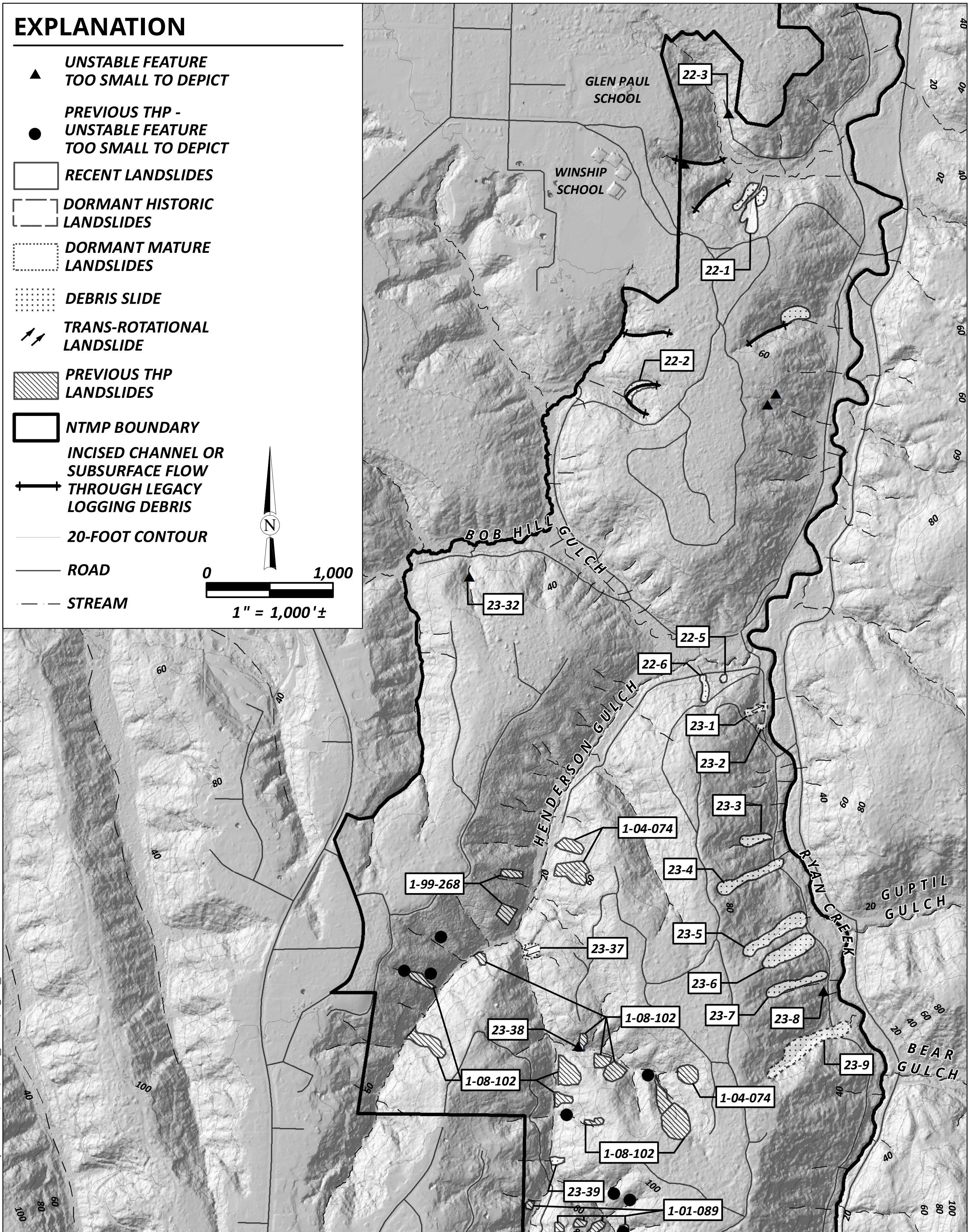
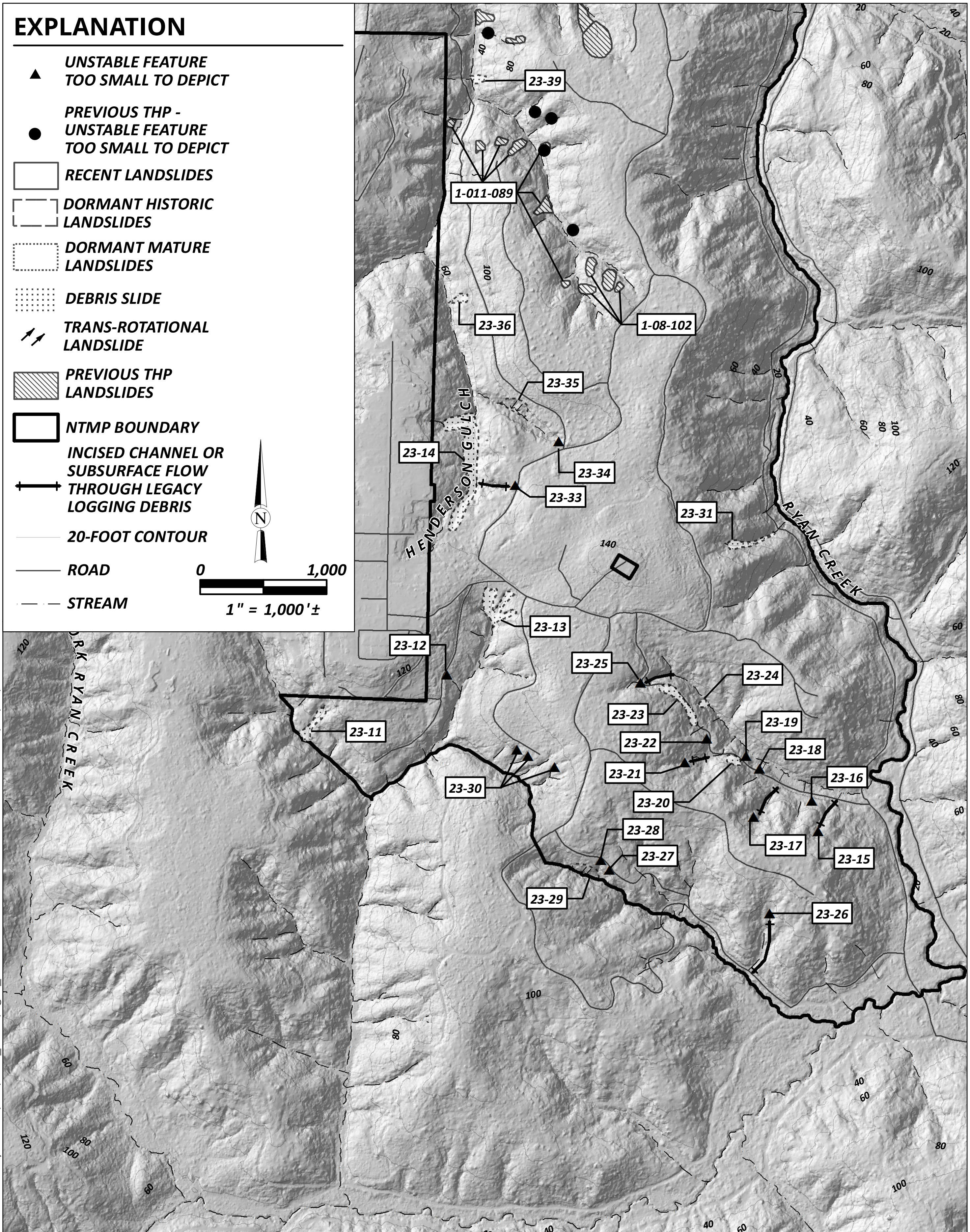


