Comments and Recommendations on the
Water Resources Issues Involved with the Application by USA Springs, Inc.
For a Large Ground Water Withdrawal

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The proposal by USA Springs, Inc. to pump 309,600 gallons of ground water per day from its three bedrock wells is an excessive request: there is insufficient bedrock recharge to meet the demand, abutters will be adversely affected, wetlands will be adversely affected, and the withdrawal may result in the Little River becoming a dry river bed in low flow years (something that has never been recorded). Each of these points will be addressed in the following sections. The data to support the comments presented here were in large part presented by USA Springs (the applicant) or their consultants in reports and electronic form. At a 16 April 2004 meeting with NH DES, all of this data was considered relevant and of value in weighing the technical aspects of the application. In addition, USGS stream gaging data and NOAA precipitation data (both available on the web) were used. A further complicating issue associated with the proposed withdrawal is the fact that overburden and bedrock contamination exist within the known capture zone for the wells. There is no compelling argument to permit any ground water production until a remediation system is constructed, online, proven to be effective, and then a study performed to demonstrate that groundwater pumping does not adversely affect the remediation system performance. No USA Springs pumping should be approved until groundwater meets AGQS within the well head protection area.

1. Nature and magnitude of the bedrock recharge

The conceptual model proposed by the applicant, since the inception of this project, is that the bedrock receives substantial recharge from precipitation. This has always been their assumption, and never once demonstrated by data. In fact their own water level and precipitation data plus consultant conclusions clearly show the opposite: the bedrock receives very little recharge from precipitation. Data that demonstrate that the bedrock receives very little annual recharge includes: the pre-pumping test water level data, pre-pumping test meteorological data, the pre-pumping test bedrock piezometric map, and the observed drawdowns during the pumping test. On various occasions, the applicant was advised to sample ground water and analyze it in order to determine its age and source. This was never done.

The first way to determine bedrock recharge from precipitation is to look at how bedrock well water levels respond to precipitation. All of the geologic cross sections presented by the applicant (for example, Figures 3-4, 3-5, and 3-6 of the 3 February 2003 Gradient report) depict a bedrock system that is confined: everywhere the water level in bedrock wells exists well above (10 feet or more) the top of the bedrock. This is an artesian (confined) aquifer system: a system in which everywhere the water pressure exceeds atmospheric pressure. Therefore when precipitation occurs and water levels in bedrock wells rise, the precipitation recharge water is not filling pore spaces (they are already filled). In this case, the recharge water goes into the storage compartments defined by the storage coefficient. The storage coefficient is the parameter that describes the characteristics of water storage in confined aquifers, and it is determined by pumping tests. The USA Springs pumping tests (step tests and pumping test) as well as the MykroWaters pumping tests (27 February 2004 MykroWaters Withdrawal Testing Report, Part One) yield similar values for the storage coefficient of 3 x 10^{-4}: This low value of the storage coefficient underscores that the bedrock is a confined hydrogeologic system. The two storage compartments of the storage coefficient are: increased water density (much like overfilling a soccer ball with air) and expansion of the pore space (how the soccer ball expands as it is overfilled with air). The pre-pumping test meteorological and water level data (3 February 2003 Gradient Report) reflect that bedrock groundwater levels rise about 0.5 feet for every inch of precipitation. For a watershed-average annual precipitation of 42 inches, times the 0.5 ft/inch rise times the storage coefficient, the annual bedrock recharge from precipitation computes to be 0.08 inches per year. At this rate, if all of the bedrock recharge over the entire 14.4 square miles of the study area flowed under the USA Springs wells (which it does not), this would be less than 55,000 gallons per day: far less than the requested pumping amount. In comparison, the USA Springs request of 309,600 gpd from the 14.4 sq. mi. study area equates to 0.45 in/year: almost six times the amount of the recharge! The reality is that if 8 inches per year of precipitation were to occur in this bedrock (as assumed by the applicant), the only way for it to move through the bedrock is to have the groundwater gradient be almost two orders of magnitude higher. The bedrock piezometric map does not reflect such a gradient. The recharge must occur over a large area: it is physically impossible for it to occur in just a few isolated fractures (such fractures have not been identified, nor has there been demonstrated a connection to such fractures if they did exist).

