STATE OF NEW MEXICO
BEFORE THE WATER QUALITY CONTROL COMMISSION

IN THE MATTER OF PROPOSED AMENDMENTS TO
SURFACE WATER QUALITY STANDARDS FOR
SAN ISIDRO ARROYO AND TRIBUTARIES **WQCC No. 19-03(R)**

PRE-FILED TECHNICAL TESTIMONY OF MR. JEFFREY OLYPHANT A WITNESS ON BEHALF OF PEABODY NATURAL RESOURCES COMPANY

I. Introduction

My name is Jeffrey Olyphant. I currently am employed as a Hydrology Manager by Peabody Investment Corporation. I am offering testimony as an expert in support of Peabody Natural Resources Company's ("Peabody") Petition to Amend Ground and Surface Water Protection Regulations. As a hydrologist, I am very familiar with what the proposed rule change seeks, and I fully support the reclassification of the segments identified in the proposed regulatory change.

I will begin my testimony by providing a brief summary of my education and experience. I will then go on to provide an introduction to the regional hydrology of the area implicated by the proposed regulatory change. Following that overview, I will offer testimony regarding the specific hydrologic surroundings of the San Isidro Arroyo.

II. Education and Experience

My resume is Peabody Exhibit 12. I have a Bachelor of Science degree from Indiana University in Environmental Science, with a minor in Geological Science. I also have a Masters in Geological Sciences-Hydrogeology from the University of Texas at Austin.

I have served in the position of Manager of Hydrology for Peabody Investment Corporation since August 2017. In this position I provide hydrology related support to Peabody's domestic operations. This includes reviewing and developing technical hydrology reports, providing environmental permitting support for the Surface Mine Control and Reclamation Act ("SMCRA") and the Clean Water Act's ("CWA") National Pollutant Discharge Elimination System ("NPDES") programs. I also conduct internal environmental audits and assist operations with permit compliance as well as design and implement hydrogeologic monitoring plans for site characterization and impact assessments.

Prior to my current position, from March 2012 through July 2017, I served as a hydrologist for Peabody Investment Corporation's Midwest operations, which included providing hydrology, environmental permitting, and regulatory compliance support for Peabody's Midwest Operations and preparing environmental permit applications, renewals, and modifications for water-related regulatory programs (CWA, SMCRA). In that capacity, I also managed water monitoring and water treatment programs, and was responsible for designing and implementing hydrogeologic monitoring plans for site characterization and impact assessments.

III. Regional Hydrology

The Use Attainability Analysis ("UAA") study area is located in the southern portion of the San Juan Basin within the Chaco Slope structural province (Kelley, 1963). The San Juan Structural Basin ("Basin") is a northwest trending, asymmetric structural basin on the eastern edge of the Colorado Plateau. The basin is approximately 19,400 mi^2 and is located predominately within northwestern New Mexico, with smaller portions of the Basin falling within southern Colorado, northeast Arizona, and southeast Utah. The Basin is located in a semi-arid to arid region and surface water resources are limited. Annual precipitation is greater in the topographic highs of the Basin and ranges from approximately 30 inches near Mount Taylor to approximately 8 inches in the central Basin (Stone et al., 1983). High evaporation rates have been reported for the lower elevations of the Basin. Measured pan evaporations rates from 46 to 67.37 inches per year at stations near Farmington, El Vado Dam, and Gallup (Stone et al., 1983). The Basin is drained primarily by the San Juan River in the north, the Puerco River in the southwest, and the Rio Puerco to the southeast. Only the San Juan River and its major northern tributaries are naturally perennial; however, portions of some streams in the Basin have been shown to be perennial for short reaches downstream from springs, wells, or industrial discharges (Kernodle, 1996). Extensive work has been done to characterize the available groundwater resources in the Basin. Major aquifers include Quaternary valley fill and sandstones of the Tertiary and Mesozoic (Cretaceous, Jurassic, and Triassic). The occurrence, movement, and availability of groundwater in the Basin is subject to significant geologic control which include the distribution of the permeable sandstone aquifers, the Basin's geologic structure, and the regional stratigraphy.