County of Humboldt
McKay Community Forest NTMP
Eureka, California

Landslide Map Middle
January 2024 - 022122

Figure 8B



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County of Humboldt
McKay Community Forest NTMP
Eureka, California

Landslide Map South
January 2024 - 022122

Figure 8C

Station 22-3: Station Geo-3 occurs just north of NTO-1 and crosses a legacy skid trail. The slide is a 30-foot-wide, 50-foot-long, slump-type failure (trans-rotational) and appears to be 4 to 5 feet deep based on the low head and lateral scarps. The slide appears recent; the slide body is unvegetated and the head scarp exposes bare soil. The slope gradient above the failure is about 45 percent. The slide initiated upslope of the pre-existing skid trail and about 5 feet of debris is deposited on the trail surface.

- **Recommendation for Station 22-3:** It is acceptable to develop access across the toe of the slide debris at station 22-3. Ramp over the debris, do not remove it, in order to re-establish skid trail access as necessary. Ramping over the existing slide debris will not exacerbate the slide itself.

Station 23-1: A narrow dormant-historic debris slide occurs uphill of Road R-7.5. The slide is 60-feet-wide and about 150 feet in length. Slide debris is retained within the stream channel and deposited across the broad valley floor at the downstream end of the tributary valley; it does not appear to have delivered to Ryan Creek. Slopes surrounding the slide are occupied by old growth redwood stumps. No specific recommendations required; standard WLPZ protections are sufficient.

Station 23-2: A recent management-related landslide occurs at this site, which is shown as Road Point 1096 on NTMP maps and on Figure 4b. An estimated 80-foot-wide, 150-foot-long slump was initiated along the outboard edge of a pre-existing truck road; the debris forms a 15+ foot high mound on Road R-7.5. Several back-tilted trees occupy the slide body, which extends to the edge of Ryan Creek. The slide appears dormant, with low potential for additional failure. Relative to timber management, standard WLPZ and unstable area treatment applies and appears adequate.

The County proposes to develop trail access across the slide body, connecting the adjacent existing sections of Road R-7.5, which is discussed below in Section 5.2.3.3.

Station 23-3: Typical of most tributary drainages, a broad, in-filled valley bottom is surrounded by steep valley sidewalls and a steep headwall. Dormant-historic debris sliding is noted along the headwall and in a narrow zone at the base of the headwall amphitheater. Steep slopes above the headwall are occupied by stable old growth stumps. Debris from the localized debris slide areas accumulates on the flat valley floor and is obscured in slash-filled channels that were previously utilized by tractors during early ground-based yarding. No specific recommendations; steep slope, WLPZ, and unstable area prescriptions provide adequate protection at this site.

Road R-7.5 crosses the mouth of the valley along the back-edge of the terrace/floodplain surface along Ryan Creek and is not impacted by slide debris generated at the headwall of the tributary canyon (it is deposited on the valley floor uphill of the road). The road is irrelevant relative to uphill mass wasting processes.

Station 23-4: A debris slide headwall occurs at the head of the valley above a narrow (±30-foot-wide) channel that leads to a wide stream valley at the base of the slope. Dormant-historic or recent activity is apparent. Concentration of alder is noted near the head; skid trail across head area no longer evident. Back-tilted stump noted on floor or valley; old growth stumps occupy surrounding slopes. Debris appears to be primarily deposited on valley floor above Road R-7.5. No specific recommendations; steep slope, WLPZ, and unstable area prescriptions provide adequate protection at this site.

Station 23-5: Steep-sided stream valley with 40- to 50-foot-high, near-vertical sidewalls opens onto a low gradient valley floor up to 100 feet wide. The canyon narrows to an apex at the valley headwall, where dormant-historic debris sliding is apparent. A narrow Class III channel extends uphill from the headwall area. A back-tilted stump was noted on the slide body. Old growth stumps are present on surrounding slopes. Debris from debris slides accumulates on the valley floor uphill of Road R-7.5. No specific recommendations; steep slope, WLPZ, and unstable area prescriptions provide adequate protection at this site.

Station 23-6: Dormant-historic debris sliding occurring at a headwall above a stream valley that widens downhill toward Road R-7.5. The most recent debris slide is associated with a 10-foot-high head scarp and initiated on the steep headwall slope at the narrow (60-foot-wide) apex of the canyon. A Class III stream in a narrow channel extends uphill of the near-vertical headwall slope (which appears to be underlain by Wildcat Fm. sediments), crossing slopes steeper than 55%. Debris from recent debris sliding has accumulated at the head of the valley and is being incised by the small Class III watercourse that occupies the stream valley. No specific recommendations; steep slope, WLPZ, and unstable area prescriptions provide adequate protection at this site.