Another way of determining the bedrock recharge is to look at what naturally flows under the site. Using the bedrock piezometric map (3 February 2003 Gradient report) and the range of hydraulic conductivities from the step tests, the pumping tests, or the remedial studies (27 February 2004 MykroWaters report), application of Darcy’s Law allows an estimate of ambient bedrock flow. From the piezometric map, the bedrock ground water gradient at the location of the USA Springs wells is 0.016 and the contour length through the property (the 400-ft MSL elevation contour) is 3,800 feet. The range of hydraulic conductivities for the bedrock found by MykroWaters was 10.9 to 345 ft^2/day with a median value of 35 ft^2/day. The USA Springs pumping test yielded a median transmissivity value of 275 ft^2/day with a range of 101 to 535 ft^2/day. Therefore the range of ambient flows under the site is 16,000 gpd to 125,000 gpd. Interestingly, the 11 December 2003 MykroWaters Combined Remedial Action Report used this same method to yield a bedrock flow of 300 gpd/100 ft of contour, translating to 11,400 gpd below the USA Springs site. These ambient groundwater flows are consistent with each other and consistent with the estimated bedrock recharge from precipitation presented in the last paragraph. As presented in Section 3 of this report, this bedrock looks very isotropic on the large scale, and therefore there is very strong merit to the argument presented here (porous media analogy). The fact that this is a bedrock system does not invalidate the methods because on the scale of these calculations, the system performs as a porous media. If the argument is posited that the majority of flow in bedrock systems is in a few, highly transmissive fractures, and therefore porous media concepts do not apply, then some measure of rationale must be offered in their stead. No such explanations of bedrock recharge have been offered by the applicant, only an unsubstantiated assumption (8 inches per year of recharge) that has no reference. In fact, the reference cited by the applicant (USGS WRIR 98-4232) for the recharge rate to till overburden, basically states that the amount of bedrock recharge is insignificant. All of the applicants data presented to date has not demonstrated that few, highly transmissive fractures are the source of groundwater to their wells nor dominate the bedrock hydraulics. Therefore there is even less documented basis to use fractured media arguments than the porous media arguments.

What is important in this section is that both the method of estimating precipitation recharge (55,000 gpd for the entire 14.4 mi^2 study area) and flow net method (16,000 to 125,000 gpd), are consistent in identifying that there is insufficient bedrock ground water recharge to sustain a pumping of 309,600 gpd. One may ask then, “How did the pumping test manage to pump at the rates (upwards of 300 gpm) that it did?” A simple answer is that even a bathtub can deliver 300 gpm: of course not on a sustained basis. The pumping test created an enormous amount of drawdown: tens of feet of drawdowns in domestic wells thousands of feet away! If one contours the cone of depression from drawdown measurements at the end of the pumping test and calculates the amount of dewatering, it is apparent that most of the pumped ground water came from dewatering of the bedrock. Dewatering and no sustainable recharge are further supported in Section 2 on bedrock hydraulic characteristics and Section 3 on sustainability.

The applicant believes that its conceptual model is conservative (11 September 2003 Gradient Supplemental Information). Yet the data presented here, data collected by the applicant, clearly demonstrates that the applicant has grossly misrepresented the recharge to the bedrock as well as water availability at the site. The applicant has not refined its original conceptual model to incorporate what the pumping test data reveals and therefore the applicant has not complied with Env-WS 388.04.c.10 nor Env-WS 389.07.11. The applicant has also not demonstrated that the requested withdrawal is sustainable and therefore has not complied with Env-WS 378.10.b.1. **In light of these facts, it is recommended that NH DES find that the applicant has failed to demonstrate that there is sufficient quantity of water available such that its proposed withdrawal can be sustained without adverse impact and that the applicant has not complied with Env WS 388. Therefore this application should be denied.**

2. Hydraulic Characteristics

The applicant consistently maintains that there is severe anisotropy in the bedrock system. However enough data does not exist to make or refute these claims (no bedrock observation wells to the northeast or to the west) and the data that does exist shows a much more homogeneous system than is being represented. In addition, there are other physical conceptual models that can explain the large-scale drawdown data rather than only anisotropy.