Topography plays an important role in the location of recharge and discharge areas within the Basin. Topography is the result of both structural and geomorphic processes that act on the local stratigraphy. Structure processes provide the elevation and general configuration of recharge areas and geomorphic processes dictate the extent that these structural features are modified by erosion and deposition. Peabody Exhibit 15 includes the structural features of the Basin. The structural features of the Basin are the result of tectonism that began as early as the late Paleozoic along the areas bordering the Basin (San Juan Uplift, Nacimiento Uplift, Zuni Uplift, and Defiance Uplift). Recurrent uplift and minor deformation continued through the Mesozoic but it was not until the Laramide Orogeny during the Late Cretaceous and early tertiary that the structural features as seen today began to form (Kelly 1950, 1951, 1957; Craigg, 2001). After the culmination of the Laramide, minor doming associated with intrusion by laccoliths and other igneous bodies modified some of the older structures in the late Tertiary (Woodward and Callender, 1977; Craigg, 2001). The structural boundaries consist primarily of large elongate domal uplifts, marginal platforms, and abrupt monoclines (Kelley, 1951; Levings et al, 1995).

The Basin contains thick sequences of sedimentary rock ranging from Cambrian through Tertiary with a maximum stratigraphic thickness of approximately 14,000 ft (Kernodle, 1996) that overlies a Precambrian crystalline-rock basement complex. Sedimentary rocks of Jurassic and Cretaceous age outcrop around the Basin rim, and over broad areas in the southern and western parts of the Basin, and are successively overlain by younger rocks towards the center of the Basin (Stone et al, 1983). Tertiary sedimentary rocks cover most of the central Basin. The sedimentary rocks dip basin-ward from the Basin's margins toward the center except where locally interrupted by folds, faults, and domes. Tertiary volcanic rocks and various Quaternary aged deposits are also present within the Basin. Faulting is common, especially in the northeastern, southeastern, and south-central parts of the Basin (Craigg, 2001).

Peabody Exhibit 20 includes a regional hydrogeologic section including the primary aquifers as identified by Stone et al, 1983. Aquifers in the southern portion of the Basin include the Permian San Andres Limestone and Glorieta Sandstone, the Entrada Sandstone of the middle Jurassic, the Westwater Canyon Member of the Morrison Formation of the Upper Jurassic, theDakota Sandstone of the Upper Cretaceous, and the Gallup Sandstone, Crevasse Canyon Formation, Point Lookout Sandstone and Menefee Formation of the Mesaverde Group of the Upper Cretaceous. The San Juan Basin was a site of both marine and continental deposition, and this is reflected by the thick aquitards of lower permeable materials that separate the aquifers. Aquifers of the late Cretaceous, Paleocene, and Eocene seen in the northern part of the Basin were removed by later Tertiary – Quaternary erosion in the southern end of the Basin. Whether a formation is used as an aquifer in an area of the Basin is dependent on the depth to groundwater, formation yield, and quality of groundwater. Although deeper formations may contain groundwater, their depths generally preclude groundwater exploration or development except along the margins of the Basin where they are close to the surface.

Regional groundwater flow is from recharge areas located at the topographically elevated Basin margins towards discharge areas along the lower reaches of the San Juan River in the northwest, Puerco River drainage in the southwest and parts of the Rio Puerco in the southeast. Peabody Exhibit 16 shows the general pattern of deep groundwater flow in rock of Jurassic and Cretaceous age. Discharge also occurs from springs and seeps located in the topographically low parts of outcrops. Water table conditions are typically encountered in the outcrop areas and confined conditions are encountered as the bedrock units dip towards the center of the Basin and are overlain by low permeable rocks that act as aquitards. Artesian discharge from the upward movement of groundwater across confining units along fault planes and fractures also occurs in the Basin. Subsurface, inter-formational movement of water across low permeable units to another aquifer with lower hydraulic head also occurs. Discharge also occurs artificially from free-flowing wells and pumped wells used for municipal, domestic, agricultural, or livestock purposes. Within some of the stream valleys, Quaternary alluvium can contain local aquifers.