Station 23-7: Dormant-historic debris sliding initiating on steep headwall and valley sidewall slopes at apex of stream valley that widens downhill. Canyon up to 150 feet wide at the base with steep sidewalls ±50 feet high. Debris is carried along a small Class III watercourse within the tributary canyon, largely buried beneath historic logging debris. No specific recommendations; steep slope, WLPZ, and unstable area prescriptions provide adequate protection at this site.

Station 23-8: Cut slope failure along Road R-7.5, extending 40 feet along the road, penetrating about 6 feet into the face. The slump block is intact and retains steep sides. Tilted spruce trees were noted. This is a maintenance issue with nominal additional mass wasting (or sedimentation) potential.

Station 23-9: A large tributary canyon occurs at this site, with steep (100+%) sidewall slopes. Dormant-historic debris sliding is noted on valley sidewalls. The valley widens downhill to up to 100 feet wide at its mouth. A narrow, winding channel carries the small Class III occupying this tributary canyon across the valley floor to a sediment fan evident in the lower canyon. Road R-7.5 is built across this Holocene-age fan, but evidence of recent sedimentation is absent. The presence of the road crossing the mouth of the tributary canyon has no impact on mass wasting conditions within the tributary canyon itself. No specific recommendations; steep slope, WLPZ, and unstable area prescriptions provide adequate protection at this site.

Station 23-10: A stump complex overhangs Road R-2 along a 40-foot-long segment of the cut bank. The stumps overhang the road about 3 feet in an area undercut by shallow erosion and mass wasting. This is a low-level mass wasting hazard, and no mitigation is required.

Station 23-11: A narrow gully forms on the steep headwall of this tributary canyon. We noted in the field the area around the headwall was brush-covered and lacked second growth conifer with no old growth stumps. Dormant-historic debris sliding was apparent at the head of the narrow gully, and debris was carried down a narrow channel to the broad stream valley at the base of the slope. A sandy debris fan was noted in the valley bottom. Valley sidewall slopes were noted to be less steep in this area relative to previous stations described along Ryan Creek. No specific recommendations; steep slope, WLPZ, and unstable area prescriptions provide adequate protection at this site.

Station 23-12: A dormant-historic road failure occurs along the outboard edge of Road R-7-2-3. The 50-foot-wide failure is filled with stumps, logs, and slash, and occurs at the head of a gully that leads to a tributary gulch. The failed debris has stabilized, and there is no apparent ongoing mass wasting potential. A water bar is currently diverting runoff toward the area.

- **Recommendation for Station 23-12:** Eliminate the water bar currently diverting water toward the failed outboard road edge. Develop new water breaks to either side of the failed area, as appropriate. The debris has stabilized and it does not appear feasible, or beneficial, to attempt to remove the remaining stumps, slash, and debris.

Station 23-13: Steep headwall located at headwaters of Class II gulch. The area is brushy and dominated by alder. Dormant-historic debris sliding is at the three lobes that form the head wall slope; 60% slopes on surrounding sidewalls. Debris sliding is restricted to localized areas along headwall and extending a short distance downstream along steep stream side slopes. No specific recommendations; steep slope, WLPZ, and unstable area prescriptions provide adequate protection at this site.

Station 23-14: Narrow, steep-sided canyon with dormant-historic and recent debris sliding. Recent debris slides noted on steep (100%) valley sidewalls. Debris sliding occurring on near-stream slopes within the riparian protection area. No specific recommendations; steep slope, WLPZ, and unstable area prescriptions provide adequate protection at this site.

Station 23-15: A small tributary canyon heavily impacted by historic logging. A very small channel flows beneath extensive slash and logging debris, forming a series of potholes and sinkholes. Legacy skid trails cross the canyon every 50 to 100 feet. Valley side walls are occupied by many old growth stumps; no significant unstable area apparent. Minor debris sliding may be occurring along the small Class III stream in this canyon, but it is not observable. A Class III stream channel daylights at the mouth of the canyon, at Road R-7.3, where it crosses the previously decommissioned road surface in a 1-foot-wide channel. No specific recommendations; WLPZ protections will provide adequate mitigation.

Station 23-16: A 30-foot-wide bank slump occurs along the cut bank along Road R-7.3 in an area that was previously decommissioned. The failure appears to have pre-dated the decommissioning work, as the slump debris has been smoothed and outsloped; the area is well-vegetated. No additional recommendations.

Station 23-17: As at Station 23-15, a narrow tributary channel has been heavily impacted by past tractor logging, as the channel is largely in-filled with slash and debris. The small Class III stream in this canyon is re-establishing its path through the debris, as apparent in a series of potholes. As such, some streamside sliding may be occurring beneath the accumulation of debris, but it is not quantifiable. No sides are apparent along the valley sidewalls. The Class III stream and minor amounts of debris are apparent where Road R-7.3 crosses the mouth of the canyon. Road R-7.3 is benign relative to mass wasting conditions upslope within the tributary canyon and having no impact. No specific recommendations; WLPZ protections will provide adequate mitigation of potential impacts.

Station 23-18: Along Road R-7.3, uphill of the area that was previously decommissioned, a failure has occurred along the outboard edge. The dormant-historic, slump-type failure affects about 30 feet of road length, the slide penetrates about 10 feet into the running surface. The vertical head scarp is about 8 feet high, approximating slide depth. The failure does not appear to have delivered much, if any, sediment to the adjacent Class II stream. The slide body is revegetating and appears stable and associated with negligible erosion and sedimentation potential.

- **Recommendation for Station 23-18:** The landslide debris has deposited below the roadway, in an area that is essentially inaccessible. The site is inaccessible to equipment without reopening a significant length of legacy roadway. Mitigation of the failed material is not deemed feasible, nor beneficial, due to its low potential for future impacts (it has reached equilibrium). Runoff from the roadway should be managed, however. Using hand equipment, relocate the water bar at the upgradient (northwestern) edge of the failure further away from the slide (minimum 30 feet).

Station 23-19: A dormant-historic failure along the outboard edge of Road R-7.3 affects about 30 feet of road length. The failure has a 6-foot-high vertical head scarp and 6-foot-high vertical lateral margins. This failure is estimated at 100 feet in length and reaches the bank of the adjacent creek. Blocky sandstone (Wildcat Fm.) is noted in the adjacent road cut.