Figure 3-23 of the 3 February 2003 Gradient report plots the anticipated zone of influence after 180 days of pumping with no recharge. The applicant maintains that this zone of influence possesses a northwest-southeast linear appearance because of anisotropy that exhibits the highest hydraulic conductivity in this direction. This is consistent with part of the fracture rose diagram in the same figure. However, in that same rose diagram, there is a more dominant northeast to southwest fracture characteristic to the bedrock, and this can play a significant role in the actual zone of influence. Yet what appears in the figure is a very unrealistic zone of influence. For example, at USA-1 there is 447 feet of drawdown, and less than 500 feet to the northeast, drawdown is represented in the figure as ending. There is no justification presented for why the zone of influence does not extend much farther to the northeast: the absence of wells does not mean that there are no hydraulic effects. Similarly, overlaying the southwest fracture orientation from the rose diagram onto the USA wells would result in a large zone of influence to the southeast, yet none is represented by the applicant to occur. As in the northeast direction, the absence of observations to the southwest does not mean that there are no hydraulic effects. The applicant is not presenting a conservative approach in the delineation of the well head area. In public hearings prior to the pumping test, it was recommended to the applicant that more bedrock monitoring wells were needed to the northeast, west and southwest. These wells were not constructed. The applicant has therefore not complied with Env-WS 389.11.b

The pumping tests performed by MykroWaters during the remedial investigations generated interwell transmissivities for a variety of the wells in the vicinity of the contamination (27 February 2004 MykroWaters Report). The transmissivities from these tests were placed into a histogram (Figure 1). This histogram shows a remarkable degree of isotropy, more so than many overburden formations. [N.B. Normally such histograms plot transmissivity or hydraulic conductivity on a logarithmic scale because they usually vary over several orders of magnitude in bedrock. For example, see various publications by Dr. Allen Shapiro on the Mirror Lake site in New Hampshire http://www.epa.gov/tio/tsp/download/2003_meeting_fall/shapiro_slides.pdf - slide 4.] The highest value of transmissivity in the MykroWaters pumping test dataset is in the north-northeast direction, not aligned with the northwest to southeast direction of anisotropy represented by the applicant. Figure 22 of the 27 February 2004 MykroWaters report shows a zone of influence for the MykroWaters 72-hour pumping test. There is no reason that the 25-foot and 10-foot contours should not be drawn further to the southwest. It is notable that wells USA-1 and USA-2 saw almost the same drawdowns (9 ft. and 7 ft., respectively) and that they are to the northeast of the pumped wells in the 72-hour test. This is strong verification that the northeast to southwest direction will manifest large drawdowns in the event of large groundwater withdrawals at the USA Springs wells.

A very simple explanation for the linear shape of the zone of influence for the USA Springs wells is a well pumping in a formation that has a sloping piezometric surface. Linear-shaped zones of influence result. For example see the WHPA Users manual. Here, a linear zone of influence occurs in a completely isotropic medium, and the linearity of the shape of the zone of influence is controlled in part by the slope of the piezometric surface.

Figures 2 through 11 display measured drawdowns in pumping, observation, and domestic wells during the USA Springs November 2002 pumping test. What is dramatic about this data is its similarity and uniformity of shape in each well. This is evidence that the formation is not as anisotropic as is portrayed by the applicant. In addition, it further substantiates the use of porous media arguments to describe recharge and bedrock hydraulics on the large scale.

The applicant has not used its data to refine the wellhead protection area and therefore has not complied with Env-WS 389.15. **It is recommended that NH DES find that the applicant has failed to identify the zone of influence sufficiently to identify adverse impacts. Thus, the applicant has not complied with Env WS 389 and therefore this application be denied.**

3. The requested withdrawal of 309,600 gpd is excessive and unsustainable

It has already been demonstrated in Section 1 that the request to pump 309,600 gpd exceeds the ambient bedrock groundwater flow at the site as well as the estimated bedrock recharge. However the pumping test itself also clearly demonstrates that even the 10 days of the USA pumping test were excessive withdrawals. Figures 2 through 11 display the plots of drawdown versus time for wells during the November 2002 pumping test of the USA Springs wells. What is quite remarkable is that for all of the bedrock wells (Figures 2 through 9), including the five days with no pumping (the recovery period), there was still a significant amount of residual bedrock drawdown: in the USA wells as well as abutter wells thousands of feet away! This demonstrates that significant dewatering occurred during the pumping test. In addition, this is proof that there is much less ambient flow below the site than is claimed by the applicant. If the recharge rate existed that is claimed by the applicant (Table 3-9 of the 3 February 2003 Gradient Report), then the system would have fully recovered well within the 5 days of recovery. This obviously did not happen. Just as troublesome is that well P-3D (a deep overburden well) also did not recover after the 5 day recovery period. This fact will be discussed in Section 5 (wetlands). This demonstrates that this application does not comply with Env-WS 389.11.b.1.