IV. Local Hydrology

The San Isidro Arroyo watershed is located along the southern end of the San Juan Basin north of Mount Taylor. The watershed is bound by the San Mateo Mesa to the south and drains to the northeast towards the Arroyo Chico approximately 4.8 miles downstream of the Lee Ranch Mine ("LRM") permit area. Elevations range from approximately 8,200 ft msl in the headwaters near the San Mateo Mesa to approximately 6,440 ft msl at the San Isidro Arroyo confluence with Arroyo Chico. The headwaters originate in steep, deeply incised canyons which rapidly drop in elevation in the central and lower portion of the watershed which is characterized by rolling hills and broad, flat channels.

Climate is the driver for the presence of surface water within the drainage channels of the San Isidro Arroyo watershed. The Basin is located in a semi-arid region and the average annual precipitation measured at the LRM weather station is approximately 10.5 inches (1985 – 2017). High evapotranspiration rates characterize this area and the annual moisture deficit is in excess of 21 inches (SMCRA Permit 19-2P). Runoff occurs irregularly in direct response to precipitation events such as summer thunderstorms, or less frequently, snow-melt runoff. Most of the rainfall occurs during the mid-summer to mid-fall monsoon season (July – October) as brief, but often intense, thunderstorms that often occur over only partial areas within a given watershed. Flow events are flashy and are characterized by rapid peaks and relatively short durations. LRM is required to monitor the primary drainage channels as part of its MMD Permit (19-2P). Monitoring points are in Arroyo Tinaja, Mulatto Canyon, and Doctor Arroyo. Because of the remote location of the stream monitoring points, the limited duration of the flow events (often less than 30 minutes), and the safety related concerns with accessing these areas after a rain event, it is very difficult to physically be present to collect water samples. Therefore, single stage, non-automated sediment samplers were installed at each monitoring station (see Figure X for SWM locations). The samplers were modeled after similar non-automated devices developed by the USGS to monitor ephemeral streams in New Mexico. The stream sample point locations are checked monthly or following sizeable rain events. Rainfall does not occur ubiquitously across the site and surface water monitoring conducted within the Mulatto Canyon, Arroyo Tinaja, and San Isidro Arroyo at the LRM indicates that the occurrence of flow events that produce sufficient volumes of water for sample collection using the single stage samplers varies from 1 -10 times per year, with a mean of 4 events per year. Most of these events occur during the summer monsoon season.

The closest USGS Gaging Station (08340500) to the study area is on the Arroyo Chico, approximately 35 miles downstream, just prior to its confluence with the Rio Puerco. A watershed, or catchment, is a precipitation collector that both stores and routes water to a common point. The outlet is located at the lowest topographic position where both surface water and shallow groundwater converge. Therefore, as the drainage area increases the potential for perennial flow increases. The drainage area reporting to the Arroyo Chico Gaging Station is approximately 880,210 acres (1375 mi^2); with the San Isidro Arroyo watershed (51,006 acres; 79.7 mi^2), representing less than six percent of its drainage area. Discharge data is available from October 1943 through September 1986 and October 2005 through present. Monitoring at the gaging station was discontinued by the USGS between October 1986 and September 2005. Peabody Exhibit 17 presents a hydrograph of the available daily mean discharge data for station 0834500. The discharge record for this station indicates extensive periods of no flow, with the arroyo averaging 198 days (range: 44 – 366 days) of measured flow on an annual basis over the 54 years during which a complete flow record was available.

The highest mean daily flows typically occur between July and September and are likely the result of intense local precipitation in the Basin. Prior to 1973 the Arroyo Chico exhibited a lower frequency of flow events per year, with a mean of 152 events per year, but had a higher frequency of mean daily flow above 1000 cubic feet per second (cfs), with 49 events exceeding this threshold between October 1, 1943 and December 31, 1972. Since that time, the frequency of flow events has increased, with a mean of 250 events per year, but the mean daily flow has only exceeded 1000 cfs twice during the period of available record. The LRM did not begin operating until late 1984, over a decade after the reduction in the mean daily flow began. Even at its current maximum, the LRM's disturbance area, 8470 acres (13.2 mi^2), represents less than one percent of the drainage area reporting to gaging station 08340500. Although discharge rarely occurs from the numerous sediment ponds that have been constructed to provide treatment of disturbed area runoff from the LRM (see NPDES Permit No. NM0029581) they do not capture and store significant volumes of water due to the infrequent nature of runoff events in the area. All runoff that originates in watersheds upstream of the LRM is routed around or through the LRM mine area using diversions. Therefore, it is understood that the LRM has not had a significant impact on the volume of water observed at the gaging station.