- **Recommendation for Station 23-19:** Constrained by the same access conditions as described at Station 23-18, it does not appear feasible (or beneficial) to attempt to mitigate this site. The failure debris is located well below the road surface (extending to the creek) and is virtually inaccessible. We recommend allowing this site to continue to stabilize and revegetate; significant ongoing impacts are not anticipated.

  Runoff from the road surface should be managed to avoid the unstable area. Using hand equipment, develop a water break upgradient of the failure to divert runoff away from the slide area.

Station 23-20: Along this segment of Road R-7.3, a cut bank up to 40-feet-high occurs. A substantial debris fan buttresses the base of the slope, which was covered with trees and significant quantities of downed wood at the time of our reconnaissance. The debris accumulating as a fan along the cut is blocky sandstone. The fan extends an estimated 30 or more feet from the base of the cut and extends to within 8 feet of the top of the cut slope; that is, only 8 feet of the cut slope is exposed. There is not a significant ongoing mass wasting hazard at this site; no additional management recommendations are required.

Station 23-21: The narrow tributary valley upstream of the large Humboldt Crossing at Road Point 477 on Road R-7.3 is characterized by a 6-foot-wide channel beneath thick accumulation of logging slash and debris. Canyon side slopes appear devoid of sliding; streamside landsliding seems apparent, but is not quantifiable. Small debris fans indicate some streamside failures are occurring. No specific recommendations; steep slope, WLPZ, and unstable area prescriptions provide adequate protection at this site.

Note that Road Point 477 is discussed below.

Station 23-22: A large cut bank slump along a 40-foot-high cut is present along an 80-foot length of road R-7.3. A broad debris fan occurs below a 10-foot-high vertical head scarp. Several recent large tree falls are apparent. There is not a significant ongoing mass wasting hazard at this site; no additional management recommendations are required.

Station 23-23: A 100-foot-wide area of the bank is ravelling due to blocky sandstone, undermining the cut below an old growth stump that is overhanging. There is not a significant ongoing mass wasting hazard at this site; no additional management recommendations are required.

Station 23-24: A dormant-historic failure is present along the outboard edge of Road R-7.3. The slide affects about 80 feet of the roadbed, is associated with a 5-foot-high vertical head scarp. The slide is about 50 feet in length and had a rotational, slump-type failure mechanism. Back-tilted trees were noted on the slide body. It does not appear this slide delivered to the adjacent watercourse.

As discussed below, the slide debris is located below the road, in an inaccessible location. Mitigation at this site is not recommended.

Station 23-25: A narrow band of active streamside debris sliding directly adjacent to the channel is apparent in this narrow log-impacted drainage. Stream flow is mostly obscured by logging debris, visible only in potholes. Valley sidewalls show no evidence of unstable areas. No additional recommendations required; WLPZ provisions will provide adequate protection.

Station 23-26: A narrow (10-foot-wide) channel with raw sidewalls is reestablishing its path through logging debris. At the headwall slope, a streamside slump is apparent with a displaced old growth stump. This dormant-historic slide is about 50 feet wide and extends about 30 feet uphill. A second slump just downstream is about 50 feet wide and extends 70 feet upslope. The slide is well-forested, but a modest sediment fan has accumulated at the toe of the failure. No additional recommendations required; WLPZ, unstable area, and steep slope provisions will provide adequate protection.

Station 23-27: A dormant-historic slump below the "Old R-7" road at the southern end of the NTMP area. This is Road Point 1293 in the NTMP documents and on Figure 4c. The site occurs along a segment of permanently decommissioned road. A 50-foot-wide, 50-foot-long area of sidecast debris (logs, stumps, dirt) has slumped; recent vertical, open scarps are apparent at the head of the failure. Intact stumps and trees on surrounding slopes suggest that native ground is stable; it appears movement is limited to the fill mass. The material is perched on the slope above the adjacent watercourse and appears to be settling internally, but the overall slide mass appears to be stabilizing on the slope. A minor amount of sediment was observed flowing from the toe of this failure.

No mitigation recommendations are necessary. The failure occurs along a section of decommissioned road, and the slide debris is situated below the road in an inaccessible location.

Station 23-28: An area of potentially unstable fill was observed perched above the head of a Class III watercourse above a large pothole. The area is inaccessible, however, and mitigation is not feasible. To the extent possible, manage runoff along the road to divert it away from the fill and large pothole.

Station 23-29: A dormant-mature slump occurs at this site. A 20-foot-high, high-angle scarp spans the 100-foot-wide failure, the body of which forms a streamside terrace. Undeformed old growth stumps and upright second-growth redwood trees on the slide body suggest this is an older failure. No specific recommendations; unstable area, WLPZ, and steep slope provisions provide adequate protection.

Station 23-30: A series of small headwall swales occur at the Hookton/Wildcat contact. Localized dormant-historic debris sliding is apparent on the steep localized slopes at the heads of these swales. The area is heavily vegetated. This is a low-level hazard. No specific recommendations required; unstable area provisions will apply.

Station 23-31: A steep-sided, narrow canyon with an incised channel and high angle inner valley wall slopes. Steep, planar sidewall slopes suggest stable conditions; the primary mass wasting hazard appears related to tree fall. The decommissioned section of Road R-7.5 crosses the mouth of this tributary valley and has no impact on the mass wasting sources upslope. No specific recommendations required; WLPZ provisions will provide adequate protection.

Station 23-32: A streamside slump occurs in a tributary canyon above Road R-6.1. The dormant-historic debris slide is about 50 feet wide, 30 feet long, and 20 feet deep. A tilted second growth redwood with a broad curve to its trunk is noted. No specific recommendations required; WLPZ and unstable area provisions will provide adequate protection.

Station 23-33: A steep headwall at the head of this stream canyon in upper Henderson Gulch is associated with a dormant-historic debris slide. A steep, well-vegetated headscarp is apparent at the headwall, leading to a drainage absent of older timber. The feature is about 70 feet wide. No specific recommendations required; WLPZ, unstable area, and steep slope provisions will provide adequate protection.

Station 23-34: Perched fill is noted behind stumps and snags at the head of this drainage. The area is above the initiation point of a watercourse. There is little gradient, and a low failure potential was noted. No specific recommendations; WLPZ and unstable area provisions will preclude disturbance at this site.