The 180 days of no recharge is a measure that exists in the statutes for determining a reasonable maximum drawdown. The history of this measure to be used in this way goes back to the predecessor rules to Env – WS 388 and Env – WS 389. In establishing those rules, the NH

DES technical advisory committee (of which this author was a member) initially (1988) focused on stratified drift aquifers. It was concurred by the committee that for the stratified drift aquifers, a 6-month period in which little to no recharge occurred would yield a reasonable low recharge period from which to make decisions about sustainable yield and well head area. In the present rules, the 180 day measure is now extended to bedrock formations. This may not be as reliable as in overburden formations. The reason for discussing this point is that the applicant (3 February 2003 Gradient Report) extends the pumping test data for all wells out to 180 days and uses these values as the expected maximum drawdown. This then presumes that the bedrock has secured some form of recharge such that drawdown does not continue past the 180 days. The applicant has failed to demonstrate that such recharge exists. The pumping test data clearly shows that no meaningful recharge was found during the 10 days of pumping. Figures 12 through 21 display derivative plots for wells during the November 2002 USA Springs pumping test. In these plots, the data points are the drawdown data supplied by the applicant, the dashed vertical lines are times when the pumping discharge was modified, the single full vertical line at 14,340 minutes is the end of the pumping test and the start of recovery, and the short solid vertical lines represent periods of precipitation (four occurrences of 0.1 inches during the pumping test). A derivative plot basically plots the slope of the previous sets of plots (drawdown versus log time). The derivative plot is a very useful tool for characterizing the hydraulic characteristics of formations. If a formation behaves like a theoretical formation with no recharge (Theis curve), then the derivative plot reaches a plateau as time increases (this is when drawdown continues to increase with increasing time). If the formation has secured a source of recharge to meet the demand of a pumping well, well water levels stabilize (a constant drawdown in the plot of drawdown versus time), and the derivative plot returns to zero yielding a characteristic inverted U-shaped derivative plot. What is clear from Figures 12 through 21 is that during the ten day pumping test there was absolutely no evidence of significant recharge. This analysis of the pumping test data also demonstrates that the request to pump 309,600 gpd is unsustainable: even after ten days of pumping, no discernable bedrock recharge occurred. If significant bedrock recharge would have occurred during the pumping test, abutter observation wells would have stabilized and their derivative plots demonstrated the inverted U-shape. Well OW-2 only shows signs of recharge after changes in pumping and after precipitation events. The OW-2 data and particularly the pumping well data are much too noisy to make conclusions about bedrock recharge that would lead to a sustainable pumping rate for the USA wells.

As stated earlier in this section, the existing rules Env – WS 388 and Env – WS 389 expressly and impliedly require sustainability, i.e., that the water levels in the pumping wells stabilize. Env-WS 378.10(d)(3). If stabilization does not occur, the flowrate from the pumping test cannot be considered to be sustainable. The USA Springs pumping test is unsuitable to support the production volume of 309,600 gpd under the present Env-WS 378.10.d.3. All of the USA Springs production wells exhibited drawdowns much greater than the sustainability measure used by NH DES (USA-1 1.7 ft/day, USA-2 4 ft/day, and USA-4 0.3 ft/day). Also, the pumping test flow rate did not comply with Env-WS 378.10.d.1.

It is recommended that NH DES find that the applicant has failed to demonstrate that its proposed use is sustainable and so the applicant has not complied with Env-WS 389 or Env-WS 378 and therefore this application be denied.

4. Abutter Wells

Both the applicants' reports and prior testimony by this author have determined that abutter wells will exhibit dramatic lowering of their water levels in response to a large withdrawal by USA Springs. Figures 22 and 23 are reproduced from Appendix H of the 3