Locally, the hydrogeologic units of importance include the shallow, accessible, sandstone aquifers and water bearing units of Cretaceous age, specifically the Point Lookout Sandstone and to a lesser extent the water bearing lenticular sandstone present within the Cleary Coal Member of the Menefee formation. The Gallup Sandstone is also an important regional aquifer but its depth (>1200 ft bgs) prevents significant usage. Similarly, the deeper Mesezoic and Permian age regional aquifers are not utilized in this area. Sandstones typically act as aquifers because of their ability to transmit significant quantities of groundwater as compared to other less permeable rocks such as shales or mudstones. A surface geology map of the study area is provided as Peabody Exhibit 18. The Menefee formation outcrops across the central and lower portion of the watershed, where the softer shale units form the rolling broad valleys or flats seen at the surface. The Cleary Coal Member of the Menefee Formation consists of sandstone, siltstone, mudstone, shale and coal. The sandstone units and coal seams are generally lenticular and tend to lack lateral continuity. Peabody Exhibit 19 includes a representative geologic column of the Menefee Formation within the LRM permit area. The Point Lookout Sandstone outcrops along the southern end of the study area where it forms the cliffs and caps the San Mateo Mesa. The Point Lookout Sandstone is broken into two units separated by the Satan Tongue of the Mancos Shale in this area. The upper (or primary unit) referred to as the Point Lookout Sandstone and the lower unit is referred to as the Hosta Tongue. It also outcrops at the San Miguel Creek Dome located east of the study area near the confluence of San Isidro Arroyo with the Arroyo Chico. The Point Lookout Sandstone is laterally continuous and is separated from the water bearing sandstones and coal units of the Menefee Formation by low permeable shale that is located at the base of the Menefee formation. The Gallup Sandstone does not outcrop within the study area and is separated from the Point Lookout Sandstone by several hundred feet of low permeable bedrock. Faulting is not extensive on the Chaco Slope, but its frequency is greater on the southern margin, adjacent to the Zuni uplift. The faults associated with the San Mateo dome have a northerly to northeasterly trend, directions that are frequently associated with faulting along the north flank of the Zuni uplift. San Miguel Creek dome is broken into segments by a series of east-trending faults. The local dip of the bedrock has been influenced by the San Mateo dome and the San Miguel Creek domes. The strata in the vicinity of the San Mateo dome dips at approximately 2° in a northeasterly direction. The strata in the eastern portion of the study area near the San Miguel Creek Dome dips to the northwest at approximately 2°.

Recharge of the shallower Menefee Formation and Point Lookout Sandstone occurs in and around the sandstone outcrops located to the south and southeast of the LRM permit area where fractures allow for more rapid infiltration of precipitation. The recharge zone of the Gallup aquifer is located southeast of the San Mateo Mesa, outside of the study area, where it outcrops. Groundwater moves downgradient to areas of discharge in accordance with Darcy’s law, where flow is equal to the groundwater gradient times the aquifers hydraulic conductivity times the cross-sectional area of the aquifer perpendicular to flow. Groundwater flow within the bedrock follows the structural dip of the lithologic units and is modified locally by the type and degree of fracturing. Groundwater flow in the vicinity of the LRM permit area is in a north-northeasterly direction

(MMD Permit 19-2P). To the north of the southern recharge zone impermeable shales limit vertical groundwater flow resulting in confined conditions which prevents appreciable connectivity with the surface. The natural bedrock groundwater discharge is limited to a small handful of low discharge rate springs predominately found in the eastern portion of the study area (Subwatershed 1D). This was supported through geochemical characterization which indicated that the water from these springs was of the same water type as the groundwater monitored in the Menefee Formation and Point Lookout Sandstone wells on the eastern side of the mine permit. Artificial discharge includes wells used for livestock water and the mine void. Water emanating from the springs and livestock wells is typically diffuse, limited in quantity and evaporates or soaks into the ground within very short distances due to the semi-arid climatic conditions.