Station 23-35: A large detachment slump affecting up to 300 feet of steep valley wall slope. The vertical head scarp is up to 20 feet high and appears to occur in undisturbed native ground. The dormant-historic slide failed to the adjacent creek; the remaining slide body has tilted old growth stumps and straight, upright second growth timber. This trans-rotational slide is the largest failure we observed within the MCF. The slide occurs well below Road R7-2-2, does not threaten the road alignment, and is not impacted by the presence of the road. No specific recommendations; WLPZ and unstable area provisions will provide adequate protection.

Station 23-36: A dormant-historic debris slide is present adjacent to the outboard edge of a broad natural flat adjacent to the stream bank. A steep, 30+-foot-high headwall occurs above a 50- to 70-foot-wide draw leading 200+ feet to the creek. The localized unstable area is surrounded by old growth stumps. No specific recommendations; WLPZ and unstable area provisions will provide adequate protection.

Station 23-37: A dormant-mature rotational slump is present at the confluence of two Henderson Gulch forks. The slide is adjacent to the stream and is associated with a steep scarp and distinct slide body. The slide body is occupied by mature second growth conifer. The slide is about 50 feet wide and long. Margins of the feature are well-rounded and vegetated. No specific recommendations; WLPZ and unstable area provisions will provide adequate protection.

Station 23-38: A recent debris slide on a densely brushy, steep valley wall slope along an upper tributary of Henderson Gulch. The slide appears to occur along the path of a short Class III stream. The slide developed a narrow-steep-sided scar about 30 feet wide, with a 15-foot-high head scarp. Some debris associated with this slide appears to have delivered to the Henderson Gulch branch below. No specific recommendations; WLPZ and unstable area provisions will provide adequate protection.

Station 23-39: A narrow dormant-historic debris slide, about 40 feet wide and up to 150 feet in length. The body of the slide is a steeped, irregular surface with several logs entrained within the debris.

The slide toe reaches the Henderson Gulch. A linear gap in the canopy occurs at the site. No specific recommendations; WLPZ and unstable area provisions will provide adequate protection.

Station 23-40: The steep headwall of this drainage in the northern part of the NTMP is associated with an amphitheater with slopes to 100% gradient. Dormant-historic debris slide scars are associated with a vegetation contrast on the lower slopes, where alder and ferns are present below a distinct transition to conifer on higher slopes. Where conifer occurs on the lower slopes, they are warped or tilted. Logs and debris have accumulated in the channel at the base of the steep slope. The inner valley along this stream canyon is considered a debris slide slope and should be managed as a broad unstable area. No specific recommendations; WLPZ, unstable area, and steep slope provisions are intended to provide protection in these areas.

5.2.3 Roads

5.2.3.1 Road R-7.6

New road construction related to timber management is expected to be limited within the NTMP due to the extensive existing road network. The one significant exception, however, is proposed Road R-7.6, which will provide critical access to the southern part of the NTMP-area that was eliminated when the larger Green Diamond Timber Company "McKay tract" was subdivided to facilitate development of the MCF. Road R-7.6 is anticipated to be "seasonal" relative to logging although all-season pickup truck access is desired; therefore, we expect that portions of the road will be rocked.

Road R-7.6 is shown on Figure 9, including the field stationing described below.