February 2003 Gradient Report and show the trace of ground water levels in one of the abutter wells. In Figure 22, prior to the pumping test, the maximum recorded drawdown experienced in this well was 26 feet. These water levels were recorded with a pressure transducer for one month prior to the start of the pumping test. During the pumping test, the water level in this well fell by almost 40 feet. More dramatically, the maximum drawdowns in this well (on top of the almost 40 feet caused by the USA Springs pumping) during and after the pumping test were 39 to 45 feet! Not only does the large groundwater withdrawal lower abutter water levels, but these wells may not be capable of supplying their typical yields if 309,600 gpd is permitted because more drawdown is required to meet domestic demands. This demonstrates that the USA Springs pumping reduced the bedrock yield to these wells, and as a result, the wells manifest more drawdown (water for domestic use now comes from the well bore, when needed, rather than from flow in the formation). This dramatic magnification of drawdown in abutter wells due to just the domestic demands was clearly evident during the 10-day pumping test (plus the 5-day recovery period). It strongly suggests adverse effects in abutter wells, and this effect will be only more pronounced if such a large withdrawal continues for much more extended periods of time because the loner duration of USA Springs pumping will regionally lower water levels thereby making the bedrock flow to individual wells even more limited. This is not an issue that simple monitoring will ameliorate. Lowering the pump intake in these wells (as suggested in the 3 February 2003 Gradient Report) may not be possible, and may actually be more harmful to the pump (potential to draw in sediments from the bottom of the well).

It has also been suggested by the applicant that in the case of abutter wells being adversely affected by the large groundwater withdrawal, that their wells can be deepened. Drilling deeper is not a panacea and can actually result in more problems. It is not a panacea because there is no guarantee that more water will be found. It may cause further problems because the water quality may decrease dramatically, possibly making the water altogether unpotable. The recent deepening of a bedrock well in Hollis, NH (from 600 ft to 800 ft) resulted in very high methane levels and the contamination of another nearby bedrock well by the methane. Deepening a well in Madbury, NH led to dramatically higher iron and pH. This is not a fair and equitable resolution to abutters adversely impacted by reduced water supply in their wells due to overpumping at a large ground water withdrawal.

It is recommended that NH DES find that the applicant has not demonstrated that the significant drawdown in abutters' wells caused by its pumping does not constitute an adverse effect and therefore on this ground this application be denied.

5. Wetlands

Very often in New Hampshire, wetlands are groundwater discharge locations, especially those that sit in topographically lower areas. Figures 24 through 27 depict the time histories of groundwater levels in overburden well couplets (a pair of wells) situated proximal to wetlands. These were drilled wells with the deeper of the two wells (designated with the letter 'D') possessing a screen close to bedrock and the shallower ('S') wells with screens closer to the ground surface. Groundwater moves from elevations of higher water elevation to lower water elevation. Therefore the overburden well couplets (deep and shallow at almost the same location) give information about groundwater flow in the vertical direction. For well couplets P-1S/P-1D and P-6S/P-6D, before, during, and after the pumping test, groundwater moved downwards. This is very reasonable given how wet it was during this time period and given the time of year. Well couplet P-2S/P-2D exhibited nearly static (in the vertical) groundwater, with a slight downward flow prior to the pumping test. Well couplet P-7S/P-7D reflected upwards flow prior to the pumping test. At the start of the pumping test, there was a near immediate reaction in all of the deep overburden wells, as well as shallow wells P-1S and P-7S. Well P-1S had such a dramatic decline that its water level was nearly the same as for P-1D during the pumping test. This may indicate a strong vertical connection in the overburden at this location. In all other couplets, there was a dramatic increase in the difference of water elevations between the deep and shallow wells. The most troubling is couplet P-7S/P-7D: this couplet demonstrated groundwater discharge, yet the pumping test dramatically reversed the gradient. Couplet P-7S/P-7D is very close to the Barrington prime wetlands. Although most of the well records show a downward gradient during this pumping test, this may not be true year-round. It is very likely that bedrock groundwater discharges to most of these wetlands for a good duration of the year. Therefore a large groundwater withdrawal can likely lead to much drier wetland conditions. The applicant has not expended the effort to understand the annual variability in vertical groundwater fluxes, especially as they relate to sustaining the wetlands. The near instantaneous and dramatic lowering of overburden well water levels in just this brief ten days of pumping, during a wet period, is cause for concern when weighing the prolonged pumping of 309,600 gpd. Given the fact that the local Towns have gone to great efforts to identify and protect wetlands, stewardship of natural resources must recognize that adverse effects from large groundwater withdrawals are implied by the data collected to date: permitting the withdrawal and only monitoring these effects is analogous to allowing them to occur. A much more prudent posture regarding wetlands is to only permit a flow that does not reverse groundwater vertical gradients.