Doctor Spring, identified as “S-3” on Figure 3, Peabody Exhibit 7, located within the mine exclusion area, does exhibit measurable volumes of water, as demonstrated by photo point PP160 on Figure 3. The spring reports to a livestock tank that produces minor contributions of overflow to the channel. In 2013 the LRM installed a water supply tank, which is supplied by wells W22-211, W22-212, and W22-213, all identified in Figure 3, and three livestock drinkers to supplement the needs of the rancher and supply additional water to the small wetland feature in the area. Overflow from the Doctor Spring area evaporates or soaks into the ground within a short distance (< 900 ft within Doctor Arroyo). No diminution or interruption of groundwater is expected to occur at the springs located outside of the permit boundary. Seven springs are located within the LRM MMD permit boundary. Five of the seven are expected to be mined through. The Coal Mine, identified as “S-9” in Figure 3, and Salazaar, identified as “S-8” in Figure 3, springs are not expected to be mined through but may be influenced by water level drawdowns from adjacent mining. Impacts to these springs are addressed through the mitigation requirements of the Army

Corp of Engineers' Clean Water Act Section 404 permit (Action No. NM-97-00200) and MMD Permit 19-2P.

Although mining has had some impact on the bedrock groundwater levels in the area, it has not impacted groundwater contributions to the stream channels. As previously described, the bedrock aquifers of the area are overlain by impermeable shales which results in confined conditions that prevents strong connectivity with the stream channels. The low hydraulic conductivities of the Menefee Formation and Point Lookout Sandstone limit the quantity of groundwater that flows into the mine pits and the radius of influence of the drawdown. Significant groundwater inflows into the LRM mine pits have not been encountered during mining. Some drawdown of the bedrock water table was expected and was contemplated in both the mines Cumulative Hydrologic Impact Assessment and by the State Engineers Office as part of the LRM's permit for appropriating groundwater. This includes an annual groundwater appropriation of 1500 acre ("ac-ft") for water that both enters the pits and water produced from the mine's water supply wells.

The study area is sparsely populated and groundwater usage is limited. A total of 20 diversion wells were identified. Five of these wells are owned by the LRM. Three are located within the Menefee Formation (TD: 215 ft bgs) and supply three livestock drinkers that supplement the needs of the rancher and supply additional water to a small wetland feature. The combined annual withdrawal at these wells averages approximately 0.2 ac-ft per year. The remaining two are mine production wells that are screened at much deeper depths within the Crevasse Canyon Formation and Gallup Sandstone (TD: 1524 - 1553 ft bgs). The two production wells are hydrologically isolated from the surface by several hundred feet of low permeable bedrock units. The remaining fifteen wells are shallow bedrock wells screened either within the Menefee or the Point Lookout

Sandstone that are used primarily for livestock purposes. These wells have permitted withdrawals of only 3 ac-ft/yr and are typically only used during periods when livestock are grazing in the immediate area. The semi-arid climate limits vegetation in this region resulting in the need for livestock herds to graze several hundred acres per year to accommodate their dietary needs. Therefore, these wells are typically only used on an as needed basis when the herd is grazing in the immediate area. These withdrawals are insignificant and have negligible effects on the available groundwater in the area or the surface water flow regimes of the stream channels evaluated during the 2017 HP Assessment and UAA.

Unconsolidated Quaternary deposits include alluvium, colluvium, and eolian deposits. Exploration drilling associated with the LRM indicates the unconsolidated materials ranged from approximately 0 – 80 ft in thickness within the permit area. Detectable groundwater was not identified in the unconsolidated materials above the shallowest coal seam during the exploratory drilling for MMD Permit 19-2P. In 1982, monitoring well MW-4, as identified in Peabody Exhibit 7, Figure 3, was also completed to a depth of 52 ft below ground surface within the unconsolidated material overlying the Menefee formation, but failed to produce water . No unconsolidated water supply wells are known to exist in the study area. This is consistent with the observations made by Cooper and John, 1968 (NMSE Technical Report 35) who noted that only minor amounts of water were present in the alluvium in southeastern McKinley County, with dug wells identified near San Mateo Creek, the Azul Creek Valley, and San Antonio Spring. All of those locations are outside of the San Isidro Arroyo watershed.

V. Conclusion

The scientific evidence demonstrates the stream segments identified in Peabody's proposed rulemaking are ephemeral. I support Peabody's request to have the stream segments identified in the proposed regulatory change properly classified as ephemeral.

This concludes my direct testimony.

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