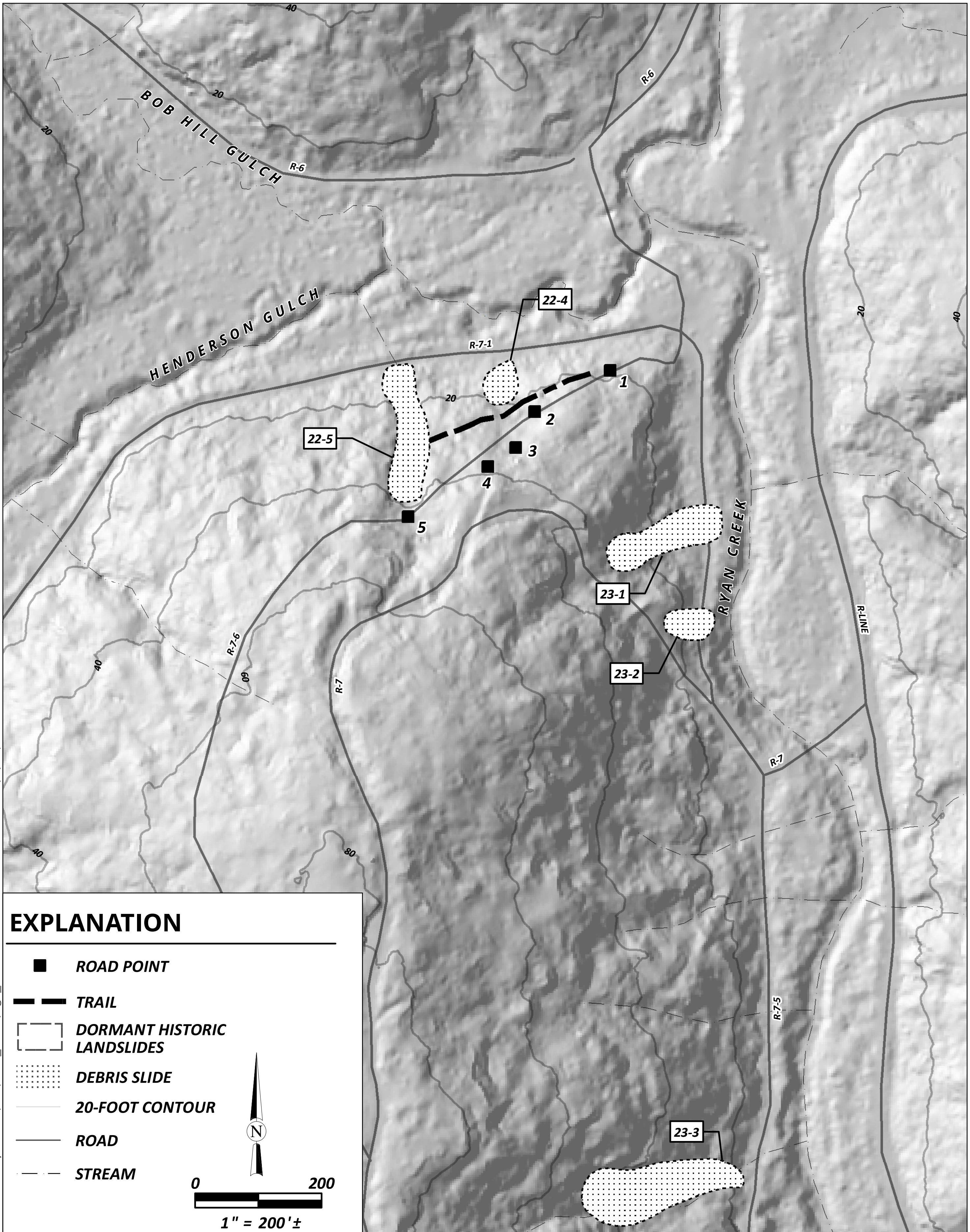
Road R-7.6, Station 1

The lower part of the proposed road alignment intersects numerous pre-existing skid trails that will complicate the earthwork necessary to achieve the desired road grade. At Station 1, the proposed alignment encounters a 12- to 15-foot-high, downhill-facing cut associated with a previous skid trail. The alignment and tall cut face intersect obliquely, at an acute angle, to further complicate site conditions. A topographic bench below the cut face, formed by the skid trail surface and the adjacent native ground, will provide the necessary subgrade for the potentially thick fill prism that will support the outboard edge of the road.

The geometry of the required earthwork at this site will depend on the final road grade, which had not been determined at the time of our site visit. We expect the grade will need to be lowered to reach Station 1, and we encourage road construction that avoids through-cuts with opposing cut banks. We expect most of the lower grade to occur on a full-cut bench approaching Station 1. Slight adjustment of the road alignment (away from the tall cut bank, for example) could have substantial impacts on the amount of earthwork at Station 1.

We noted that the existing skid trails and their associated cut slopes maintain their original form and appear relatively stable.

Balancing the cut and fill in the vicinity of Station 1 will be critical; we expect additional fill material will be generated further uphill along the alignment, so it may be necessary to move spoils along the alignment during construction.



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County of Humboldt
McKay Community Forest NTMP
Eureka, California

Road R-7

January 2024 - 022122

Figure 9

It appears that the alignment uphill of Station 1 will occur mostly on a full cut bench as it approaches Station 2, with a few low areas associated with existing skid trails that will require minor in-filling.

Recommendations for Station 1:

- Use the existing topographic bench below the tall cut bank to found the fill prism on, as necessary.
- Use the spoils from the excavations along the roadway as fill; these soils should be adequate for re-use as fill. However, it is important to ensure there is no debris or organic material in the spoils to be re-used as fill material.
- In areas to receive fill, site preparation should include removal of existing surface and subsurface improvements, and removal of debris, organics, organic topsoil, loose soil, and any other unsuitable material. Any vegetation and organic topsoil with more than 2 percent organic material by dry weight should be removed. All areas to receive engineered fill should be stripped of loose and/or soft surface soils and vegetation, and benched into firm soil. If zones of weak or saturated soils are encountered during site preparation, they should be removed by further excavation to expose firm natural soil/rock and replaced with engineered fill compacted to at least 90 percent relative compaction. (Relative compaction refers to the in-place dry density of a soil expressed as a percentage of the maximum dry density of the same soil, as determined by the ASTM-International D1557 compaction test procedure. Optimum moisture is the water content [percentage by dry weight] corresponding to the maximum dry density).
- The subgrade surface in areas to receive engineered fill should be scarified, and fill should be placed in lifts not exceeding 8 inches in thickness and compacted to at least 90 percent relative compaction. We recommend compaction verification testing of engineered fills during construction but recognize the remote nature of the site and the difficulty in testing. As an alternative, develop a performance standard or criteria (wheel rolling with loaded dump truck or water truck, for example) to identify problem areas that may require additional effort.
- In general, the outboard face of fill slopes should not be constructed steeper than 2:1 (horizontal:vertical).
- Through-cuts with opposing cut faces should be avoided to the extent feasible where grade needs to be lowered.

Road R-7.6 Station 2

The ascending segment in this area follows an old skid trail and we anticipate the road will need to be supported on fill to achieve the necessary road grade. The final grade of the proposed road is not known at this time, but we expect a 5- to 6-foot-thick fill prism. We noted several old growth stumps along the alignment and downhill of the alignment at this site. Removal of an old growth stump along a road alignment will result in a large, disturbed area that will require adequate site preparation (as discussed below).

Recommendations for Station 2:

- Complete adequate site preparation in areas to receive engineered fill by removing existing vegetation, organic material, stumps, and loose soil. Develop a firm, non-yielding surface benched into native soils to initiate fill placement. Where stumps are removed, the resulting depression should be cleaned out and filled with suitable, compact fill soils, compacted to 90 percent relative compaction, as defined above.

- The subgrade surface in areas to receive engineered fill should be scarified, and fill should be placed in lifts not exceeding 8 inches in thickness and compacted to at least 90 percent relative compaction.

Road R-7.6 Station 3
The road alignment traverses above a dormant-historic debris slide (Slide 22-4 in the landslide database and on landslide maps) at this site. The head of the debris slide scar is about 30 feet below the proposed road alignment, and we noted an intact skid trail and numerous old growth stumps on the slope above the unstable area. The well-vegetated slide body is wet and abundant alder and skunk cabbage was noted, but no evidence of recent movement was observed. A fallen redwood and re-growth from the large maple it landed on was noted at this site, presumably having occurred after the most recent debris sliding event.

Recommendations for Station 3:

- Recognize the downslope proximity of the unstable area during road layout and construction. We anticipate the road through this segment will be a full-cut bench and that no substantial filling will be required, but to the extent filling can be minimized or avoided, it should be. Do not direct concentrated road run-off toward the unstable area.

Road R-7.6 Station 4
An approximately 100-foot segment of the proposed road crosses steep slopes with gradients of about 65 percent. The slope is not tall at this site; there is a skid trail just above the proposed alignment that will effectively limit the height of the cut bank required to achieve the desired road grade. The road will be a full-cut bench through this segment, and the spoils will need to be relocated elsewhere along the alignment.

There are no specific recommendations for Station 4.