By minimally addressing the relationship between bedrock groundwater and wetlands the application does not comply with WS 388.06.m and Env-WS 07. **It is recommended that NH DES find that the applicant has not demonstrated that significant drawdown which will occur at prime wetlands does not constitute an adverse effect and therefore on this ground this application be denied.**

6. Little River and Lamprey River

The applicant was urged, on various occasions, to discuss the ramifications of the proposed groundwater withdrawal on surface water. To date, no such discussion has been offered by the applicant. The majority of the site Study Area (Figure 3-1 of the 3 February 2003 Gradient Report) lies in the Little River watershed. The Little River is a tributary to the Lamprey River. The USGS has a stream gage on the Lamprey River with records that extend back to 1934. At the USGS gage, the Lamprey River watershed area is 183 square miles. The daily flow data at the gage exhibit a median flow of 167 cfs.

The Little River watershed is 12 square miles at its confluence with the Lamprey River. In order to develop stream flows for the Little River, upstream of the USGS Lamprey River gage, a weighting factor based on watershed area is used, as is recommended in the NH DES instream flow methods. Using the ratio of watershed areas (12 sq. mi./183 sq. mi.), the ratio is multiplied times the gage data to get an approximation of the daily flows for the Little River. In doing so, for example, the median flow of the Little River is then 11 cfs. By compiling all of the estimated daily Little River flows, a flow duration curve can then be generated (Figure 28). In addition, monthly flow duration curves can also be generated. Figure 29 shows a magnification of the flow duration curves for all data as well as the months of August and September (normally the two lowest flow months of the year). It is apparent that the Little River (based on the Lamprey River gage data) never runs dry. The lowest estimated flows are 0.2 to 0.08 cfs. In comparison, the pumping of 309,600 gpm is equivalent to 0.5 cfs. If the natural discharge of the bedrock groundwater is to tributaries of the Little River (as evidenced by the well couplet data), then the proposed large groundwater withdrawal has the potential to dry-up the Little River. In addition, because the applicant does not know the lag time between groundwater pumping and river flow, if this withdrawal were to be permitted with the stipulation that withdrawals be cutback in low river flow times, the applicant and NH DES do not know the amount of lag time at which to start the cutback. It is possible that the lag time is months to years, in which case we could never count on cutbacks to bring back the Little River flows during the low flow periods: rarely can we accurately predict drought and low flow more than days in advance. Removing large quantities of water from the Little River watershed is an important issue since flow in the Lamprey River serves as water supply, creates habitat, and dilutes pollutants. None of these issues has been discussed by the applicant.

It is noteworthy that of the 70 years of record on the Lamprey River, the three lowest flow periods occurred in 1994, 1995 and 2002, and the lowest flow ever recorded was 1994. This recent spate of drought may be related to large-scale issues such as global climate change, or more watershed-based factors, such as increasing population (and therefore water demand) since 1960. The reality is that the watershed will continue to see increasing population and demand for water resources. This needs to be factored into any decision on the long term permitting of water withdrawals, especially withdrawals that return little flow to the watershed.

The USGS has studied the impact of groundwater withdrawals and stream flow reductions in the Ipswich River watershed. They noted that groundwater withdrawals, and not surface water withdrawals, had the most dramatic consequence to the flow duration curves for the Ipswich River for the low flow periods (Zariello and Ries, 2000, USGS WRIR 00-4029).

By ignoring any discussion of surface waters and the impacts of this withdrawal on surface waters, the applicant has not complied with Env-WS 388.04.c.12 or Env-WS 378.10.b.1. In addition, the applicant has completely ignored the existing environmental role of this groundwater: that is, where the groundwater currently flows towards and discharges. This then does not comply with the requirement of Env-WS 388.06.j or Env-WS 389.07. NH DES has a role in stewardship of the Lamprey River and its tributaries, especially since the Lamprey River is designated as a Wild and Scenic River. This role must consider the effects of the large groundwater withdrawal on instream flow, reductions in water quality, and water supplies. If the applicant does not address these issues in the application for a large groundwater withdrawal, then NH DES must deny the permit for lack of compliance with statutes. **It is recommended that NH DES find that the applicant has not complied with Env-WS 389 in that it has not evaluated the impacts of this withdrawal on surface waters and surface water users specifically the Lamprey River and its tributaries. The applicant has not demonstrated that the loss of bedrock groundwater in this watershed does not constitute an adverse effect and therefore on this ground this application be denied.**

7. Contamination

The applicant has acknowledged both overburden and bedrock contamination on the USA Springs site as well as the property to the north (Harnum). The remedial investigations have estimated the depths and areal extent of the contamination. The proposed remediation system is in a state of flux. First, a hydraulic strategy was proposed, next the addition of amendments, later combinations. This author has served as a consultant to NH DES in reviewing designs for remediation of contaminated sites. After the remedial investigation is completed, a design is proposed. When the design is approved, the next phase is some construction of the system and pilot testing. In no cases have the designed systems functioned as desired, and this was verified by the pilot testing. In no cases were large withdrawals of groundwater permitted in which the zone of influence surrounded the contamination, unless the pumping was part of the remediation itself. There is no sound logic in conditionally approving a large groundwater withdrawal for USA Springs when it is known to result in significant drawdown below the contamination and such pumping has already demonstrated that the contaminants will be pulled into the USA Springs wells.

There is a real conundrum in how the issue of contamination remediation and USA Springs' groundwater withdrawal are being treated. On the one hand, estimates being made based on porous media hydraulics (presented here in sections 1, 2, and 3) are considered marginal because this is an anisotropic bedrock system (16 April 2004 meeting with NH DES). However, all the predictions that the contamination can be remediated and the pumping of the USA Springs wells will have no effect on the remedial systems are being made based on porous media arguments (Appendix 3 of the 11 December 2003 MykroWaters Combined Remedial Action Plan). How can one be correct and not the other? If porous media arguments are unsuitable to be used to show that the pumping of 309,600 gpd is unsustainable, how can such arguments be considered as conservative to allow this pumping when it is known that it will cause hydraulic consequences at the location of contamination? If the porous media arguments are acceptable for making conclusions about the remediation system, they must be acceptable for the hydraulic and sustainability arguments involving the large groundwater withdrawal. If the system is so complex that only fractured rock models are acceptable, then the remedial strategies for bedrock must all be based on such models, and in addition, the ability for the large groundwater withdrawal to occur without affecting the remediation.

The troublesome aspect of permitting the large groundwater withdrawal with the condition that no pumping may occur until the remediation is proven to be successful is that years may need to pass until the condition is met. This then unjustly and unfairly delays other proposals for groundwater withdrawals in the area. In addition, domestic wells that postdate the permit yet predate the large groundwater withdrawal pumping may be adversely affected by the pumping and yet were not treated in the application. There is no good reason to permit the large ground withdrawal until the contaminated bedrock is remediated. Pumping the USA Springs wells prior to bedrock groundwater meeting AGQS does not comply with Env-WS 389.17: it was already demonstrated by the pumping test that the USA Springs wells will unnecessarily draw contaminants into the pumped water. Since the remedial action plan has not yet been approved, the application for a large groundwater withdrawal at the USA Springs site cannot comply with Env-WS 389.17.c. **It is recommended that NH DES find that the existence of bedrock contamination, well within the wellhead area of the proposed large groundwater withdrawal and hydraulically connected to the large groundwater withdrawal wells, poses as an uncontrolled source on this ground this application be denied. Further, it is recommended that no permit for a large groundwater withdrawal be considered until the site meets AGQS.**

Summary

The logic used by the applicant to support its request for a large groundwater withdrawal is severely flawed. The flaws were pointed out in the first application, and yet the same flawed analysis of data and logic have been re-submitted. The applicant does not understand the basic bedrock hydrology, the applicant has no perception of the actual bedrock recharge mechanism, the applicant does not demonstrate the ability to use their own data and draw conclusions about a sustainable withdrawal at this site, the applicant failed to adequately address wetlands, the applicant ignored the role of groundwater in surface water flows, and the applicant is overly optimistic about the ability of a remedial system to rapidly clean the formation. The remediation system will take at least 5 – 10 years before water quality fall below AGQS. For all of these reasons, there is no necessity or imperative to approve of this application. Many of the reasons for denial are the same that existed in August 2003. No new hydrologic or hydraulic information have been supplied regarding the large groundwater withdrawal itself. The only new issue addressed in the present application concerns the contamination: no permit should be approved until the aquifer systems consistently meet AGQS. **It is recommended that NH DES find that this application possesses numerous deficiencies of the prescribed administrative rules, and as such should be denied in accordance with Env-WS 389.20.**