Road R-7.6 Station 5
At this site, the road will occupy an intact existing skid trail that crosses above the head of a dormant-historic debris slide (Slide 22-5 in the landslide database and on landslide maps). The slide occurs within a dry swale and is characterized by a narrow, steep-sided swale (debris chute) with intact redwood trees on both sides. No channelization of flow was observed within the head of the slide, although a Class III watercourse is mapped further downslope. The slide body is notably alder-covered. The skid trail crosses above the head of the slide and remains intact. Slopes above the skid trail crossing do not appear to have been affected by past debris sliding and are forested with numerous old growth redwood stumps. The low-cut bank along the uphill side of the existing skid trail maintains its vertical orientation. Numerous intersecting skid trails above the proposed alignment are well-vegetated and concentrated overland flow from these trails was not observed although we noted sinkholes and erosion along the skid trail alignment due to past flows.

Recommendations for Station 5:

- Use the existing skid trail alignment to the extent feasible to minimize the necessary earthwork at this site. Do not sidecast fill into the head of the debris slide scar, and do not allow concentrated runoff to be diverted toward the slide. If the road surface needs to be widened, retreat into the low-cut bank on the uphill side.

Beyond Station 5
The proposed road alignment beyond Station 5 traverses low to moderate gradient slopes devoid of mass wasting features, and there are no significant water course crossings. There are no engineering geologic issues or recommendations uphill of Station 5.

In terms of developing a pickup-accessible, all-season road, we recommend concentrating the placement of aggregate surfacing on the areas between Stations 1 and 5.

5.2.3.2 New Segment of Road R-6
A new segment of Road R-6 is proposed to develop access from the upper plateau to the valley bottom in the northeastern part of NTO-1. Reconnaissance along the proposed alignment of the new segment of Road R-6 encountered no apparent unstable areas; it is at least 70 feet from the recent landslide at Station 22-1. Slope gradients along the alignment are modest.

From an engineering geologic standpoint, the proposed new segment of Road R-6 follows a reasonable alignment with a low potential for impacts related to mass wasting and sedimentation. We have no recommendations for this proposed new road segment.

5.2.3.3 Road Point 477
A very large legacy watercourse crossing ("Humboldt" crossing) occurs at this site, involving a volume of stumps and debris estimated by PWA (2014) as 2,000+ cubic yards. The debris appears along the downstream edge as a chaotic log and stump pile with dirt in-fill. The logs do not appear uniformly stacked in this crossing (quite the contrary). The jumble of logs within this "structure" poses a low risk of catastrophic failure (it consists of interlocking logs) but can be expected to be an ongoing source of a small volume of sediment. There is a small sediment fan accumulating in the channel downstream of the crossing. Removal of this crossing would be a massive undertaking and the short-term impacts associated with dismantling the log crossing appear to be significantly greater than that associated with the minor impacts with retaining it. Removal of the crossing would generate significant ground disturbance and a large volume of debris, and we do not advocate for this approach. We recommend retaining the crossing due to its low ongoing sediment-related impact and the significant impacts associated with its removal.

5.2.3.4 Road Point 482
As at Road Point 477, a large legacy watercourse crossing occurs consisting of a jumble of buried logs. Similar conditions are present, and we offer similar reasoning for retaining the crossing. The potential for future impacts is low under current conditions, the potential impacts of removing the structure are great, and the potential benefits appear minimal considering the impacted condition of the adjacent streams.

5.2.3.5 Road Point 1096
This site occurs at the toe of the slide at Station 23-2, described above, where slide debris buries Road R-7.5. The County intends to develop a trail across the mound of slide debris to reconnect the disconnected segments of Road R-7.5. A footpath currently exists over the mound, and we expect that minimal clearing, grubbing, and ground work will be required to develop the proposed trail. We expect the work will have negligible impacts to the stability of the body of the slide and surrounding area, and assuming basic erosion control, there is little potential for sedimentation to nearby Ryan Creek. There are several severely leaning (back-tilted) trees on the slide body; removal of these trees to enhance public safety would not impact stability of the slide body.

5.2.3.6 Proposed Trails

Specific attention was paid to non-timber operation trails that are currently proposed by the County along existing legacy roads. These include:

- Road R-6-1 (Northridge unit)
- Road R-7-1 (South McKay unit 2)
- Road R-7.5 (South McKay units 1 and 2)
- Road R-7-3 (South McKay unit 2)
- Old R-7 (South McKay unit 2)

The proposed trails on the legacy roads defined above are all situated in low-slope positions adjacent to the principal streams, crossing the mouths of the tributary canyons within which the mass wasting described above is occurring. Roads R-6-1, R-7-1, and R-7.5 all extend along the back-edge of the Ryan Creek floodplain/terrace and represent remnants of flat mainline roads that have tied the area together for many years. The lower segment of Road R-6 surrounding NTO-1 is a similar legacy road. Road R-7-3 and the Old R-7 occupy legacy near-stream roads on sidehill cuts within larger tributary valleys in the southern end of the MCF.

Where unstable areas were encountered along these roads, the information relative to these specific stations is presented above. However, because these roads traverse the mouths of many of the various stream valleys where the mass wasting described above is occurring, the proximity of these roads is a worthy consideration.

Virtually all of the landsliding we observed occurs along steep headwalls and streamside slopes within the tributary canyons adjacent to the principal streams. Debris sliding at the heads of canyons near the Hookton/Wildcat contact is the most common form of mass wasting in the watershed. These unstable areas are far removed from the low roads described above, and the processes driving mass wasting do not apply to the subject roads. As the roads cross the mouths of the tributary canyons, they may be subject to debris from slides inundating segment of the subject roads over time. We did not observe evidence of this occurrence throughout the areas we visited, however, and consider it a very low probability event that would qualify as a low-level maintenance issue, should these roads be successfully re-developed. These roads are essentially benign relative to landsliding in the MCF; they do not affect the geologic conditions relative to unstable areas, and those areas do not affect the subject roads.

5.2.4 Public Safety

The McKay Community Forest is directly adjacent to residential areas along much of its western border. Access to the community forest is a critical aspect to its development and several key access points have been proposed. Responsible management along the residential interface is an important objective of the FSP.

From a landslide hazard standpoint, much of the public interface occurs on flat or low-gradient slopes along the edges of the Eureka terrace. Where steep slopes encroach on developed areas (Henderson Gulch area, for example), existing watercourse and steep slope restrictions will largely eliminate management-related landslide impacts. Current conditions dictate that access to slopes near residential areas is extremely limited, such that we would expect management activities in these areas to be rare.

6.0 Conclusions

The McKay Community Forest NTMP is intended to provide a long-term timber management plan for the nearly 1,200-acre area that is focused on sustainability, improvement of overall forest conditions, and responsible management. The community forest will be managed under a forest stewardship plan. Impacts related to forest uses are intended to be low. The area has been heavily managed in the past for commercial timber production, and from most appearances, the ground appears to have sustained that level of management. An extensive network of roads and skid trails is present throughout the project area, many of which will provide continued access opportunities that will reduce the need for future road building. The proposed level of future management is substantially lower than that of the industrial logging of the recent past.

Silviculture and yarding operations are designed to reduce impacts to steep slopes where mass wasting potential is the highest. The area is associated with unique topographic conditions with generally low-relief and flat planar uplands that provide easy access to the steeper valley wall slopes surrounding the broad alluvial lowlands of the Ryan Creek watershed. Steeper slopes will be cable-yarded or low-impact ground equipment will be used on existing skid trails where appropriate.

In general, rates of mass wasting are low throughout the watershed. Mitigation of landslides will occur through a defined process intended to significantly reduce impacts to unstable areas. Due to the propensity of streamside landslides in the project area, most unstable areas occur within existing harvest exclusion or reduction zones (WLPZ areas). Where feasible, single-tree selection of a small number of trees, requiring a high basal area retention, and exclusion of equipment will provide the basis of landslide mitigation. Based on the geologic conditions of the NTMP area, it appears the landslide-related impacts related to the proposed uses can be reduced to a less than significant level.

An existing road network provides access to most of the project area. Most of these roads meet commercial logging standards, so there will be a reduced need to develop new roads. Maintenance and storm-proofing will be an important consideration relative to future management. A comprehensive road inventory has been completed and sites requiring improvement, upgrades, or decommissioning have been identified and will be addressed under the management of the County. The importance of aggregate surfacing on erosion-prone roads and roads in high susceptibility areas (roads on valley wall slopes near watercourses, for example) cannot be overstated.

Much of the western boundary of the proposed community forest occurs along a residential interface, so public safety considerations will be important in those areas. Where steeper slopes encroach on residential areas in the southern part of the plan area, steep-slope provisions for timber management and limited access will reduce impacts to a nominal level.

Based on the geologic site conditions and the approach laid out in the NTMP, we conclude the plan is associated with an acceptably low potential for impacts to area watercourses and the public from an engineering geologic standpoint. This endorsement of the operations plan outlined in the NTMP assumes that, when necessary, a professional geologist will be consulted to provide focused technical consultation.

This document is intended to guide forest management practices into the future. As such, unstable areas mapping is being provided to the Client (and RPF) as GIS shapefiles to facilitate future field work.

7.0 References

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Landslide Inventory Table

1

Landslide Inventory—McKay Community Forest NTMP

Slide ID	Slide Type	Activity	Size			Sed Delivery?	Man. Related?	Comments
			L	W	D			
22-1	DS	R	100+	30	20	N	N	-
22-2	DS/IC	DH	200+	20	20	Y	Y	-
22-3	DS	DH	50	30	5	N	Y	-
22-4	DS	DH	75	75	10	N	Y	Road R-7.6, Sta.3
22-5	DS	DH	200	80	10	Y	N	Road R-7.6, Sta. 5
23-1	DS	DH	150	60	10	N	Y	-
23-2	DS	DH	150	100	30	N	Y	R.P. 1096
23-3	DS/DSS	DH	150+	50	10	Y	Y	-
23-4	DS/DSS	DH	200+	30	10	Y	Y	-
23-5	DS/DSS	DH	200+	100	10	Y	Y	-
23-6	DS	DH	200+	60	10	Y	Y	
23-7	DS/DSS	DH	200+	30	10	Y	Y	
23-8	CSF	DH	<10	40	<5	N	Y	
23-9	DS/IC	DH	300+	20	10	Y	Y	
23-10	CSF	DH	<10	40	<5	N	Y	
23-11	DS	DH	200+	50	10	Y	Y	
23-12	DS	DH	50	50	10	Y	Y	
23-13	DS	DH	50	100	5	Y	Y	X3 (3 lobes)
23-14	DS/DSS	DH	50	150	10	Y	Y	
23-15	DS	DH	50	200	10	Y	Y	
23-16	CSF	DH	20	30	15	N	Y	
23-17	DS	DH	50	200	10	Y	Y	
23-18	DS	DH	20	30	10	Y	Y	
23-19	DS	DH	100	30	6	Y	Y	
23-20	CSF	DH				N	Y	
23-21	DS	DH	100	10	5	Y	Y	
23-22	CSF	DH				N	Y	
23-23	CSF	DH				N	Y	
23-24	DS	DH	50	80	5-10	Y	Y	
23-25	DS	DH	100	10	5	Y	Y	
23-26	DS	DH	200	10	5	Y	Y	
23-27	DS	DH	50	50	10	Y	Y	
23-28	PF						Y	
23-29	TR	DH	200	100	20	Y	N	
23-30	DS	DH	50	20	10	Y	Y	
23-31	DS/DSS	DH	200	50	10	Y	Y	
23-32	DS	DH	30	50	20	Y	Y	
23-33	DS	DH	50	50	5	Y	Y	
23-34	PF					N	Y	
23-35	TR	100	300	40	40	Y	N	
23-36	DS	DH	200	70	30	Y	Y	
23-37	TR	DM	50	50	20	Y	N	
23-38	DS	R	150	30	15	Y	N	

Landslide Inventory—McKay Community Forest NTMP

Slide ID	Slide Type	Activity	Size			Sed Delivery?	Man. Related?	Comments
			L	W	D			
23-39	DS	DH	150	40	10	Y	Y	
23-40	DS/DSS	DH	1000	200	10	Y	Y	

Abbreviations

Slide Type

DS Debris slide
IC Incised channel or subsurface flow through legacy logging debris
DSS Debris slide slope
CSF Cut slope failure
PF Perched fill

Activity

R Recent
DH Dormant-historic
DM Dormant-mature

Eureka, CA | Arcata, CA | Redding, CA | Willits, CA | Fort Bragg, CA | Coos Bay, OR | Klamath Falls, OR